KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
DEPARTMENT OF INFORMATION TECHNOLOGY

B.TECH.CURRICULUM

ACADEMIC YEAR:2024–25

DEPARTMENT OF INFORMATION TECHNOLOGY

Undergraduate Rules and Regulations-2024 (URR24)
In accordance with the National Education Policy 2020
w.e.f AY 2024-25

Regulations Governing the
Choice Based Credit System with
Multiple Entry and Multiple Exit Options
with
Competancy-Focused Outcome Based Curriculum (CF-OBC)

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 506 015, TELANGANA
(UGC Autonomous Institute UnderKakatiyaUniversity, Warangal)

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DEPARTMENT OF INFORMATION TECHNOLOGY

History:

PROGRAM	DESCRIPTION	
	INTAKE	NBA ACCREDITATION
UG in B.Tech. Information Technology	• Started with 40 seats in 1999-2000 • Intake increased to 60 in 2001-2002 • Intake increased to 120 in 2020-2021	• First time Tire-II accreditation: 2016-2019 • Tire-I accreditation: 2019-2022 • Tire –I Reaccreditation: 2022-2025

INSTITUTE VISION AND MISSION

INSTITUTE VISION

To make our students technologically superior and ethically strong by providing quality education with the help of our dedicated faculty & staff and thus improve the quality of human life

INSTITUTE MISSION

M1	■ **To provide latest technical knowledge, analytical & practical skills, managerial competence and interactive abilities to students, so that their employability is enhanced**
M2	■ **To provide strong human resource base to cater to the changing needs of the industry and commerce**
M3	■ **To inculcate a sense of brotherhood and National Integrity**

DEPARTMENT OF INFORMATION TECHNOLOGY : VISION AND MISSION

VISION

To become a Center of Excellence in the Information Technology discipline with effective teaching and strong research environment that makes our students globally competitive with strong ethical values and leadership abilities.

MISSION

M1:	To impart technical knowledge to the students to turn out proficient and well groomed engineers.
M2:	Motivate students to improve skills by attending training programs and internships that leads to develop innovative projects in emerging technologies.
M3:	To train our students for higher education, leadership in profession and adopt quality research.

PROGRAM EDUCATIONAL OBJECTIVES

Within first few years after graduation , the information technology graduates will be able to…

PEO1:	**Technical Competence** analyze, formulate and solve engineering problems by using sound theory and practices knowledge of Information Technology
PEO2:	**Successful Career** develop Information Technology solutions with the changing needs of the society for the career-related activities
PEO3:	**Soft Skills and Life-longLearning** utilize the knowledge of Information Technology to pursue higher education and research

PEOS TO MISSION MAPPING

	M1	M2	M3
PEO1	3	2	2
PEO2	3	3	2
PEO3	2	3	3

PEO Statements	Mission Statements	Mapping Level	Justification
PEO1	**M1**	**3**	The curriculum is well designed to impart in-depth knowledge in theory and lab courses for the students to excel in the Information Technology discipline.
	M2	**2**	Students are encouraged to attend training programmes organized by the Institute and to carry out internships in various organizations. Department conducts various technical events like seminars, workshops on latest technologies for the students periodically.
	M3	**2**	Guidance is provided to the students to appear for entrance examinations to pursue their higher studies. Faculty advises the students to do projects relevant to research and societal needs by referring papers published in high quality journals like, IEEE, ACM, Elsevier, Springer etc.

PEO2	M1	3	Choice based curriculum is introduced to the students to concentrate more on practical and elective courses which prepare them in developing optimized algorithms and efficient application software.
	M2	3	Attending training and internship programmes, students acquire the knowledge in developing real world applications.
	M3	2	Department organizes seminars to the students to acquire knowledge on current technologies which help them to develop innovative research projects. Students are also encouraged to publish papers in reputed journals and conferences.
PEO3	M1	2	Curriculum is revised periodically which makes the students to get the knowledge about emerging technologies required by the industry.
	M2	3	Participation in various technical events like paper presentations, coding contest and attending guest lectures delivered by eminent persons from industry, students acquire the knowledge about the changing needs of society which drives them to implement innovative projects. Faculty enrich their knowledge by attending faculty development programmes on current technologies and impart the knowledge to the students.
	M3	3	Faculty discuss the concepts and current research areas in relevant subjects during teaching learning process. It helps the students to decide the area for their higher studies and develop projects based on research and societal needs.

PROGRAM SPECIFIC OBJECTIVES

Within first few years after graduation, the INFORMATION TECHNOLOGY graduates will be able to

PSO1:	apply analytical and experimental problem-solving skills in the Information Technology discipline
PSO2:	make use of programme specific knowledge to investigate new and emerging technologies leading to innovations and to begin immediate professional practice in the field of Information Technology

PO/PSO TO PEO MAPPING

PO's		PEO1	PEO2	PEO3
PO1	Engineering Knowledge	3	2	2
PO2	Problem Analysis	3	2	2
PO3	Design/Development of solutions	3	2	3
PO4	Conduct investigations of complex problems	2	2	2
PO5	Engineering Tool Usage	2	2	2
PO6	The Engineer and The World	1	2	3
PO7	Ethics	2	2	2
PO8	Individual and Collaborative Team work	2	2	2
PO9	Communication	2	2	2
PO10	Project management and finance	1	2	3
PO11	Lifelong Learning	3	2	2
PSO's				
PSO1	Apply analytical and experimental problem-solving skills in the Information Technology discipline	3	2	2
PSO2	Make use of programme specific knowledge to investigate new and emerging technologies leading to innovations and begin immediate professional practice in the field of Information Technology	3	3	2

DESIGN OF CURRICULUM

Salient Features

- The URR24 regulations are inline with the National Education Policy 2020 (NEP2020) and the AICTE model curriculum to provide multidisciplinary holistic education to produce well-rounded engineering graduates.
- Mulitple Entry Multiple Exit (MEME) option.
- Multidisciplinary four year UG progrmme with award of following degrees
    - B. Tech
    - B. Tech with "Minor"
    - B. Tech "Honours"
    - B. Tech "Honours with Research"
- 160+ Credit Liberal Engineering Education.
- A strong program core of 26 courses and 5 baskets of program electives to ensure the breadth and depth in a chosen domain of studies. Program electives are arranged either to grow in a specified vertical or have diversified exposure.
- Full semester industry internship to the interested students.
- Aggressive model of "Learning-by-doing" in the form of PRACTICUM.
- Activity Based Learning (ABL) about Life, Literature and Culture is embedded in to the curriculum in four semesters, ensuring all dimensional holistic growth of the learner. These four activity based mini courses are offered as two sequels namely Social Empowerment Activities (SEA) and Self Accomplishment Activities (SAA).
- These regulations follow holistic approach of education, ensure strong science, mathematics foundation and program core, develop expertise in domain vertical though sequel of electives, ensure significant exposure of additional discipline through "Minor" programme, challenge good learners through "Honours" programme and the research oriented students through "Honours with Research" programme.
- Along with Major and Minor disciplinary courses, students are expected to learn Multidisciplinary Open Elective Courses (MOPEC), Skill Enhancement Courses (SEC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Activity Based Learning (AL) and Experiancial Learning (EL) towards multidisciplinary holistic education and for increased employability.
- These regulations provide Competency-Focused Outcome Based Curriculum (CF-OBC) for skill development, multidisciplinary learning, wider access, inclusiveness and entrepreneurship.
- In our CF-OBC, each course has an additional component of "Contents for self-study", which is carefully designed to ensure additional hours of learners engagement. The learner thus is nurtured towards the "Self-Learning" and "lifelong learning" which are essential attributes of a 21st Century learner. The same is incorporated in the scheme of instructions in the form of (i) Outside the class work (self-study) hours, (ii) total engagement hours for every course.
- In summary, these regulations are expected to develop technical competencies through courses from programme core, programme electives, engineering science and basic

science; and also develop generic competencies, soft skills, social, physical, mental and spiritual personality through carefully articulated courses from MOPEC baskets, liberal learning and humanities sequels. Thus, offer a unique "T-Shaped" liberal "Pi-Model" of Engineering Education

The Curriculum consists of the following components of study:

BSC	Basic Science Course	**ABL-SAA**	Self- Accomplishment Activities
HSMC	Humanities and Social Sciences including Management Course	**ABL-SEA**	Social Empowerment Activities
ESC	Engineering Science Course	**VAC**	Value Added Course
PCC	Program Core Course	**AEC**	Ability Enhancement Course
PEC	Program Elective Course	**ELC**	Experiential Learning Course
OEC	Open Elective Course	**SEC**	Skill Enhancement Course

Open Electives Courses (MOPEC)

The Curriculum provides three slots of open electives with fourteen baskets. This is planned to give exposure to interdisciplinary and cross disciplinary domains. The courses in these baskets are planned both at department and institute level. Students can choose any combination of these courses (not floated by the parent department) to get familiar with other domains of learning.

Practicum

The curriculum provides ample opportunities for experiential learning (learning-by-doing) to impart important skills like problem solving, critical thinking and communication. Under experiential learing the PRACTICUM is a semester long project work included in I to IV semesters, having a weightage of 1 credit in each semester. Under PRACTICUM, the students are expected to implement a micro level project (at a level of course project) solving a practical problem or a project based on the combination of different theory or lab courses studied in a corresponding semester. The experintial learning is continued in the form of a Seminar in fifth semester, a mini project in sixth semester, major project in seventh & eight semesters and mandatory 6-8 week internship during summer breaks.

A batch of students (according to Roll Numbers) will be allotted to each of the course handling teachers of the corresponding semester. The teacher will be assigning a micro level project to each student. At the end of the semester the student will demonstrate a prototype / working model / system / process and submit a four to six page report. Course teacher is expected to evaluate the allotted batch of students and submit grades to the HoD. There will not be ESE for PRACTICUM. The batch of students will be allotted to a course handling teacher on the basis of series of Roll Numbers, similar to the allotment done for tutorial matrix.

Example: The project work under PRACTICUM for the course Machine Learning may be

1. *Data collection*
2. *Data PreProcessing*
3. *Application of Supervised Learning algorithms*
4. *Application of Un-Supervised Learning algorithms*
5. *Visualization*
6. *Analysis of Performance metrics*

The URR24 focuses on CF-OBC with program depth component in terms of Program Core Courses (PCCs) and Program Elective Courses (PECs)

Program Core Courses (PCC)
The curriculum offeres twenty six core courses referred to as Program Core. Several academic models from reputed institutions in the country and outside the country are studied in articulating this Program Core, to make curriculum globally competitive. The courses are augmented with laboratory components as per the need.

Program Electives Courses (PEC)
The curriculum offeres five baskets of Program Electives, each basket having identified courses corresponding to the programme specializations called verticals. This enables learners to grow in a domain-specialization or domain-vertical. The student can opt courses in sequel (PEC-1 to PEC-4) in any of the specific vertical or accorss the verticals.

Activity-Based Learning (ABL) about Life, Literature and Culture

Activity based learning (ABL) is blended with the curriculum for ensuring holistic growth of the learner. These activity based mini courses are offered as two sequels namely "SEA" (Social Empowerment Activities) and "SAA" (Self Accomplishment Activities).

According to Dr. K. M. Munshi, "Education will fail ignominiously in its objective if it manufactures only a robot and called him an economic man stressing the adjective economic and forgetting the substantive man. A university cannot afford to ignore the cultural aspects of education whatever studies it specializes in. Science is a means, not an end. Whereas culture is an end in itself. Even though you may ultimately become a scientist, a doctor, or an engineer, you must, while in college, absorb fundamental values which will make you a man of culture..."

The NEP-2020 quotes, "*Higher education must develop good, well-rounded and creative individuals, with intellectual curiosity, spirit of service and a strong ethical compass*". Moving towards a more liberal undergraduate education is one of the most important feature of the NEP2020 . *"The needs of the 21stcentury require, that liberal broad-based multidisciplinary education become the basis for all higher education. This will help develop well-rounded individuals that possess critical 21stcentury capacities in fields across arts, humanities, sciences, social sciences, and professional, technical, and vocational crafts, an ethic of social engagement, and rigorous specialization in a chosen field or fields. The approach across all undergraduate programs, including those in professional, technical, and vocational disciplines would be leading to holistic education, in the long run.*

Imaginative and flexible curricular structures will enable creative combinations of disciplines for students to study, thus demolishing currently prevalent rigid boundaries and creating new possibilities for lifelong learning. The notion of 'knowledge of many arts'- i.e. what is called 'liberal arts' in modern times – must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21stcentury."

To ensure holistic development of the learner, an attempt has been made in this curriculum to blend engineering education appropriately with arts, humanities, crafts, ethics of personal and social engagement. Activity based liberal learning courses covering life, literature, and culture are added. Every learner is expected to take one such course in first four semesters. We strongly believe that these four liberal learning modules will expose the learners to holistic education as envisaged in NEP2020.

(END OF THE SALIENT FEATURES OF URR24)

Undergraduate Rules and Regulations-2024 (URR24)
In accordance with the National Education Policy 2020, w.e.f AY 2024-25

1. **Title:**

   URR24 Regulations governing the Choice Based Credit System (CBCS) with Multiple Entry and Multiple Exit (MEME) options with Competency-Focused Outcome Based Curriculum (CF-OBC)

2. **Scope:**

   These regulations are applicable to the undergraduate programmes being offered by the Institute

3. **Duration of Programmes:**

   The undergraduate degree should be of four years duration, with multiple entry and multiple exist (MEME) options. The maximum duration for a student for completing the degree requirement is as per NEP2020/UGC/AICTE guidelines. Four years multidisciplinary undergraduate programme allows the opportunity to experience the full range of holistic and multidisciplinary education with a focus on major and minor subjects as per the student's preference. The four-year programme may also lead to a degree with Research, if the student completes a rigorous research project in the major area(s) of study. The undergraduate programmes shall extend over four academic years (eight semesters).

   With multiple entry and multiple exit options, the students can exit after the completion of one academic year (two semesters) with the UG certificate in IT; UG Diploma in IT after the study of two academic years (four semesters); and B. Voc in IT degree after the completion of three academic years (six semesters). The successful completion of four years undergraduate programme would lead to B.Tech in IT degree with optional Minor/Honours/ Honours with Research.

4. **Credit Requirements:**

   As per the guidelines released by UGC under **National Higher Education Qualification Framework (NHEQF)**, for Multiple Entry and Multiple Exit (MEME) in Academic Programmes offered in Higher Educational Institutions, the students shall complete the courses equivalent to minimum credit requirements as shown in the table given below for the award of UG certificate, UG diploma, Bachelor degree, Postgraduate diploma and Master's degree:

Qualification Type and Credit Requirements		
NHEQF Levels	**Exit with**	**Credit Requirements**
4.5	**Undergraduate Certificate** (in the field of learning/discipline) for those who exit after the first year (two semesters) of the undergraduate programme. (Programme duration: first year or two semesters of the undergraduate programme)	36-40
5	**Undergraduate Diploma** (in the field of learning/discipline) for those who exit after two years (four semesters) of the undergraduate programme. (Programme duration: First two years or four semesters of the undergraduate programme)	72-80
5.5	**Bachelor's Degree** (Programme duration: Three years or six semesters).	108-120
6	**Bachelor's Degree (Honours/ Research)** (Programme duration: Four years or eight semesters).	144-160
6.5	**Post-Graduate Diploma** for those who exit after the successful completion of the first year or two semesters of the two-year Master's degree programme. (Programme duration: One year or two semesters of the Post-Graduate programme)	36-40
7	**Master's Degree** (Programme duration: Two years or four semesters after obtaining four year Bachelor's degree).	72-80
7	**Master's Degree** (Programme duration: One year or two semesters after obtaining a four-year Bachelor's degree (Honours/Research).	36-40
8	**Doctoral Degree**	Minimum prescribed credits for course work and a thesis with published work

* Details of course-wise credits are described in the later part of the Regulations.

5. Commencement:

These Regulations in accordance with National Education Policy 2020 shall come into force from Academic Year 2024-25 onwards. These regulations shall be implemented from the academic year as mentioned below.

NHEQF Level	**Programme**	**From Academic Year**
Undergraduate Programme		
Level 4.5	Undergraduate Certificate (One year or two semesters)	2024-25
Level 5	Undergraduate Diploma (Two years or four semesters)	2025-26
Level 5.5	Bachelor's Degree (Three years or six semesters)	2026-27
Level 6	Bachelor's Degree with Honours/ Research (Four years or eight semesters)	2027-28

6. Eligibility Criteria:

(i) **Level 4.5:** The students who have successfully completed Grade 12 / Intermediate with MPC or its equivalent course shall be eligible for admission to the first year degree programme

(ii) **Level 5** : The students who have successfully completed Level 4.5 of the undergraduate programme at this Institute or any other HEIs registered on Academic Bank of Credits Portal

(iii) **Level 5.5** : The students who have successfully completed Level 5 of the undergraduate programme at this Institute or any other HEIs registered on Academic Bank of Credits Portal

(iv) **Level 6** : The students who have successfully completed Level 5.5 (bachelor degree of three years or six semesters) of undergraduate programme at this Institute or any other HEIs registered on Academic Bank of Credits Portal

7. Academic Bank of Credits (ABC):

The Academic Bank of Credits (ABC), a National-level facility promotes the flexibility of curriculum framework and interdisciplinary/ multidisciplinary academic mobility of students across the higher educational institutes (HEIs) in the country with appropriate "credit transfer" mechanism. It is mechanism to facilitate the students to choose their own learning path to attain a Certificate / Diploma / Degree, working on the principle of multiple entry and exit as well as anytime, anywhere, and any level of learning. ABC will enable the integration of multiple disciplines of higher learning leading to the desired learning outcomes including increased creativity, innovation, higher order thinking skills and critical analysis. ABC will provide significant autonomy to the students by providing an extensive choice of courses for a programme of study, flexibility in curriculum, novel and engaging course options across a number of higher education disciplines / institutions.

7.1 Operationalization of ABC:

Institute shall appoint institutional nodal officer for ABC as per UGC directives. The nodal officer shall be responsible for proper operationalization of ABC within the college and with the university.

The ABC related operations shall be as follows:

(i) The MEME option for student is facilitated at the undergraduate and postgraduate levels.

(ii) It would facilitate credit accumulation through the facility created by the ABC scheme in the "Academic Bank Account" opened for students across the country to transfer and consolidate the credits earned by them by undergoing courses in any of the eligible HEIs. The eligibility of HEIs to offer courses shall be as per UGC (Establishment and Operationalization of ABC scheme in Higher Education) Regulations 2021 dated 28.7.2021 and changes therein notified by the UGC from time to time.

(iii) The ABC allows credit redemption through the process of commuting the accrued credits in the Academic Bank Account maintained in the ABC for the purpose of fulfilling the credits requirements for the award of certificate/ diploma/ PG diploma/ degree by the authorized HEIs

(iv) Upon collecting a certificate, diploma, PG diploma or degree, all the credits earned till then, in respect of that certificate, diploma, PG diploma or degree shall stand debited and redeemed from the account concerned.

(v) HEIs offering programmes with the MEME system need to register in the ABC to enable acceptance of multidisciplinary courses, credit transfer, and credit acceptance.

(vi) The validity of credits earned will be for a maximum period of seven years or as prescribed by the UGC

(vii) The procedure for depositing credits earned, its shelf life, redemption of credits, would be as per UGC (Establishment and Operationalization of ABC scheme in Higher Education) Regulations 2021 dated 28.7.2021 and changes therein notified by the UGC from time to time

7.2 Monitoring, Support and Quality by Universities and ABC:

(i) It shall be the responsibility of Registered HEIs, to monitor the development and operationalization of the ABC programme at the university level and at the level of their affiliated colleges

(ii) Registered HEIs shall offer teachers training, staff training, mentoring, academic and administrative audit and other measures for improving the quality of performance of the ABC facility and promotion of holistic and multidisciplinary education with the support of ABC

(iii) The quality assurance of the implementation of ABC at the level of the registered university shall be looked by the Director, Examinations and Evaluation of the Institute of the officer nominated by him different from ABC nodal officer, under the directives and guidance of Controller of Examinations of the Institute

(iv) The Institute shall upload, annually, on its website, a report of its activities related to the Academic Bank of Credits, as well as of measures taken by it for Quality Assurance, Quality Sustenance and Quality Enhancements

(v) The Grievance Redressal Committee constituted by the examination section shall be responsible for addressing the Grievance and appeals related to ABC

8. Building Competencies through Padegogy:

Effective learning requires appropriate competency focused outcome based curriculum (CF-OBC), an apt pedagogy, continuous formative assessment and adequate student support. The intention is to contextualize curriculum through meaningful pedagogical practices, which determine learning experiences directly influencing learning outcomes expected competencies. ICT will be used in creating learning environment that connects learners with content, peers and instructors all through the learning process respecting pace of learners. The faculty shall follow innovative learner centric padagogocal approches:

(i) Classroom process must encourage rigorous thinking, reading and writing, debate, discussion, peer learning and self-learning

(ii) The emphasis is on critical thinking and challenge to current subject orthodoxy and develop innovative solutions. Curricular content must be presented in ways that invite questioning and not as a body of ready knowledge to be assimilated or reproduced. Faculty should be facilitators of questioning and not authorities on knowledge.

(iii) Classroom teaching should focus on the 'how' of things i.e. the application of theory and ideas. All courses including social sciences and humanities shall have design project and practicums to enable students get relevant hands-on experiences

(iv) Learning must be situated in the Indian context to ensure that there is no sense of alienation from their context, country and culture

(v) Classroom processes must address issues of inclusion and diversity since students are likely to be from diverse cultural, linguistic, socio-economic and intellectual backgrounds

(vi) Cooperative and peer supported activities shall be part of empowering students to take charge of their own learning

(vii) Faculty shall have the freedom to identify and use the pedagogical approach that is best suited to a particular course and student

(viii) Pedagogy PBL (Problem/Project Based Learning) shall be brought into practice as part of curriculum. Experiential learning in the form of practicum, seminar, mini-project, major project and internship with a specified number of credits is made mandatory

(ix) The course faculty shall provide the "Contents for self-study", and motivate the learners to engage in outside the class work learning (self-learning). The learner thus is nurtured towards the "Self-Learning" and "Lifelong learning" which are essential attributes of a 21st Century learner

(x) Blended Learning (BL) mode shall be used to help learners develop 21st century skills. BL should be carefully implemented and should not be replacing classroom time as a privilege

(xi) The UGC regulations, 2021 on Credit Framework for Online Learning Courses through SWAYAM, facilitates an institution to allow up to 40 percent of the total courses being offered in a particular programme in a semester through massive open online courses (MOOCs) offered by the SWAYAM / NPTEL and other e-learning platforms. Students shall be encouraged to complete equivalent courses through SWAYAM / NPTEL and other e-learning platforms, approved by the BoS chair and Dean AA, towards obtaining required credits where ever necessary.

9. Skill Enhancement, Ability Enhancement, Value Added Courses through e-learning:

Students shall be encouraged to obtain the required credits related to the skill enhancement courses (SECs), ability enhancement courses (AECs) and value added courses (VAC) through MOOCS platforms such as:

(i) SWAYAM
(ii) IIM-B
(iii) University LMS
(iv) CEC
(v) NPTEL
(vi) IGNOU
(vii) Infosys Spring Board
(viii) Future Skills Prime (Digital skilling ecosystem developed by Govt. Of India and NASSCOM)
(ix) Wadhavani Foundation
(x) Tata Strive
(xi) Any other platform approved by the BoS chair and Dean AA

After completing such courses, students have to submit the certificate to the concerned department and then after verification of the certificate the respective department will communicate the credits earned to the Dean, Academic Affairs for approval and onward transmission to examination section of the institute to deposit the credits in Academic Bank of Credits (ABC).

10. CONFORMANCE TO NEP2020

MULTIPLE EXIT OPTIONS

Sl. No.	Exit Description	ExitPoint	Degree/Certificate offered	Goal
1.	First Exit	After completion of First year.	UG Certificate in IT	The student should be employable as Technical Assistant (IT) in any industry/organization.
2.	Second Exit	After completion of Second year.	UG Diploma in IT	The student should be employable as Technician (IT) in any industry/organization.
3.	Third Exit	After completion of Third year.	B. Voc. in IT	The student should be employable as Technical Supervisor (IT) in any industry/organization.
4.	Normal Exit	After completion of Fourth year.	B.Tech in IT	The student should be employable as an Engineer (IT) in any relevant industry/organization.

10.2 MULTIPLE ENTRY OPTIONS

Sl. No.	Entry Descriptions	Entry Point	Eligibility
1.	Normal (First) Entry	I - Sem. of the program	As per the TGSCHE guidelines & through Common Entrance Examination TGEAPCET
2.	Second Entry	III - Sem. of the program	The successful completion of first year with UG certificate in IT from our institute.
3.	Third Entry	V- Sem.of the program	The successful completion of UG Diploma in IT from our institute.
4.	Fourth Entry	VII - Sem. of the program	The successful completion of B. Voc. in IT from our institute.

(i) **No. of maximum exits:** As per NEP2020/UGC/AICTE guidelines on MEME

(ii) **No. of maximum entry:** As per NEP2020/UGC/AICTE guidelines on MEME

(iii) **Maximum gap between exit and entry:** As per NEP2020/UGC/AICTE guidelines on MEME

(iv) **Academic Bank of Credits shall be maintained**

11. Options for Degree Certificate

(i). Learners who earn a minimum of total 162 credits will be **awarded** ***"B.Tech" degree which confirms to NEP2020 requirements of multidisciplinary holistic education.***

(ii). Fast Learners will have the following options to earn ***B. Tech degree with Honours/ Minor.***

a) ***B.Tech with "Minor" degree (with additional 18 credits): 162+18 Credits***

Students opting for Minor degree offered by other departments / in identified cutting-edge technologies /external recognized organizations, can start the programme in either 3rd semester or in 5th semester as per their interest. The requirement for completion of Minor degree programme is that the students are,

(i) **3rd to 6th semeseters**: allowed to take maximum one theory and one lab course in each semester, starting from 3rd to 6th semesters

(ii) **7th & 8th semesters**: allowed to take only one theory course per semester in 7th and 8th semesters

Students should complete 4 theory and two lab courses by the end of 8th semester. However, All four theory courses have to be completed through MOOCS and lab courses have to be completed in the department which offers the Minor degree programme.

b) ***B.Tech with "Honours" degree (with additional 18 credits): 162+18 Credits***

Students opting for Honours degree offred by their own department / external recognized organizations, can start in eith 3rd or 5th semester aas per their interest. The requirement for completion of Minor degree programme is that the students are,

(i) **3rd to 6th semeseters**: allowed to take maximum one theory and one lab course in each semester, starting from 3rd to 6th semesters

(ii) **7th & 8th semesters**: allowed to take only one theory course per semester in 7th and 8th semesters

Students should complete 4 theory and two lab courses by the end of 8th semester. However, All four theory courses have to be completed through MOOCS and lab courses have to be completed in the department which offers the Minor degree programme.

c) B.Tech – "Honours with Research" degree (with additional 18 credits by research): 162+18 credits

Students opting for Honours with Research degree, can start in 4th semester. They are expected to complete one course on "Research Methodology" through MOOCS or can complete one week FDP on "Research Methodology" during 4th semester (4 credits).

They have to complete two research internships each of 2-month duration, one in summer after 2nd year (5 credits) and other in summer after 3rd year (5 credits). They have to work on **individual research based project**, starting from 5th semester onwards. They have to present a Seminar on the individual research project in 5th semester, carryout a Mini-Project during 6th semester and continue the same as Major Project during 7th & 8th semesters. Finally, publish a research paper as outcome of their research project, in a journal indexed by SCI/SCOPUS/WEB OF SCIENCE (4 credits), by the end of 8th semesetr. ***(The individual research project itself shall be considered for regular B. Tech degree programme under Seminar, Mini-Project and Major Project work courses)***

11.1 Summary of requirements for earning additional credits leading to "Minor", "Honours" and "Honours with Research" degrees:

Semester	B. Tech with "Minor"	B. Tech with "Honours"	B. Tech "Honours with Research"
I	-	-	-
II	-	-	-
III	1 theory (4 credits) + 1 lab (1 credit)	1 theory (4 credits) + 1 lab (1 credit)	-
IV	1 theory (4 credits) + 1 lab (1 credit)	1 theory (4 credits) + 1 lab (1 credit)	"Research Methodology" Theory Course (4 Credits)
Summer break after 2nd year	-	-	2-Months Research Internship -I (5 credits)
V	1 theory (4 credits) + 1 lab (1 credit)	1 theory (4 credits) + 1 lab (1 credit)	-
VI	1 theory (4 credits) + 1 lab (1 credit)	1 theory (4 credits) + 1 lab (1 credit)	-
Summer break after 3rd year	-	-	2-Months Research Internship -II (5 credits)
VII	1 theory (4 credits)	1 theory (4 credits)	
VIII	1 theory (4 credits)	1 theory (4 credits)	One research publication in Journal indexed by SCI / SCOPUS / Web of Science (4 Credits)
Total additional credits to be earned	**Overall 18 credits (through 4 theory and 2 lab courses)**	**Overall 18 credits (through 4 theory and 2 lab courses)**	**18 credits (through Research Methodology, 2 Research Internships and a Research Publication out of Individual Research Project)**

11.2 Credit requirements for four different options of the B. Tech Degree

	I	II	III	IV	V	VI	VII	VIII	Total
B. Tech.	**21**	**23**	**23**	**21**	**22**	**20**	**20**	**12**	162
B. Tech. with Minor	**21**	**23**	**23**	**21**	**22**	**20**	**20**	**12**	162 (+18)*
B. Tech. with Honours	**21**	**23**	**23**	**21**	**22**	**20**	**20**	**12**	162 (+18)*
B. Tech. Honours with Research	**21**	**23**	**23**	**21**	**22**	**20**	**20**	**12**	162 (+18)*

*Optional additional Credits leading to Minor/Honours/Honours with Research as applicable

11.3 Options for earning of "Additional Points" for Honours certification

S. No.	Activity	Points earned	Maximum Limit
1	Success in the GATE Exam	Percentile: Above 98 – 8; Above 95 – 6; Above 90 – 4; Qualified – 2	8 Points
2	Research Publication indexed by SCI / SCOPUS / Web of Science*	SCI Journal: 8 Points SCOPUS / Web of Science Journal: 4 Points Patent: 4 Points	8 Points
3	Winning Prestigious Technical Competition at National Level#	Rank: 1 – 4; 2 – 3; 3 – 2	6 Points
4	Completion of PG level MOOCs	Percentile: Above 95 – 6; Above 90 – 5; Above 80 – 4	6 Points
	Total Points Restricted to a maximum of		*8 Points*

Note: As the activities mentioned in the above Table of 11.3 are aimed at an additional professional dimention to the professional personality of the learners, each Point earned is given 1 credit equivalency. Thus, Honours registered students are allowed to accumulate a maximum of 8 additional points through these activities equivalent to two courses (8 credits) of Honours curriculum requirement.

***In identified journals only. Journal to be approved by the BoS chair and Dean AA.**

#In events approved by the BoS chair and Dean AA.

12. Distribution of Courses:

(i) Humanities and Social Sciences including Management Courses (HSMC)

Sl. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	HSM 01	U24MH105	English Communication and Report Writing	I	2
2.	HSM 02	U24MH607	Technical English	VI	1
				Total:	3

(ii) Basic Science Courses (BSC)

Sl. No.	Course Type	Course Code	Course Name	Semester	Credits
1	BSC 01	U24MH101	Differential Calculus and Ordinary Differential Equations	I	3
2	BSC 02	U24CY102B	Engineering Chemistry	I	4
3	BSC 03	U24MH201	Matrix Theory and Vector Calculus	II	3
4	BSC 04	U24PY202B	Engineering Physics	II	4
5	BSC 05	U24MH401	Discrete Mathematics and Probability Statistics	IV	3
				Total:	17

(iii) Engineering Science Courses (ESC)

Sl. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	ESC 01	U24IT103	Digital Logic Design	I	3
2.	ESC 02	U24ME107	Engineering Graphics through CAD	I	1
3	ESC 03	U24EE205B	Basic Electrical Engineering	II	4
4	ESC 04	U24IT301	Artificial Intelligence	III	3
5	ESC 05	U24IT604	Introduction to Internet of Things	VI	3
6	ESC 06	U24IT609	Internet of Things Laboratory	VI	1
				Total:	15

(iv) Program Core Courses (PCC)

Sl. No.	Course Type	Course Code	Course Name	Semester	Credits
1	PCC 01	U24IT104	Programming for Problem Solving with C	I	4
2	PCC 02	U24IT203	Computer Architecture and Organization	II	3
3	PCC 03	U24IT204	Data Structures through C	II	4
4	PCC 04	U24IT302	Advanced Data Structures	III	4
5	PCC 05	U24IT303	Software Engineering	III	3
6	PCC 06	U24IT304	Database Management Systems	III	4
7	PCC 07	U24IT305	Object Oriented Programming through Java	III	4
8	PCC 08	U24IT402	Design and Analysis of Algorithms	IV	3
9	PCC 09	U24IT403	Python Programming	IV	3
10	PCC 10	U24IT404	Operating Systems	IV	3
11	PCC 11	U24IT405	Computer Networks	IV	3
12	PCC 12	U24IT408	Design and Analysis of AlgorithmsLaboratory	IV	1
13	PCC 13	U24IT409	Python Programming Laboratory	IV	1
14	PCC 14	U24IT410	Operating Systems Laboratory	IV	1
15	PCC 15	U24IT502	Machine Learning	V	3
16	PCC 16	U24IT503	Big Data Analytics	V	3
17	PCC 17	U24IT504	Cryptography and Network Security	V	3
18	PCC 18	U24IT505	Full Stack Development	V	4
19	PCC 19	U24IT507	Machine Learning Laboratory	V	1
20	PCC20	U24IT508	Full Stack Development Laboratory	V	1
21	PCC 21	U24IT603	Cloud Computing	VI	4
22	PCC 22	U24IT608	Cloud Computing Laboratory	VI	1
23	PCC 23	U24IT703	DevOps Essentials	VII	4
24	PCC 24	U24IT704	Data Science	VII	3
25	PCC 25	U24IT705	DevOps Laboratory	VII	1
26	PCC 26	U24IT706	Data Science Laboratory	VII	1
				Total:	70

(v) Program Elective Courses (PEC)

SL. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	PEC 01	U24IT602A	Cyber Security	VI	3
		U24IT602B	Generative Artificial Intelligence		
		U24IT602C	Advanced Computer Networks		
		U24IT602D	Parallel Programming		
		U24IT602E	Applications of IoT		
2.	PEC 02	U24IT702A	Ethical Hacking	VII	3
		U24IT702B	Computer Vision & Image Processing		
		U24IT702C	Mobile Computing		
		U24IT702D	High Performance Computing Architecture		
		U24IT702E	Industrial IoT		
3.	PEC 03	U24IT801A	Blockchain Technologies	VIII	3
		U24IT801B	Natural Language Processing		
		U24IT801C	Wireless Adhoc Networks		
		U24IT801D	Fog & Edge Computing		
		U24IT801E	Privacy and Security in IoT		
4.	PEC 04	U24IT802A	Computer Forensics	VIII	3
		U24IT802B	Deep Learning		
		U24IT802C	Wireless Sensor Networks		
		U24IT802D	Augmented Reality &Virtual Reality		
		U24IT802E	IoT Architectures and Protocols		
				Total:	12

(vi) Experiantial Learning Courses (ELC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	ELC01	U24EL108	Practicum-1	I	1
2.	ELC02	U24EL209	Practicum-2	II	1
3.	ELC03	U24EL308	Practicum-3	III	1
4.	ELC04	U24IT510	Seminar	V	1
5.	ELC05	U24IT610	Mini Project	VI	1
6.	ELC06	U24IT707	Internship Evaluation*	VII	1
7.	ELC07	U24IT708	Major Project Phase-1 / Industrial Internship - 1	VII	4
8.	ELC08	U24IT803	Major Project Phase–2 / Industrial Internship - 2	VIII	6
				Total:	16

(vii) Indian Knowledge System Course (IKSC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	IKSC 01	U24IK100	AICTE Mandated Student Induction Programme (Universal Human Values - I)	I	0
2.	IKSC 02	U24IK506B	Essence of Indian Traditional Knowledge	V	2
3.	IKSC 03	U24IK606A	Universal Human Values -II	VI	2
				Total:	4

(viii) Open Electives Courses (OEC)

Sr. No.	Course Type	Course Code	Course Name	Sem	Credits
1.	OE 01	U24OE501G	IoT based Precision Agriculture Technology for Crop Farming (CSE (Networks))	V	3
		U24OE501I	Sustainable AI (CSE (AI & ML))		
		U24OE501O	AI Ethics (CSE (AI & ML))		
		U24OE501R	Software Quality Assurance & Testing (CSE)		
2.	OE 02	U24OE601X	OE -Startups & Entrepreneurship Basket	VI	3
		U24OE601A	Design Thinking		
		U24OE601B	Innovative Product Design and Development		
		U24OE601C	Entrepreneurship		
		U24OE601D	Design Studio		
		U24OE601Z	Any other course approved by BoS Chair and Dean AA		
3.	OE 03	U24OE701A	Management Economics and Accountancy	VII	3
		U24OE701B	Engineering Finance		
		U24OE701C	Organisational Behaviour		
		U24OE701D	E-Commerce and Digital Marketing		
		U24OE701Z	Any other course approved by BoS Chair and Dean AA		
				Total:	9

(ix) Value Added Courses (VAC)

SL. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	VAC 01	U24VA106	Sports & Yoga	I	1
2.	VAC 02	U24VA109 XXXXX	SEA – I / SAA-1	I	1
3.	VAC 03	U24CY206	Environmental Studies	II	-
4.	VAC 04	U24VA210 XXXXX	SEA-2 / SAA -2	II	1
5.	VAC 05	U24VA306B	Soft and Interpersonal Skills Laboratory	III	1
6.	VAC 06	U24VA309XXXXX	SEA-3 / SAA -3	III	1
7.	VAC 07	U24VA406A	Quantitative Aptitude and Logical Reasoning	IV	2
8.	VAC 08	U24CY411*	Environmental Studies*	IV	-
				Total:	7

(x) Skill Enhancement Courses (SEC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	SEC 01	U24SE208	Programming Skill Development Lab – 1	II	1
2.	SEC 02	U24SE307	Programming Skill Development Lab –2	III	1
3.	SEC 03	U24SE407	Programming Skill Development Lab –3	IV	1
4.	SEC 04	U24SE509	Programming Skill Development Lab - 4	V	1
5.	SEC 05	U24SE605	Programming Skill Development Lab –5	VI	1
				Total:	5

(xi) Ability Enhancement Courses (AEC)

Sl. No.	Course Type	Course Code	Course Name	Semester	Credits
1	AEC 01	U24AE110	Expert Talk Series-1	I	1
2	AEC 02	U24AE207	Idea Lab Makerspace	II	1
3	AEC 03	U24AE211	Expert Talk Series-2	II	1
4	AEC 04	U24AE310	Expert Talk Series-3	III	1
				Total:	4

(xii) Activity Based Learning (ABL) @ Value Added Courses:

Activity Based Learning (ABL) @ Value Added Courses

- Students are required to earn 4 credits through the first four semesters (2 credits from **Social Empowerment Activities - SEA** and 2 credits from **Self Accomplishment Activities - SAA**)
- If a student is not able to attend/ fulfill performance requirements, he/she shall be dropped from the course and will have to repeat by enrolling in the forthcoming semesters.
- The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i2RE) shall act as nodal units for activities listed under SEA/SAA.

Social Empowerment Activities - SEA

- These activities are designed to uplift and empower a group or community. The emphasis is on collective benefit, social change, and improving the conditions or capabilities of a community or specific group within society.

- These are categorized under four groups namely
    1. **Swacch Bharat** (Clean India)
       The aim of activities under Swachh Bharat is to promote cleanliness, hygiene and sanitation across India.
    2. **Shikshit Bharat** (Educated India)
       The aim of activities under Shikshit Bharat is to ensure inclusive and equitable quality education for all, promoting lifelong learning opportunities.
    3. **Samruddha Bharat** (Prosperous India)
       The aim of activities under Samrudha Bharat is to promote economic growth, self-reliance, and prosperity for all citizens.
    4. **Surakshit Bharat** (Safe India)
       The aim of activities under Surakshit Bharat is to ensure the safety, security, and well-being of all citizens.

Self-Accomplishment Activities - SAA

- These activities are centered on individual growth, personal development, and self-improvement. The emphasis is on enhancing one's own skills, knowledge, and well-being.
- These are categorized under four groups namely
    1. **Socho Bharat** (Think India)

        The aim of activities under Socho Bharat is to foster critical thinking, innovation, and intellectual development among citizens.
    2. **Sanskarit Bharat** (Cultured India)

        The aim of activities under Sanskarit Bharat is to preserve, promote, and celebrate India's rich cultural heritage, traditional values, and ethical practices by nurturing morals, fostering social harmony and creating awareness and appreciation of Inda’s rich history.
    3. **Saksham Bharat** (Empowered India)

        The aim of activities under Saksham Bharat is to empower individuals and communities with the skills, resources, and opportunities needed to achieve self-reliance and economic independence by fostering physical fitness, discipline, teamwork leadership and mental resilience.
    4. **Sunder Bharat** (Beautiful India)

        The aim of activities under Sunder Bharat is to enhance the aesthetic and environmental beauty of India, making it a visually pleasing and environmentally sustainable country by emphasizing the importance of culture and heritage.

Table: SEA

Group	Guiding club/ center	Code of activity (U24VAYYY)*	Title of activity
SEA Group-1: Swacch Bharat	**NSS**	**SE101**	Clean India—Green India (River/Beach/Mohalla/School/Campus/Govt offices Cleaning)
		SE102	Waste Management/Waste Segregation Surveys
		SE103	Village Empowerment / NSS camp in village for a week
		SE104	Healthy habits-happy schools/Medical camps in schools /peer health
		SE105	Lifesaving skills /school clinics /First Aid training for a week
		SE106	Sustainable living /Surveys and Estimation for roof tops
		SE110	Any other activity approved by Dean Academic Affairs
SEA Group-2: Shikshit Bharat	**Humanity Club**	**SE201**	Peer mentoring /Mentoring of School Children
		SE202	Rural digital revolution / Digital Literacy for yielders & Participation in "Teach-for-India" movement
		SE203	Empowering learners –schools /Value addition for deprived schools
		SE204	Peer Mentoring /Mentoring junior (first year) students at KITSW
		SE205	Learning by Teaching /Teaching Assistantship at KITSW/Teaching AIDE
		SE206	Enriching Education/Development of learning material for schools/ITIs
		SE210	Any other activity approved by Dean Academic Affairs
SEA Group-3: Samruddha Bharat	**C-i2RE**	**SE301**	Great Grass Root Innovations
		SE302	Innovation and Creativity/ Critical Thinking and Problem solving
		SE303	Team work and collaboration
		SE304	Leadership & Entrepreneurship
		SE305	Design Thinking
		SE306	Work with START-UP at KITSW
		SE310	Any other activity approved by Dean Academic Affairs
SEA Group-4: Surakshit Bharat	**NCC**	**SE401**	NCC participation/National Integrity
		SE402	Basics of fire safety/Community safety
		SE403	Disaster Management
		SE404	Environmental health & sustainability
		SE405	Road safety
		SE406	Pollution control
		SE410	Any other activity approved by Dean Academic Affairs

Code of each activity shall be: **U24VAYYY + activity code of SEA/SAA**
Example: **U24VAYYYSE101** ***(for the activity Clean India—Green India (River/Beach/ Mohalla/School/Campus/Govt. offices Cleaning) under SEA Group1 Swacch Bharath)***

Table: SAA

Group	Guiding club/ center	Code of activity (U24VAYYY)*	Title of activity
SAA Group-1: SochoBharat	**Literary Club**	**SA101**	Study of Green & White Revolutions in India
		SA102	Study of any 2 Government Missions or National Policies
		SA103	Study of India's top 2 problems
		SA104	Study of World's top 2problems
		SA105	Study of one department ofthe Central/ State Government
		SA106	Study of one of the identified Books on leadership or innovation
		SA110	Any other activity approved by Dean Academic Affairs
SAA Group-2: Sanskarit Bharat	**Team - UHV**	**SA201**	Values and Ethos of KITSW
		SA202	Philosophy of religion (any)
		SA203	Study of Life Management / Kindle Life / Life Empowerment and Enriching Program or any other book cited.
		SA204	Study of any of GREAT sons of INDIA (Ex. Gandhi, Ambedkar, Phule, Savarkar, Sardar Patel, Nehru, Shivaji, JRD Tata etc)
		SA205	Harmony in FAMILY & SOCIETY
		SA206	Harmony in NATURE
		SA210	Any other activity approved by Dean Academic Affairs
SAA Group-3: Saksham Bharat	**Sports Club**	**SA301**	Physical Fitness, Self-defence for Women, Target based Physical Exercise for example-Running (Test 5 kms in a stretch), Swimming (Test 1 km in a stretch), Walking (Test 20 kms in a stretch), Trekking (7days), Cycling
		SA302	Sports – Representation of Institute at University level / Inter college level and above in ANY sport
		SA303	Pran-vidya (Yoga & Pranayama), Jeevan-vidya (work-life balance)
	Technical club	**SA304**	Participation in National Tech Fest, AICTE-Hackathon, industry floated global and National competitions, Robocon, BAHA etc
		SA305	Participation in National level or State level bodies in professional bodies like ISTE/IEEE/CSI/IETE etc.
		SA306	Present research papers at National and International conferences
		SA310	Any other activity approved by Dean Academic Affairs
SAA Group-4: Sunder Bharat	**MDF**	**SA401**	Institute representation in prestigious cultural fests/competitions
		SA402	Dance (Bharatanatyam /Kathak /Lavani /Western Dance). *Only for beginners*
		SA403	Music composition / Learning musical instrument (Any type). *Only for beginners.*
		SA404	Film Appreciation/Dramatics/Seeing through Painting
		SA405	Making short film/Photography
		SA406	Sculptures (focusing on themes of unity, peace and environmental conservation)
		SA410	Any other activity approved by Dean Academic Affairs

Code of each activity shall be: **U24VAYYY + activity code of SEA/SAA**
Example: **U24VAYYYSA101***(for the activity Study of Green & White Revolutions in India under SAA Group1 Socho Bharat)*

13. SUMMARY OF CURRICULUM COMPONENTS

S.NO.	CATEGORY	COURSECOMPONENT	TOTAL COURSES	TOTAL CREDITS	CURRICULUM CONTENT (%OF CREDITS)
1	HSMC	Humanity and Social Sciences including Management Courses	2	3	1.85
2	BSC	Basic Science Courses	5	17	10.49
3	ESC	Engineering Science Courses	6	15	9.26
4	PCC	Program Core Courses	26	70	43.21
5	PEC	Program Elective Courses	4	12	7.41
6	OEC	Open Elective Courses	3	9	5.56
7	ELC	Experiantial Learning Courses	8	16	9.88
8	IKSC	Indian Knowledge System Courses	3	4	2.47
9	VAC	Value Added Courses	8	7	4.32
10	SEC	Skill Enhancement Courses	5	5	3.09
11	AEC	Ability Enhancement Courses	4	4	2.47
Total			**74**	**162**	**100**

14. SEMESTER WISE COURSE / CREDIT DISTRIBUTION

Semester	Number of Courses / Number of Credits (*Course Category wise*)											
	BSC	**ESC**	**HSMC**	**PCC**	**OEC**	**PEC**	**SEC**	**VAC**	**ELC**	**AEC**	**IKSC**	**TOTAL**
I	2/7	2/4	1/2	1/4				2/2	1/1	1/1	1/0	11/21
II	2/7	¼		2/7			1/1	2/1	1/1	2/2		11/23
III		1/3		4/15			1/1	2/2	1/1	1/1		10/23
IV	1/3			7/15			1/1	2/2	1/1			12/22
V				6/15	1/3		1/1		1/1		1/2	10/23
VI		2/4	1/1	2/5	1/3	1/3	1/1		1/1		1/2	10/20
VII				4/9	1/3	1/3			1/4			7/19
VIII						2/6			1/6			3/12
Total	**5/17**	**6/15**	**2/3**	**26/70**	**3/9**	**4/12**	**5/5**	**8/7**	**8/16**	**4/4**	**3/4**	**74/162**
% Weightage of Course Category	10.49% (17/162)	9.26% (15/162)	1.85 % (3/162)	43.21% (70/162)	5.56% (9/162)	7.41 % (12/162)	3.09 % (5/162)	4.32% (7/162)	9.88% (16/162)	2.47% (4/162)	2.47% (4/162)	100 % (162/162)

* Seminar - 1C, Mini Project - 1C, Internship Evalution-1C, Major Project : 4+6=10C

Scheme of Instruction

SEMESTER-WISE CURRICULUM WITH SCHEME OF INSTRUCTION

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credits Assigned

I SEMESTER

Sl. No.	Category	Course Code	Course Title		Lectures / week				Credits
				L	T	P	O	E	C
-	IKSC	U24IK100	AICTE Mandated Student Induction Programme (Universal Human Values - I)						-
1	BSC	U24MH101	Differential Calculus and Ordinary Differential Equations	2	1	-	-	3	3
2	BSC	U24CY102B	Engineering Chemistry *(from Pool-I)* *(Common to CSM, CSD, CSN, CSO & IT)*	2	1	2	-	5	4
3	ESC	U24IT103	Digital Logic Design	2	1	-	-	3	3
4	PCC	U24IT104	Programming for Problem Solving with C	2	1	2	-	5	4
5	HSMC	U24MH105	English Communication and Report Writing	2	-	-	-	2	2
6	VAC	U24VA106	Sports & Yoga	-	-	2	-	2	1
7	ESC	U24ME107	Engineering Graphics through CAD	-	-	2	-	2	1
8	ELC	U24EL108	Practicum-1	-	-	-	4	4	1
9	VAC	U24VA109 XXXXX	SEA – I / SAA-1	-	-	-	2	2	1
10	AEC	U24AE110	Expert Talk Series-1	-	-	-	1	1	1
			Total:	10	4	8	7	29	21
Summer/ Inter-semBridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)									

Pool – I (Chemistry)		
S. No.	Course Code	Course Title
1.	U24CY102A	Engineering Chemistry *(for Mechanical Engineering)*
2.	U24CY102B	Engineering Chemistry *(Common to CSM, CSD, CSN, CSO & IT)*

II SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	BSC	U24MH201	Matrix Theory and Vector Calculus	2	1	-	-	3	3
2	BSC	U24PY202B	Engineering Physics *(from Pool-II)* *(Common to CSM, CSD, CSN, CSO & IT)*	2	1	2	-	5	4
3	PCC	U24IT203	Computer Architecture and Organization	2	1	-	-	3	3
4	PCC	U24IT204	Data Structures through C	2	1	2	-	5	4
5	ESC	U24EE205B	Basic Electrical Engineering *(from Pool-III)* *(Common to CSM, CSD, CSN, CSO & IT)*	2	1	2	-	5	4
6	VAC	U24CY206	Environmental Studies	2	-	-	-	2	-
7	AEC	U24AE207	Idea Lab Makerspace	-	-	2	-	2	1
8	SEC	U24SE208	Programming Skill Development Lab – 1	-	-	2	-	2	1
9	ELC	U24EL209	Practicum-2	-	-	-	4	4	1
10	VAC	U24VA210 XXXXX	SEA-2 / SAA -2	-	-	-	2	2	1
11	AEC	U24AE211	Expert Talk Series-2	-	-	-	1	1	1
			Total:	12	5	10	7	34	23
Summer/ Inter-semBridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-	-

Pool – II (Physics)		
S. No.	Course Code	Course Title
1.	U24PY202A	Engineering Physics *(for Mechanical Engineering)*
2.	U24PY202B	Engineering Physics *(Common to CSM, CSD, CSN, CSO & IT)*

Pool – III (Basic Electrical & Electronics Engineering)		
S. No.	Course Code	Course Title
1.	U24EE205A	Basic Electrical and Electronics Engineering *(for Mechanical Engineering)*
2.	U24EE205B	Basic Electrical Engineering *(Common to CSM, CSD, CSN, CSO & IT)*

Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute
OR
Successful completion of two suitable skill based courses (external) to qualify for Certification

A. After First Year: (UG Certificate in IT)

(i) The candidate should pass any two of the following additional courses (ITI Level) during the 2-Months internship at institute

Exit Option to Qualify UG Certificate in IT: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24IT212X	PC Software	2	-	2	-	4	3
2	PCC	U24IT213X	Digital Marketing	2	-	2	-	4	3
3	PCC	U24IT214X	Web Designing	2	-	2	-	4	3
4	PCC	U24IT215X	Hardware and Networking	2	-	2	-	4	3
5	PCC	U24IT216X	Any other course approved by BoS Chair and Dean AA						

(OR)

(ii) Any two suitable skill based courses to qualify for Certification.

Exit Option to Qualify UG Certificate in IT: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE212X	UNIX/LINUX Programming https://www.udemy.com/course/complete-linux-training-course-to-get-your-dream-it-job/?couponCode=ST3MT72524	-	-	6	-	6	3
2	SEC	U24SE213X	Java Programming https://learn.oracle.com/ols/learning-path/java-fundamentals/55593/55578	-	-	6	-	6	3
3	SEC	U24SE214X	Advanced Data Structures https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java/?couponCode=ST3MT72524	-	-	6	-	6	3
4	SEC	U24SE215X	SQL and PL/SQL Programming https://www.udemy.com/course/the-ultimate-mysql-bootcamp-go-from-sql-beginner-to-expert/?couponCode=ST3MT72524	-	-	6	-	6	3
5	SEC	U24SE216X	Any other skill based course approved by BoS Chair and Dean, AA	-	-	6	-	6	3

III SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	ESC	U24IT301	Artificial Intelligence	2	1	-	-	3	3
2	PCC	U24IT302	Advanced Data Structures	2	1	2	-	5	4
3	PCC	U24IT303	Software Engineering	2	1	-	-	3	3
4	PCC	U24IT304	Database Management Systems	2	1	2	-	5	4
5	PCC	U24IT305	Object Oriented Programming through Java	2	1	2	-	5	4
6	VAC	U24VA306B	Soft and Interpersonal Skills Laboratory *(from Pool-IV)*	-	-	2	-	2	1
7	SEC	U24SE307	Programming Skill Development Lab –2	-	-	2	-	2	1
8	ELC	U24EL308	Practicum-3	-	-	-	4	4	1
9	VAC	U24VA309 XXXXX	SEA-3 / SAA -3	-	-	-	2	2	1
10	AEC	U24AE310	Expert Talk Series-3	-	-	-	1	1	1
			Total:	**10**	**5**	**10**	**7**	**32**	**23**
			Additional Learning@:Maximum credits allowed for Honours/Minor	**-**	**-**	**-**	**-**	**-**	**5**
			Total credits for Honours/Minor students:	**-**	**-**	**-**	**-**	**-**	**28**
Summer/ Inter-semBridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-	-

Pool-IV T&P Basket		
S. No.	**Course Code**	**Course Title**
1.	U24VA306A	Quantitative Aptitude and Logical Reasoning
2.	U24VA306B	Soft and Interpersonal Skills

IV SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	BSC	U24MH401D	Discrete Mathematics and Probability Statistics *(from pool-V)*	2	1	-	3	3
2	PCC	U24IT402	Design and Analysis of Algorithms	2	1	-	3	3
3	PCC	U24IT403	Python Programming	2	1	-	3	3
4	PCC	U24IT404	Operating Systems	2	1	-	3	3
5	PCC	U24IT405	Computer Networks	2	1	-	3	3
6	VAC	U24VA406A	Quantitative Aptitude and Logical Reasoning	2	-	-	2	2
7	SEC	U24SE407	Programming Skill Development Lab –03	-	-	2	2	1
8	PCC	U24IT408	Design and Analysis of AlgorithmsLaboratory	-	-	2	2	1
9	PCC	U24IT409	Python Programming Laboratory	-	-	2	2	1
10	PCC	U24IT410	Operating Systems Laboratory	-	-	2	2	1
11	VAC*	U24CY411*	Environmental Studies*	2*	-	-	2*	-
Total:				12	5	8	25	21
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	26
Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-

**For Lateral Entry Students Only*

T&P Basket		
S. No.	Course Code	Course Title
1.	U24VA406A	Quantitative Aptitude and Logical Reasoning
2.	U24VA406B	Soft and Interpersonal Skills

Branch Specific Mathematics (Pool-V)		
S. No.	Course Code	Course Title
1.	U24MH401A	Numerical and Statistical Methods *(for Civil Engineering)*
2.	U24MH401B	Applied Mathematics *(for Mechanical Engineering)*
3.	U24MH401C	Applied Mathematics *(Common to ECI, EEE & ECE)*
4.	U24MH401D	Discrete Mathematics and Probability Statistics *(Common to CSE, CSN, CSO & IT)*
5.	U24MH401E	Essential Mathematics and Statistics for Machine learning *(for CSM)*
6.	U24MH401F	Essential Mathematics and Statistics for Data science *(for CSD)*

Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute

OR

Successful completion of two suitable skill based courses (external) to qualify for Certification

B. After Second Year: (UG Diploma in IT)

(i) The candidate should pass any two of the following additional courses (Diploma Level) during the 2-Months internship at institute

Exit Option to Qualify UG Diploma in IT: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24IT412X	Introduction to Web Programming	2	-	2	-	4	3
2	PCC	U24IT413X	Internet of Things	2	-	2	-	4	3
3	PCC	U24IT414X	Cloud Computing	2	-	2	-	4	3
4	PCC	U24IT415X	Full Stack Development	2	-	2	-	4	3
5	PCC	U24IT416X	Any other course approved by BoS Chair and Dean, AA	2	-	2	-	4	3

(OR)

(ii) Any two suitable skill based courses to qualify for Diploma.

Exit Option to Qualify UG Diploma in IT: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE412X	Programming for Web Design https://onlinecourses.swayam2.ac.in/nou24_cs12/preview	-	-	6	-	6	3
2	SEC	U24SE413X	Internet of Things using Aurdino/Raspberry Pi https://onlinecourses.swayam2.ac.in/ntr24_ed44/preview	-	-	6	-	6	3
3	SEC	U24SE414X	Cloud Computing using AWS/Google Cloud https://www.coursera.org/specializations/cloud-computing	-	-	6	-	6	3
4	SEC	U24SE415X	Full Stack using JAVA / .NET https://www.coursera.org/specializations/java-fullstack	-	-	6	-	6	3
5	SEC	U24SE416X	Any other skill based course approved by BoS Chair and Dean, AA	-	-	6	-	6	3

B. Tech Honours with Research:

Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-I (5 Credits) at respective department during the summer vacation after IV Semester.

V SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE-I	U24OE501X-SDG	OE-SDGB *(from Pool – VI)*	2	1	-	3	3
2	PCC	U24IT502	Machine Learning	2	1	-	3	3
3	PCC	U24IT503	Big Data Analytics	2	1	-	3	3
4	PCC	U24IT504	Cryptography and Network Security	2	1	-	3	3
5	PCC	U24IT505	Full Stack Development	3	1	-	4	4
6	IKSC	U24IK506B	Essense of Indian Traditional Knowledge	2	-	-	2	2
7	PCC	U24IT507	Machine Learning Laboratory	-	-	2	2	1
8	PCC	U24IT508	Full Stack Development Laboratory	-	-	2	2	1
9	SEC	U24SE509	Programming Skill Development Lab - 4	-	-	2	2	1
10	ELC	U24IT510	Seminar	-	-	2	2	1
			Total:	13	5	8	26	22
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	27
Summer/ Inter-semBridge Courses (Approved by BoS and Dean, AA):1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-

@List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula

Pool - VI Sustainable Development Goals Basket (OE - SDGB)			
S. No.	**Course Code**	**Course Title**	Offered by
1.	U24OE501G	IoT based Precision Agriculture Technology for Crop Farming	CSE (Networks)
2.	U24OE501I	Sustainable AI	CSE (AI & ML)
3.	U24OE501O	AI Ethics	CSE (AI & ML)
4.	U24OE501R	Software Quality Assurance & Testing	CSE

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE-II	U24OE601X-S&EB	Startups & Entrepreneurship Basket *(from Pool – VII)*	2	1	-	3	3
2	PEC	U24IT602X	Program Elective –I / MOOCs-I *(from Pool – VIII)*	2	1	-	3	3
3	PCC	U24IT603	Cloud Computing	3	1	-	4	4
4	ESC	U24IT604	Introduction to Internet of Things	2	1	-	3	3
5	SEC	U24SE605	Programming Skill Development Lab –05	-	-	2	2	1
6	IKSC	U24IK606A	Universal Human Values - II	2	-	-	2	2
7	HSMC	U24MH607	Technical English	-	-	2	2	1
8	PCC	U24IT608	Cloud Computing Laboratory	-	-	2	2	1
9	ESC	U24IT609	Internet of Things Laboratory	-	-	2	2	1
10	ELC	U24IT610	Mini Project	-	-	2	2	1
Total:				11	4	10	25	20
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	25
Summer/ Inter-semBridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)								

@List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula

B. Tech Honours with Research:

Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-II(5 Credits) at respective department during the summer vacation after VI Semester.

Pool -VII Startups & Entrepreneurship Basket (OE - S&EB)		
S. No.	**Course Code**	**Course Title**
1.	U24OE601A	Design Thinking
2.	U24OE601B	Innovative Product Design and Development
3.	U24OE601C	Entrepreneurship
4.	U24OE601D	Design Studio
5.	U24OE601Z	Any other course approved by BoS Chair and Dean AA

	Pool – VIII Program Elective – I	
S. No.	**Course Code**	**Course Title**
1	U24IT602A	Cyber Security
2	U24IT602B	Generative Artificial Intelligence
3	U24IT602C	Advanced Computer Networks
4	U24IT602D	Parallel Programming
5	U24IT602E	Applications of IoT

Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute
OR
Successful completion of two suitable skill based courses (external) to qualify for Certification

C. After Third Year: (B. Tech. Voc. in IT)

(i) The candidate should pass any two of the following additional courses (Degree Level) during the 2-Months internship at institute

Exit Option to Qualify B. Voc in IT: Any Two (02) Courses during the 2 - Months internship								
S. No.	Category	Course Code	Course Title	L	T	P	E	C
1	PCC	U24IT611X	Natural Language Processing	2	-	2	4	3
2		U24IT612X	Software Testing	2	-	2	4	3
3	PCC	U24IT613X	Fundamentals of DevOps	2	-	2	4	3
4	PCC	U24IT614X	Cyber Security	2	-	2	4	3
5	PCC	U24IT615X	Any other course approved by BoS Chair andDean AA	2	-	2	4	3

(OR)

(ii) Any two suitable skill based courses to qualify for B. Voc. in IT Degree.

Exit Option to Qualify B. Voc. in IT: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE611X	Deep Learning using Python https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-with-python	-	-	6	-	6	3
2	SEC	U24SE612X	Cyber Security Tools https://onlinecourses.swayam2.ac.in/nou19_cs08/preview	-	-	6	-	6	3
3	SEC	U24SE613X	Automated Testing Tools https://www.udemy.com/course/automated-software-testing-with-python/?couponCode=ST3MT72524	-	-	6	-	6	3
4	SEC	U24SE614X	DevOps https://www.udemy.com/course/devops-with-docker-kubernetes-and-azure-devops/?couponCode=ST3MT72524	-	-	6	-	6	3
5	SEC	U24SE615X	Any other skill based course approved by BoS Chair and Dean AA	-	-	6	-	6	3

VII SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE-III	U24MB701X	Open Elective-MB *(from Pool – IX)*	2	1	-	3	3
2	PEC	U24IT702X	Program Elective - II/ MOOCs-II *(from Pool – X)*	2	1	-	3	3
3	PCC	U24IT703	DevOps Essentials	3	1	-	4	4
4	PCC	U24IT704	Data Science	2	1	-	3	3
5	PCC	U24IT705	DevOps Laboratory	-	-	2	2	1
6	PCC	U24IT706	Data Science Laboratory	-	-	2	2	1
7	ELC	U24IT707	Internship Evaluation*	-	-	2	2	1
8	ELC	U24IT708	Major Project Phase-1 / Industrial Internship – 1	-	-	8	8	4
Total:				9	4	14	27	20
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	24

Pool –IX Management Courses Basket (OE-MB)		
S. No.	Course Code	Course Title
1.	U24OE701A	Management Economics and Accountancy
2.	U24OE701B	Engineering Finance
3.	U24OE701C	Organisational Behaviour
4.	U24OE701D	E-Commerce and Digital Marketing
5.	U24OE701Z	Any other course approved by BoS Chair and Dean AA

	Pool –X Program Elective – II	
S. No.	Course Code	Course Title
1	U24IT702A	Ethical Hacking
2	U24IT702B	Computer Vision & Image Processing
3	U24IT702C	Mobile Computing
4	U24IT702D	High Performance Computing Architecture
5	U24IT702E	Industrial IoT

VIII SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	PEC	U24IT801X	Program Elective - III / MOOCs-III *(from Pool – XI)*	2	1	-	3	3
2	PEC	U24IT802X	Program Elective - IV / MOOCs-IV *(from Pool – XII)*	2	1	-	3	3
3	ELC	U24IT803	Major Project Phase – 2 / Industrial Internship - 2	-	-	12	12	6
			Total:	4	2	12	18	12
			Additional Learning@:Maximum credits allowed for Honours/Minor:	-	-	-	-	4
			Total credits for Honours/Minor students:	-	-	-	-	16

	Pool – XI Program Elective - III	
S. No.	Course Code	Course Title
1	U24IT801A	Blockchain Technologies
2	U24IT801B	Natural Language Processing
3	U24IT801C	Wireless Adhoc Networks
4	U24IT801D	Fog & Edge Computing
5	U24IT801E	Privacy and Security in IoT

	Pool – XII Program Elective - IV	
S. No.	Course Code	Course Title
1	U24IT802A	Computer Forensics
2	U24IT802B	Deep Learning
3	U24IT802C	Wireless Sensor Networks
4	U24IT802D	Augmented Reality &Virtual Reality
5	U24IT802E	IoT Architectures and Protocols

SUMMARY

SEMESTER	I	II	III	IV	V	VI	VII	VIII	TOTAL
CREDITS	21	23	23	21	22	20	20	12	162

PROGRAM ELECTIVE COURSES (PEC)

There are four slots allotted to Program Elective Courses (PECs).

Each major specialization of the B. Tech Programme is treated as a vertical.

PROGRAM ELECTIVE COURSES - VERTICALS

VERTICAL/ PE	PE1	PE2	PE3	PE4
VERTICAL 1: Cyber Security	U24IT602A: Cyber Security	U24IT702A: Ethical Hacking	U24IT801A: Blockchain Technologies	U24IT802A: Computer Forensics
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL 2: Artificial Intelligence& Machine Learning	U24IT602B: Generative Artificial Intelligence	U24IT702B: Computer Vision & Image Processing	U24IT801B: Natural Language Processing	U24IT802B: Deep Learning
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL 3: Computer Networks	U24IT602C: Advanced Computer Networks	U24IT702C: Mobile Computing	U24IT801C: Adhoc Networks	U24IT802C: Wireless Sensor Networks
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL4: High Performance Computing	U24IT602D: Parallel Programming	U24IT702D: High Performance Computing Architecture	U24IT801D: Fog & Edge Computing	U24IT802D: Augmented Reality &Virtual Reality
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL5: Internet of Things	U24IT602E: Applications of IoT	U24IT702E: Industrial IoT	U24IT801E: Privacy and Security in IoT	U24IT802E: IoT Architectures and Protocols
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			

1st Semester Syllabi

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credit Assigned

I SEMESTER

Sl. No.	Category	Course Code	Course Title		Lectures / week				Credits
				L	T	P	O	E	C
-	IKSC	U24IK100	AICTE Mandated Student Induction Programme (Universal Human Values - I)						-
1	BSC	U24MH101	Differential Calculus and Ordinary Differential Equations	2	1	-	-	3	3
2	BSC	U24CY102B	Engineering Chemistry *(Common to CSM, CSD, CSN, CSO & IT)*	2	1	2	-	5	4
3	ESC	U24IT103	Digital Logic Design	2	1	-	-	3	3
4	PCC	U24IT104	Programming for Problem Solving with C	2	1	2	-	5	4
5	HSMC	U24MH105	English Communication and Report Writing	2	-	-	-	2	2
6	VAC	U24VA106	Sports & Yoga	-	-	2	-	2	1
7	ESC	U24ME107	Engineering Graphics through CAD	-	-	2	-	2	1
8	ELC	U24EL108	Practicum-1	-	-	-	4	4	1
9	VAC	U24VA109 XXXXX	SEA – I / SAA-1	-	-	-	2	2	1
10	AEC	U24AE110	Expert Talk Series-1	-	-	-	1	1	1
Total:				10	4	8	7	29	21
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)									

Pool – I (Chemistry)		
S. No.	Course Code	Course Title
1.	U24CY102A	Engineering Chemistry *(for Mechanical Engineering)*
2.	U24CY102B	Engineering Chemistry *(Common to CSM, CSD, CSN, CSO & IT)*

DIFFERENTIAL CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

Class: B. Tech. I – Semester		**Branch:** IT	
Course Code:	**U24MH101**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : examine the convergence of a series and interpret mean value theorems.

CO2 : apply partial differentiation to functions of several variables in solving various engineering problems.

CO3 : apply partial differentiation to functions of several variables in solving various engineering problems.

CO4 : analyze the solutions of higher order linear differential equation with constant coefficients

UNIT-I	**9 Hrs**

Infinite Series: Sequences, Series, General properties of series, Series of positive terms, Comparison tests-Limit form, Integral test, D'Alembert's Ratio test, Cauchy's root test

Differential Calculus and its applications: Fundamental theorems-Rolle's theorem (Geometrical interpretation), Lagrange's mean value theorem (Geometrical interpretation), Cauchy's mean value theorem, Taylor's theorem (Generalized mean value theorem), Expansions of functions- Maclaurin's series, Taylor's series, Maxima and Minima-Conditions, Practical problems (rectangle, right circular cylinder, cone)

Self-Learning Topics (SLTs): *Review of basic concepts of limit, continuity and differentiability [Reference 1: topic (3.1,3.2,3.5,4.1)]Alternating series [(Text 1: topic 9.12, Solved problems: 9.16,9.17, Practice problems: exercise 9.7(1, 7)]*

Additional problems on fundamental theorems [(Text 1: topic 4.3, Solved problems: 4.13(i),4.14,4.17, Practice problems: exercise 4.4 (1(i),1(ii), 3(ii), 10(i), 10(ii))]

Additional problems on Maclaurin's series [(Text 1: topic 4.4, Solved problems: 4.20, Practice problems: exercise 4.5 (3, 5)]

UNIT-II	**9 Hrs**

Partial differentiation and its applications: Functions of two or more variables, Partial derivatives, Total derivative, Change of variables, Jacobians, Functional relationship, Geometrical Interpretation-Tangent plane and Normal to a surface, Taylor's theorem for function of two variables (without proof), Errors and approximations, Total differential, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers, Differentiation under the integral sign

Self-Learning Topics (SLTs):

Leibnitz rule of Differentiation under the integral sign for variable limits [(Text 1: topic 5.13(2)), Solved problems: 5.54, Practice problems: exercise 5.11 (1)]

Additional problems on maxima and minima of function of two variables [(Text 1: topic 5.11 (1), Solved problems: 5.42, 5.43, Practice problems: exercise 5.10 (1(i),1(ii),1(iii))].

Additional problems on Lagrange's methods of undetermined multipliers [(Text 1: topic (5.12), Solved problems: 5.45, 5.48, Practice problems: exercise 5.10 (3(i) ,3(ii))]

UNIT-III	**9 Hrs**

Differential equations of first order (DE): Reorientation of differential equation of first order and first degree (Formation a differential equation, variables separable method, homogeneous equations, Linear equations), Exact differential equations, Equations reducible to exact equations,

Applications of differential equations of first order: Orthogonal trajectories - Orthogonal trajectories of the family of curves f(x, y, c)=0, Physical applications-Motion of a boat across a stream, Resisted motion, Velocity of escape from the earth, Simple electric circuits - RL series circuit, Newton's law of cooling, Rate of decay of Radio-active materials, Rate of growth of population

Self-Learning Topics (SLTs): *Review of DEs of first order (Text 1: topic 11.1, 11.2, 11.3, 11.4,11.5)*

Solutions of Non-exact DEs by Inspection Method [(Text 1: topic 11.12(1), Solved Problems: 11.30, Practice problems: exercise 11.8 (1,3)]

Additional problems on Non-exact DEs [(Text 1: topic 11.12(2,3,4,5), Solved problems: 11.33,11.35,11.36, Practice problems: exercise 11.8 (9,15)]

Orthogonal Trajectories of family of curves in polar coordinates [(Text 1: topic 12.3(3), Solved problems :12.7,12.8 , Practice problems: exercise 12.2(9,10)]

UNIT-IV	**9 Hrs**

Linear differential equations: Linear differential equations with constant coefficients, Rules for finding complementary function, Inverse operator, Rules for finding the particular integral ($Q=e^{ax}$, sin(ax+b) or cos(ax+b), x^m and $e^{ax}V(x)$), Method of variation of parameters, Linear dependence of solutions

Applications of linear differential equations: Simple harmonic motion, Simple pendulum, Oscillations of spring, Oscillatory electrical circuit-LCR circuit, Electro-mechanical analog

Self-Learning Topics (SLTs):

Finding the particular integral of Q(X) =$X^m V(X)$ $X^m V(x)$[*(Text 1: topic 13.7, Solved problems: 13.16,13.17,13.19, Practice problems: exercise 13.2 (21,22)].*

Additional problems on method of variation of parameters [(Text 1: topic 13.8(1), Solved problems: 13.25, 13.26, Practice problems: exercise 13.3(1,5)]

Cauchy's homogeneous linear differential equation [(Text 1: topic 13.9(1), Solved problems: 13.31,13.34, Practice problems: exercise 13.4(3,6,9)]

Textbook(s):

1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, Delhi, 44th edition, 2017

Reference Book(S):

1. Shanti Narayan, Dr. Mittal P.K, *Differential Calculus*, S. Chand & Co., New Delhi, 1st edition, Reprint 2014
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, U.K, John wiely & sons, 10th edition, 2020

3. S.S. Sastry, *Engineering Mathematics, Vol.II,* Prentice Hall of India, 3rd edition, 2014.

Web and Video link(s):

1. https://youtu.be/4EYko9rdF7g?si=WUu12 *NPTEL Video Lecture on Infinite series by Prof. S.K.Ray, Professor of Mathematics, IITK Kanpur.*
2. https://youtu.be/0apMXhWG_W8?si=M-abw2Gq3buX5HLM *NPTEL Video Lecture on Fundamental mean value theorems by Prof. Jithedra Kumar, Professor of Mathematics, IITK Kharagpur.*
3. https://youtu.be/6r5jfT8xrXM?si=ryLXYVJr4-iUkdlV; *NPTEL Video Lecture on Exact Differential Equations, Prof. Jithedra Kumar, Professor of Mathematics, IIT Kharagpur.*
4. https://youtu.be/kbGhrqV9AOM?si=yGyK_V7kJKGa3OaR *NPTEL Video Lecture on Orthogonal Trajectories of family of curves by Prof. Aditya Sharma, Professor of Physics, IISE Bhopal.*
5. *https://youtu.be/btOCUmJkrrg?si=zq3nB00kplm7b5se; NPTEL Video Lecture on Higher Order Linear Differential Equations, Prof. Jithedra Kumar, Professor of Mathematics, IIT Kharagpur..*

Course Articulation Matrix (CAM):		**U24MH101:DIFFERENTIAL CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24MH101.1**	2	2	1	1	-	-	-	1	1	-	1	-	-
CO2	**U24MH101.2**	2	2	1	1	-	-	-	1	1	-	1	-	-
CO3	**U24MH101.3**	2	2	1	1	-	-	-	1	1	-	1	-	-
CO4	**U24MH101.4**	2	2	1	1	-	-	-	1	1	-	1	-	-
U24MH101		**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Examine the convergence of a series and interpret mean value theorems.	SDG4	Quality Education	Develops analytical thinking, mathematical reasoning, and problem-solving skills essential for quality technical education.
CO2	Apply partial differentiation to functions of several variables in solving various engineering problems.	SDG9	Industry, Innovation and Infrastructure	Supports engineering design, optimization, modelling, and innovation in industrial and technological applications.
CO3	Apply appropriate methods of differential equations of first order and first degree to solve real-life engineering problems.	SDG9	Industry, Innovation and Infrastructure	Differential equation models are widely used in transportation, environmental systems, population studies, and engineering infrastructure.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO4	Analyze the solutions of higher order linear differential equations with constant coefficients.	SDG9	Industry, Innovation and Infrastructure	Helps in analyzing dynamic systems, control systems, electrical/mechanical engineering applications, and technological advancement.

ENGINEERING CHEMISTRY

Class: B.Tech. I Semester			**Branches:** IT	
Course Code	**:**	**U24CY102B**	**Credits** **:**	**4**
Hours/Week (L-T-P-O-E)	**:**	**2-1-2-5-10**	**CIE** **:**	**60 %**
Total Number of Teaching Hours :		**60 Hrs**	**ESE** **:**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to...

(based on cognitive skills acquired from theory component)

CO1: apply the concepts of electrochemical energy systems for batteries and fuel cells
CO2: interpret suitable techniques of water analysis and corrosion treatment of solid materials
CO3: apprise manufacturing of engineering materials and spectroscopic techniques of chemical analysis
CO4: apprise the synthesis, applications of engineering materials and principles of green chemistry

(based on psychomotor skills acquired from laboratory component)

CO5: determine water quality parameters-alkalinity, hardness
CO6: make use of analytical instruments for chemical analysis
CO7: determine metals present in their ores
CO8: design the synthesis of nanomaterial and polymer

THEORY COMPONENT

UNIT-I	9 Hrs

Electrochemical Technology and Engineering: Introduction, Specific conductance, Equivalent conductance, Effect of dilution; Conductometric titrations - Acid base titrations - Strong acid vs strong base, Strong acid vs weak base, Weak acid vs strong base, Weak acid vs weak base, Advantages of conductometric titrations; Galvanic cell, Electrodepotential, Electrochemical series, Nernst equation; Potentiometric titrations - Acidbase titrations and advantages of potentiometric titrations

Batteries: Classification, Lead-acid battery, Li-ion battery

Fuel cells: Hydrogen-oxygen fuel cell

Self Learning Topics (SLTs): *Types of conductors (Text 1: topic 5.1), Ohms law (Text 1: topic 5.5)*

UNIT-II	9 Hrs

Applied Chemistry:

Water Technology: Introduction, Hardness of water, Estimation of hardness of water by complexometry, Alkalinity, Determination of alkalinity, Numerical problems; Determination of dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Softening methods-Ion exchange method, Desalination processes, Reverse osmosis; Quality parameters of potable water (BIS and WHO)

Corrosion: Introduction, Dry corrosion, Pilling-Bedworth rule, Wet corrosion; Factors effecting corrosion - Purity of the metal, Relative areas of anodic and cathodic parts, Nature of surface film, Humidity, pH and Temperature; Prevention methods of corrosion – Cathodicprotection - Impressed current cathodic protection, Sacrificial anodic protection

Self Learning Topics (SLTs): *Units of hardness(Text1: topic 1.5), Introduction to corrosion (Text 1: topic 7.1)*

UNIT-III	9 Hrs

Engineering Materials: Nanomaterials-Introduction, Synthesis of nanomaterials - Top down and bottom-up approaches, Synthesis by sol-gel method; Nanoscalematerials - Fullerenes, Carbon nanotubes and Graphene, Properties and applications, Biosensors

Spectroscopy: Introduction to spectroscopy, Microwave spectroscopy - Principle, Selection rules, Applications; Infra-red spectroscopy - Principle, Selection rules, Applications; UV Spectroscopy – Lambert - Beer's law and its applications

Self Learning Topics (SLTs): *Introduction to nanotechnology (Text 1: topic 37.1), Electromagnetic spectrum (Text 1: topic 35.1)*

UNIT-IV	9 Hrs

Polymers: Introduction,Monomer, Polymer, Types of polymerization reactions-Addition and condensation; Preparation, Properties and Applications-Polythene, Polyvinyl cyanide, Polyvinyl chloride, Bakelite, Nylon 6:6; Thermosetting resins and thermoplastic resins; Conducting polymers and their applications

Green Chemistry: Principles of green chemistry, Synthesis of adipic acid by traditional pathway and green pathway; Green methods in electronic production, Impact of electronic waste on environment and public health

Self Learning Topics (SLTs): *Mechanism of addition polymerization (Text 1: topic 3.6); Aalternative solvents for green synthesis (Text 2: topic 5)*

LABORATORY COMPONENT

List of Experiments

1. Estimation of hydroxide ion by acidimetry using standard sodium carbonate solution
2. Estimation of alkalinity of water sample containing (i) carbonate; (ii) carbonate & bi carbonate in ground water
3. Estimation of alkalinity of water sample containing (i) bicarbonate; (ii) carbonate & hydroxide in potable water
4. Determination of hardness of water by complexometric method
5. Determination of dissolved oxygen in a sample of water
6. Standardization of sodium hydroxide (NaOH) by conductometry using standard hydrochloric acid (HCl)
7. Standardization of acetic acid (CH_3COOH) by conductometry using standard sodium hydroxide (NaOH)
8. Standardization of strong acid hydrochloric acid (HCl) by potentiometry using standard sodium hydroxide (NaOH)
9. Colorimetric analysis-verification of Lambert-Beer's law
10. Estimation of ferrous (Fe^{2+}) ion in the given solution using potassium permanganate
11. Preparation of nanoparticles of cadmium sulphide (CdS)
12. Synthesis of polymer (phenol- formaldehyde)

Text Book(s):

1. Jain and Jain, *Engineering Chemistry*, 17th ed., New Delhi, India: Dhanpat Rai Publishing Company, 2019 (Chapters 1, 3, 5, 6, 7, 35, 36, 37)
2. D. A. Dornfeld, *Green Manufacturing: Fundamentals and Applications*, 1st ed. New York, NY, USA: Springer Science & Business Media, 2012 (Chapters 5, 8, 9)

Reference Book(s):

1. J. C. Kuriacose and J. Rajaram, *Chemistry in Engineering and Technology*, Vol. I., 1st ed., New Delhi, India: Tata McGraw-Hill Publishing Co. Ltd., 2001
2. S. Chawla, *A Textbook of Engineering Chemistry*, 3rd ed., New Delhi, India: Dhanpat Rai & Co., 2003
3. S. S. Dara and S. S. Umare, *A Textbook of Engineering Chemistry*, 12th ed., New Delhi, India: S. Chand & Company Ltd., 2010

Web and Video link(s):

https://elearn.nptel.ac.in/shop/iit-workshops/completed/battery-cell-technology-materials-and-industrial-applications/?v=c86ee0d9d7ed; *NPTEL Video Lecture on Battery technology by Dr. Kothandaraman, Professor of Chemistry, IIT Madras & Dr.Raghunathan, Professor of Chemical engineering, IIT Madras*

Course Articulation Matrix (CAM):		U24CY102B: ENGINEERING CHEMISTRY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CY102B.1	2	-	-	-	1	1	1	-	1	-	1	-	-
CO2	U24CY102B.2	2	-	-	-	1	1	1	-	1	-	1	-	-
CO3	U24CY102B 3	2	-	-	-	1	1	1	-	1	-	1	-	-
CO4	U24CY102B.4	2	-	-	-	1	2	1	-	1	-	1	-	-
U24CY102B		2	-	-	-	1	1.25	1	-	1	-	1	-	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply the concepts of electrochemical energy systems for batteries and fuel cells	SDG7	Affordable a n d Clean Energy	Electrochemical energy systems such as batteries and fuel cellsprovide clean, reliable, and efficient energy storage and reduce dependence on fossil fuels, promote renewable energy utilization.
CO2	interpret suitable techniques of water analysis and corrosion treatment of solid materials	SDG3	Good Health and well being	Water analysis techniques help identify contaminants and ensure safe drinking water, thereby protecting human health and preventing water-borne diseases. Corrosion treatment of solid materials improves the safety and durability of pipelines, storage systems, and medical equipment.
CO3	apprise manufacturing of	SDG9	Industry,	Engineering materials enhancing

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	engineering materials and spectroscopic techniques of chemical analysis		Innovation and Infrastructure	knowledge of manufacturing processes for engineering materials and Spectroscopic techniquedevelops knowledge ofmodern spectroscopic techniques used in chemical analysis. These concepts promote industrial innovation, quality improvement, and advanced material development for sustainable industries.
CO4	apprise the synthesis, materials and principles of green chemistry applications of engineering	SDG9	Industry, Innovation and Infrastructure	Engineering materials, and principles of green chemistry promotes sustainable industrial development through the design of eco-friendly materials and processes. It encourages innovation in engineering applications by reducing waste, energy consumption, and environmental impact in manufacturing industries.

DIGITAL LOGIC DESIGN

Class: B.Tech. I –Semester		**Branch:** IT	
Course Code:	**U24IT103**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-4-7**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : apply number systems, binary codes, complements, and binary arithmetic operations to represent and process digital information efficiently.

CO2 : analyze and simplify Boolean expressions using Boolean algebra, logic gates, Karnaugh maps, and Quine–McCluskey minimization techniques.

CO3 : design and evaluate combinational circuits including adders, comparators, encoders, decoders, and multiplexers for specified digital applications.

CO4 : design and analyze sequential circuits using latches, flip-flops, registers, shift registers, and counters to realize digital systems.

UNIT-I	**9 Hrs**

Number Systems and Codes: Review of number systems, Number-Base conversions, Octal and Hexadecimal numbers, Complements of numbers, Signed binary numbers, Binary codes, Binary weighted and non-weighted codes, Error detecting and error correcting codes

Binary Arithmetic: Addition, Subtraction, Multiplication-Long hand multiplication, Booth multiplication, Fast multiplication, Division-Restoring integer division, Non-Restoring integer division

Self Learning Topics (SLTs): *Binary storage and registers (Text1: topics 1.8), Arithmetic operations on floating-point numbers (Text2: topic 9.7.1), Practice Problems (Text1: Prob 1.3, Prob 1.7, Prob 1.9 to 1.21)*

UNIT-II	**9 Hrs**

Boolean Algebra and Logic Gates: Basic definitions, Axiomatic definition of boolean algebra, Basic theorems and properties of boolean algebra, Boolean functions, Canonical and standard forms, Other logic operations, Digital logic gates

Gate Level Minimization: The map method, Four - variable K-Map, Minimization using K-Map, Quine Mc'Clusky method

Self Learning Topics (SLTs): *Basic theorems and properties of boolean algebra (Text1: topic 2.4), Practice Problems (Text1: Prob 2.1 to 2.4, Prob 2.13, Prob 2.19 to 2.22, Prob 3.1 to 3.7)*

UNIT-III	**9 Hrs**

Design of Combinational Circuits: Combinational circuits, Analysis procedure, Design procedure, Binary adder–subtractor, Decimal adder, Magnitude comparator, Decoders, Encoders, Multiplexer, Realization of switching functions using multiplexers and decoders

Self Learning Topics (SLTs): *Design of code converters (Reference1: topic 7.12), Expansion of decoders (Reference1: topic 7.16), BCD to 7-Segment Decoders (Reference1: topic 7.17), Expansion of MUXs (Reference1: topic 7.22)*

UNIT-IV	**9 Hrs**

Sequential Circuits: Sequential circuits**,** Storage elements-Latches, Flip-Flops: SR flip flop,

JK flip flop, D flip flop, T flip flop and Master-slave flip flop, Analysis of clocked sequential circuits, Registers, Shift registers, Ripple counters, Synchronous counters, Ring counter, Johnson counter

Self Learning Topics (SLTs): *Conversion of flip flops (Reference1: topic 8.8)*

Text Book(s):

1. M. M. Mano and M. D. Ciletti, *Digital Design: With an Introduction to the Verilog HDL*, 5th ed., Upper Saddle River, NJ, USA: Pearson Education, 2013 (Chapters 1,2,3,4,5,6)
2. C. Hamacher, Z. Vranesic, S. Zaky, and N. Manjikian, *Computer Organization and Embedded Systems*, 6th ed., New York, NY, USA: McGraw-Hill Education, 2012 *(Chapter 9)*

Reference Book(s):

1. A. Anand Kumar, *Switching Theory and Logic Design*, 1st ed., New Delhi, India: PHI Learning Pvt. Ltd., 2014
2. G. K. Kharate, *Digital Electronics*, 1st ed., New Delhi, India: Oxford University Press, 2012
3. R. P. Jain, *Modern Digital Electronics*, 4th ed., New Delhi, India: McGraw-Hill Education (India) Pvt. Ltd., 2010
4. S. C. Lee and B. S. Sonde, *Digital Circuits and Logic Design*, 1st ed., Englewood Cliffs, NJ, USA: Prentice-Hall, 1976

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_ee147/course; *NPTEL Video Lecture on Digital Circuits by Prof. Santanu Chattopadhyay, Professor of E&ECE, IIT Kharagpur*
2. https://onlinecourses.nptel.ac.in/noc21_ee10/preview; *NPTEL Video Lecture on Digital Electronic Circuits by Prof. Goutham Saha, Professor of E&ECE, IIT Kharagpur.*

Course Articulation Matrix (CAM):		**U24IT103 - DIGITAL LOGIC DESIGN**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT103.1**	2	2	1	-	-	-	1	-	1	-	1	1	-
CO2	**U24IT103.2**	2	2	1	-	-	-	1	-	1	-	1	1	-
CO3	**U24IT103.3**	2	2	2	1	-	-	1	-	1	-	1	1	-
CO4	**U24IT103.4**	2	2	2	2	-	-	1	-	1	-	1	1	-
U24AI505		2	2	1.5	1.5	-	-	1	-	1	-	1	1	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Perform number system conversions, represent data using binary codes, and apply binary arithmetic operations including addition, subtraction, multiplication, and	SDG4	Quality Education	Develops fundamental knowledge and computational skills required for understanding digital systems and computer engineering concepts.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	division.			
CO2	Analyze and simplify Boolean functions using Boolean algebra, logic gates, Karnaugh maps, and Quine–McCluskey minimization techniques.	SDG4	Quality Education	Enhances logical reasoning, analytical thinking, and problem-solving abilities essential for engineering education and lifelong learning.
CO3	Design and implement combinational logic circuits such as adders, comparators, encoders, decoders, and multiplexers for digital applications.	SDG9	Industry, Innovation and Infrastructure	Enables students to develop efficient digital hardware solutions that support innovation and modern technological infrastructure.
CO4	Enables students to develop efficient digital hardware solutions that support innovation and modern technological infrastructure.	SDG9	Industry, Innovation and Infrastructure	Contributes to the development of reliable digital systems used in computing, automation, communication, and industrial applications..

PROGRAMMING FOR PROBLEM SOLVING WITH C

Class: B.Tech. I –Semester			**Branch:** IT		
Course Code	**:**	**U24IT104**	**Credits**	**:**	**4**
Hours/Week (L-T-P-O-E)	**:**	**2-1-2-5-10**	**CIE**	**:**	**60 %**
Total Number of Teaching Hours	**:**	**60 Hrs**	**ESE**	**:**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

- **CO1:** enumerate programming development steps, design an algorithm and draw flow chart for a given application
- **CO2:** apply logical skills for problem solving using control structures and arrays
- **CO3:** develop string operations and modular programming with functions
- **CO4:** analyse and implement structures, unions, pointers and files in C programming

(based on psychomotor skills acquired from laboratory component)

- **CO5:** develop programs using operators and decision making statements
- **CO6:** apply loops and arrays to develop a program of an application
- **CO7:** implement string operations and develop modular programs using user-definedfunctions, recursion, and storage classes
- **CO8:** develop programs using structures, unions, pointers and files

THEORY COMPONENT

UNIT-I	**9 Hrs**

Introduction to Programming: Art of programming through algorithms and flowcharts

Overview of C: History of C, Importance of C, Basic structure of C programs

Constants, Variables and Data Types: Character set, C tokens, Declaration of variables, Defining symbolic constants

Managing Input and Output Operations: Reading a character, Writing a character**,** Formatted input, Formatted output

Operators and Expressions: Arithmetic, Relational, Increment, Decrement, Conditional, Logical, Bit-wise, Special operators, Arithmetic expressions, Evaluation of expressions, Operator precedence and associativity

Self Learning Topics (SLTs): *Components of a computer, concept of hardware and software (Text1: chapter 1), Executing a C program (Text1: chapter 2), Type conversions in expression (Text1: chapter 4), Solved problems (Text1: chapter 2 to chapter 5), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 2 to chapter 5)*

UNIT-II	**9 Hrs**

Decision Making and Branching: Simple if statement, if-else statement, Nesting of if-else statements, else if ladder, switch statement, Conditional operator, goto statement

Decision Making and Looping: while statement, do-while statement, for statement, Nested loops, Jumps in loops

Arrays: One-dimensional arrays, Declaration of one-dimensional arrays, Initialization of one-dimensional arrays, Linear search, Two-dimensional arrays, Initializing two dimensional arrays, Multi-dimensional arrays

Self Learning Topics (SLTs): *Concise test expressions (Text1: chapter 7), Dynamic arrays (Text1: chapter 8), Solved problems (Text1: chapter 6 to chapter 8), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 6 to chapter 8)*

UNIT-III	**9 Hrs**

Character Arrays and Strings: Declaring and initializing string variable, Reading strings from terminal, Writing strings to screen, String handling functions, Table of strings

Modular Programming with User Defined Functions: Need for user-defined functions, Elements of user-defined functions, Definition of functions, Return values and their types, Function calls, Function declaration, Category of functions, Recursion, The scope, visibility and lifetime of variables (storage classes)

Self Learning Topics (SLTs): *Arithmetic operations on characters, comparison of strings (Text1: chapter 9), Nesting of functions, (Text1: chapter 10), Solved problems (Text1: chapter 9 & chapter 10), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 9 & chapter 10)*

UNIT-IV	**9 Hrs**

Structures and Unions: Defining a structure, Declaring and initializing structure variables, Accessing structure members, Array of structures, Structures within structures, Unions

Pointers: Understandingpointers, Declaring and initializing pointer variables, Pointer expressions, Pointers and arrays, Pointers and character strings, Pointers to functions, Pointers and structures

File Management in C: Defining and opening afile, Closing a file, Input and output operations on sequential text files

Self Learning Topics (SLTs):*Operations on individual members (Text1: chapter 11), Chain of pointers, array of pointers (Text1: chapter 12), Random access to files, Command line arguments (Text1: chapter 13), Solved problems (Text1: chapter 11 to chapter 13), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 11 to chapter 13)*

LABORATORY COMPONENT

List of Experiments

1. Programs using input output functions, operators (arithmetic, relational and conditional)
2. Programs using operators (bit-wise, logical, increment and decrement)
3. Programs using conditional control structures: if, if-else, nested if
4. Programs using else if ladder, switch and goto statements
5. Programs using loop control structures: while
6. Programs using loop control structures: do-while and for
7. Programs on one dimensional array and two-dimensional arrays
8. Programs on String operations and string handling functions
9. Programs on different types of functions, parameter passing using call-by-value & call-by-address, recursion and storage classes
10. Programs using structures, unions, pointers to arrays and pointers to strings
11. Programs using array of pointers and pointers to structures
12. Programs on File operations and file handling functions for sequential text files

Text Book(s):

1. E. Balagurusamy, *Programming in ANSI C*, 8th ed., New Delhi, India: McGraw Hill Education (India), 2022

Reference Book(s):

1. P. Deitel and H. Deitel, *C How to Program: With Case Studies Introducing Applications Programming and Systems Programming*, 9th ed., Harlow, England: Pearson Education Limited, 2022
2. B. W. Kernighan and D. M. Ritchie, *The C Programming Language*, 2nd ed., New Delhi, India: Pearson Education India, 2015
3. R. Thareja, *Programming in C*, 3rd ed., New Delhi, India: Oxford University Press, 2023
4. Y. Kanetkar, *Let Us C*, 19th ed., New Delhi, India: BPB Publications, 2022
5. A. K. Sharma, *Computer Fundamentals and Programming in C*, 2nd ed., Hyderabad, India: Universities Press, 2018

Web and Video link(s):

1. https://nptel.ac.in/courses/106105171*NPTEL Video Lecture on Problem Solving through Programming in C by Prof. Anupam Basu, Professor of CSE, IIT Kharagpur.*
2. https://nptel.ac.in/courses/106104128*NPTEL Video Lecture on Introduction to Programming in C by Prof. Satyadev Nandakumar, Professor of CSE, IIT Kanpur*

Laboratory Manual (for laboratory component):

1. *Programming for Problem Solving with C Laboratory Manual and Record Book,* Department of IT, KITSW.

Course Articulation Matrix (CAM):		**U24IT104: PROGRAMMING FOR PROBLEM SOLVING WITH C**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT104.1**	2	1	1	1	-	-	1	-	1	-	2	1	2
CO2	**U24IT104.2**	2	2	2	1	-	-	1	-	1	-	2	2	2
CO3	**U24IT104.3**	2	2	3	1	-	-	1	-	1	-	2	2	2
CO4	**U24IT104.4**	2	2	3	2	-	-	1	-	1	-	2	2	2
CO5	**U24IT104.5**	1	1	1	1	1	-	1	1	1	-	2	1	2
CO6	**U24IT104.6**	1	2	2	2	1	-	1	1	1	-	2	2	2
CO7	**U24IT104.7**	1	2	3	2	1	-	1	1	1	-	2	2	2
CO8	**U24IT104.8**	1	2	3	2	1	-	1	1	1	-	2	2	2
U24IT104		**1.5**	**1.75**	**2.25**	**1.5**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1.75**	**2**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	enumerate programming development steps, design an algorithm and draw flow chart for a given application	SDG4	Quality Education	Algorithm design and flowchart development strengthen computational thinking and problem-solving skills, which are fundamental competencies for quality technical education and lifelong learning
CO2	apply logical skills for problem solving using	SDG9	Industry, Innovation	Control structures and arrays enable the development of efficient software

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	control structures and arrays		and Infrastructure	solutions that support innovation, digital infrastructure, and technological advancement
CO3	develop string operations and modular programming with functions	SDG9	Industry, Innovation and Infrastructure	Modular programming promotes software reusability, maintainability, and scalable application development, contributing to innovative and sustainable software systems
CO4	analyse and implement structures, unions, pointers and files in C programming	SDG9	Industry, Innovation and Infrastructure	Advanced programming concepts such as data structures, pointers, and file handling form the foundation for developing reliable software systems and modern computing infrastructure

ENGLISH COMMUNICATION AND REPORT WRITING

Class: B.Tech. I–Semester			**Branch:** Common to all branches		
Course Code	**:**	**U24MH105**	**Credits**	**:**	**2**
Hours/Week(L-T-P-O-E)	**:**	**2-0-0-3-5**	**CIE**	**:**	**60 %**
Total Number of Teaching Hours	**:**	**36 Hrs**	**ESE**	**:**	**40 %**

Course Learning Outcomes(COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

- **CO1:** apply basic grammar principles in speech and writing, read fast, form new words, make coherent paragraphs and adapt the real value of life
- **CO2:** maintain professionalism in speech and writing by using correct grammar and appropriate vocabulary and write letters and resumes effectively
- **CO3:** analyze the given texts and write clear and unambiguous reports
- **CO4:** deduct the superfluous information from lengthy text, prepare SoP (Statement of Purpose) effectively and solve critical problems in life with emotional balance

UNIT-I	**9Hrs**

Grammar : Tenses, Structures, usage, examples, exercises for practice; Sentence correction, Correct use of tenses, Verb forms, Punctuation

Vocabulary : Word formation: Prefixes, Suffixes, Sentence Formation with newly formed words

Reading Skill : Definition, Sub skills of reading, Emphasis on skimming, Purpose, How to skim through the text, Examples, Exercises for practice

Writing Practices: Paragraph Writing, Definition, Organizing Principles of paragraphs, Making a paragraph through hints/graphs and pictures, Coherence, Linking devices, Systematic development of ideas; Paraphrasing, Précising lengthy expressions for clarity and brevity

Life Skills: Ethical values and humanity, The Last Leaf: A Short story by O.Henry

Self Learning Topics (SLTs): *Articles - (Text2, Unit-II), English vocabulary (Text2: Unit I to III), Verb forms (Refer: topic 31), Tenses (Refer : topics: 16, 17, 18, 19), Reported Speech (Reference2: topics 161-167)*

UNIT-II	**9 Hrs**

Grammar : Tenses, Revision, Exercises for practice; Subject, Verb agreement, Reported speech, Transformation; Sentence correction, Emphasis concord, Report speech, Sentence structures

Vocabulary : Synonyms, Antonyms, Single word substitutes - Popular abbreviations

Reading Strategy: Emphasis on scanning the text, Purpose, Advantages, Examples, Exercises and Practice through Teamwork

Writing Practices: Letter writing, Effective letter writing techniques, Information seeking letters, Job application letters, Apology letters, Explanation to memos, E-mails, Cover Letters, Resume

Life Skills: Determination, How I Became a Public Speaker: An essay by George Bernard Shaw

Self Learning Topics (SLTs): *English vocabulary (Text2 : Unit-I to III), Tenses (Reference3 : topic 30, Exercises 30.1 to 30.3)*

UNIT-III	**9 Hrs**

Grammar: Tenses, Revision, Exercises for practice; Nouns, Prepositions, Adverbs, Adjectives

Sentence Correction: Correct Use of tenses, nouns, prepositions, adverbs and adjectives

Vocabulary: Phrasal verbs, Technical words, Latin words

Reading Strategy: Intensive reading, Purpose, Types of comprehension questions, Examples, Exercises and practice through teamwork

Writing Practices: Report writing, Definition, Purpose, Qualities of a good report, Formal and informal reports, Report format, Sample reports, Exercises, Emphasis on technical reports

Life Skills:PositiveAttitude; Be the best of whatever you are: A poem by Douglas Malloch

Self Learning Topics(SLTs): *Parts of speech(Text1: Unit-I), Tenses (Reference1: topics 16 to 19), Phrasal verbs (Reference 3)*

UNIT-IV	**9 Hrs**

Grammar: Tenses, Revision, Exercises for Practice; Clauses, Conjunctions, Transformation of Sentences; Sentence correction (Based on parts of speech), Clauses, Tenses
Vocabulary: Appropriate use of words in communication, Commonly confused words
Active Reading and Note-Making: Note, Making, Definition, Purpose, Effectiveness
Writing Practices: Précis writing, Definition, Purpose, Uses, Examples and exercises, Practice through teamwork; Preparing statement of purpose (SoP)
Life Skills: Emotional balance a poison tree: Poem by William Blake

Self-Learning Topics(SLTs): *Tenses (Refer2: Topics 152-157)*

Text Book(s):

1. S. Kumar and P. Lata, *English Language and Communication Skills for Engineers*, 1st ed., New Delhi, India: Oxford University Press, 2018
2. Orient BlackSwan, *Language and Life: A Skills Approach*, 2nd ed., Hyderabad, India: Orient BlackSwan Pvt. Ltd., 2019

Reference Book(s):

1. A. J. Thomson and A. V. Martinet, *A Practical English Grammar*, 3rd ed. Oxford, UK: Oxford University Press, 1997
2. A. J. Thomson and A. V. Martinet, *A Practical English Grammar: Exercises 2*, 3rd ed. Oxford, UK: Oxford University Press, 1997
3. W. S. Allen, *Living English Structure*, 5th ed. New Delhi, India: Pearson Education India, 2009

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc20_hs56/preview Technical English for Engineers by Aisha Icbal, IIT Madras
2. https://onlinecourses.swayam2.ac.in/cec21_lg13/preview Indian Writing in English by Dr. Bindu Ann Philip, StMary's College Trissur

CourseArticulationMatrix (CAM):		**U24MH105:ENGLISH COMMUNICATION & REPORTWRITING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24MH105.1**	-	-	-	-	-	-	-	2	2	2	2	-	1
CO2	**U24MH105.2**	-	-	-	-	-	-	-	-	2	2	2	-	1
CO3	**U24MH105.3**	-	-	-	-	-	-	-	2	2	2	2	-	1
CO4	**U24MH105.4**	-	-	-	-	-	-	-	2	2	2	2	-	1
U24MH105		-	-	-	-	-	-	-	**2**	**2**	**2**	**2**	-	1
3–HIGH, 2 –MEDIUM, 1-LOW														

CO–SDGAlignmentMatrix				
CO	**CO Statement** *Thestudentshouldbeable to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply basic grammar principles in speech and writing, read fast, form new words, make coherent paragraphs and adapt the real value of life.	SDG-3	Good health and well-being	This aligns with SDG-3 as it partially contributes to the negative impact of mental imbalance on health through the irrational fears of Johnsy who is certainof her death when the last leaf falls
		SDG-5	Gender equality	This also aligns with SDG-5 as is highlights women accomplishments on par with men by exposing Johnsy and Sue as painters who come out of their hometown to stay in another place and work along with men for societal exposure.
		SDG-4:	Quality education	This aligns with SDG-4 as its primary focus is on enhancing the quality of language in speech and writing by strengtheninggrammar,vocabularyand writing skills.
CO2	Maintain professionalism in speech and writing by using correct grammar and appropriate vocabulary and write letters and resumes effectively	SDG-4	Quality education	This aligns with SDG-4 as its aim is to enhance reading and writing skills by helping students write letters and resumeseffectively applying grammar rules and using relevant vocabulary .
		SDG-8	Decentwork and economic growth	This aligns with SDG-8 as it indirectly contributes to economic growth and helps students become aware of the inevitability of strengthening their resume by improving their skills.
CO3	analyze the given texts and write clear and unambiguous reports.	SDG-4	Quality education	This aligns with SDG-4 as it focuses on enhancing the speaking, reading and writing skills of students to prove their abilities and the best communicators in society and workplace by exhibiting professionalism in the usage of language.
CO4	deduct the superfluous information from lengthytext, prepare SoP (Statement of Purpose) effectively and solve critical problems in life with emotional balance.	SDG-4	Quality education	This aligns with SDG-4 as it orientates the students towards reading and writing, and improves critical and critical thinking
		SDG-16	Peace, justice, and strong institutions	Though not completely, it aligns with SDG-16 partially as it emphasizes the need to give up anger which isthe most potential enemy of man to enjoy peace and become morally strong.

SPORTS /YOGA

Class: B.Tech. I-Semester		**Branch: Common to all branches**	
Course Code:	**U24VA106**	**Credits:**	**1**
Hours/Week(L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**48 Hrs**	**ESE:**	**40 %**

Course Learning Outcomes(COs):

After completion of this course, the student should be able to..

- **CO1:** demonstrate physical fitness by performing Yoga – Asanas
- **CO2:** demonstrate physical fitness through various games & sports events with defined bench marks
- **CO3:** demonstrate Sportsman spirit and ethics
- **CO4:** demonstrate Physical, Psychological, Social and Emotional balance

Sports and Games

List of Sports and Games

1	Badminton	2	Basket Ball	3	Chess
4	Carrom	5	Foot Ball	6	Table Tennis
7	Volley Ball	8	Cricket	9	Hand Ball
10	Kabaddi	11	Kho-Kho	12	Yoga Aasanas

Text book(s):

1. J. Downey, *Badminton for Schools*, New Delhi, India: S. Chand & Company Ltd., 159 pp.
2. O. P. Sharma, *Basketball Skills & Rules*, New Delhi, India: Khel Sahitya Kendra, 166 pp.
3. J. Silman, *How to Reassess Your Chess: Chess Mastery Through Chess Imbalances*, 4th ed., Los Angeles, CA, USA: Silman-James Press, 2010, 658 pp.
4. O. P. Sharma, *Football Skills & Rules*, New Delhi, India: Khel Sahitya Kendra, 215 pp.
5. D. Jain, *Teaching & Coaching Table Tennis*, New Delhi, India: Khel Sahitya Kendra, 196 pp.
6. D. James, *Volleyball for Schools*, New Delhi, India: S. Chand & Company Ltd., 125 pp.
7. T. N. Pramanik, *Yoga Education*, New Delhi, India: Sports Publication, 347 pp.
8. G. Viswanath (Ed.), *Indian Cricket 1999*, 53rd ed., Chennai, India: Kasturi & Sons Ltd., 784 pp.
9. A. K. Srivastava, *Health and Fitness*, New Delhi, India: Sports Publication, 72 pp.
10. E. Prasad Rao, *Modern Kabaddi*, New Delhi, India: D.V.S. Publications.

Reference Book(s):

1. B. K. Chaturvedi, *Rules and Skills of Games and Sports*, 1st ed., New Delhi, India: Goodwill Publishing House, n.d.
2. L. C. Wei, *Dare to Be a Champion*, 1st ed., Selangor, Malaysia: Bukuganda Digital & Publication, Jan. 2012, 199 pp.
3. B. Simmons, *The Book of Basketball: The NBA According to the Sports Guy*, 1st ed., New York, NY, USA: ESPN Books, 2009.
4. J. Silman, *How to Reassess Your Chess: Chess Mastery Through Chess Imbalances*, 4th ed., Los Angeles, CA, USA: Silman-James Press, 2010, 658 pp.
5. R. Gaudin, *The Stars of Football: The World's Best Players*, Kindle ed., n.p.: Amazon Digital Services, n.d.

6. B. Bertucci, M. Katsumoto, Y. Nakanishi, and T. Yoshida, *The Complete Volleyball Handbook*, Kindle ed., 1st ed., n.p.: Amazon Digital Services, n.d.
7. V. Thani, *Cricket Skills & Rules*, 1st ed., New Delhi, India: Khel Sahitya Kendra, 202 pp.
8. J. P. Muller, *Health, Exercise and Fitness*, 1st ed., New Delhi, India: Sports Publication, 117 pp.
9. T. Thangamani and T. G. V. Rajkumar, *Yogic Science*, 1st ed., New Delhi, India: Physical Education & Sports Books, 274 pp.

Web and Video link(s):

1. Badminton game Video Link : https://www.youtube.com/watch?v=HucIqi8Lw3E&t=22s
2. Basket Ball game Video Link : https://www.youtube.com/watch?v=-tkE2lJoR58
3. Chess Video Link : https://www.youtube.com/watch?v=mDw7lgM8ePo
4. Carrom game Video Link : https://www.youtube.com/watch?v=z8vvJpNceeg
5. Football game Video Link : https://www.youtube.com/watch?v=mXjW78AgGu4
6. Table Tennis game Video Link: https://www.youtube.com/watch?v=bLrJGWvWI4U
7. Volleyball game Video Link : https://www.youtube.com/watch?v=BJJb3-O0Q1U
8. Cricket game Video Link : https://www.youtube.com/watch?v=87hO_Vs3-wQ
9. Handball game Video Link : https://www.youtube.com/watch?v=VCa_0USaq8k
10. Kabaddi game Video Link : https://www.youtube.com/watch?v=ai1m7ARNyNI
11. Kho-Kho game Video Link : https://www.youtube.com/watch?v=P3_z3LKdLdg
12. Yoga Aasanas Video Link : https://www.youtube.com/watch?v=e0Q88DUOXjk https://www.youtube.com/watch?v=JoDKbXEUrvQ

ESE: 40 Marks

		Grade-P (50%)	Grade-D (60%)	Grade-C (70%)	Grade-B (80%)	Grade-A (90%)	Grade-S (100%)
50 mts / 30 mts (Sprint)	Women	11sec above	10-11 sec	9-10 sec	8-9 sec	7-8 sec	7 sec below
		5	6	7	8	9	10
	Men	11sec above	10-11 sec	9-10 sec	8-9 sec	7-8 sec	7 sec below
		5	6	7	8	9	10
Jump (Standing Broad Jump)	Women	0.90 – 1 mts	1.00 – 1.25 mts	1.25 – 1.50 mts	1.5 – 1.75 mts	1.75 – 2 mts	2 mts above
		5	6	7	8	9	10
	Men	1.50 – 1.7 mts	1.7 – 1.9 mts	1.90 – 2.1 mts	2.30 – 2.1 mts	2.5 – 2.7 mts	2.70 mts above
		5	6	7	8	9	10
Throw (Shot-put)	Women	3.5-4.0mts	4.0-4.5mts	4.5.5.0mts	5.0-5.5mts	5.5-6.0mts	6.0-6.5mts
		5	6	7	8	9	10
	Men	4.0-5.0mts	5.0-6.0mts	6.0-7.0mts	7.0-8.0mts	8.0-9.0mts	9mts above
		5	6	7	8	9	10
Yoga Aasanas (Surya Namaskaras)	Women	2 repetition (12min)	3 repetition (18min)	4 repetition (24min)	5 repetition (30min)	6 repetition (36min)	7 repetition (42min)
		5	6	7	8	9	10
	Men	2 repetition (12min)	3 repetition (18min)	4 repetition (24min)	5 repetition (30min)	6 repetition (36min)	7 repetition (42min)
		5	6	7	8	9	10

CIE-60

	Grade-P	Grade-D	Grade-C	Grade-B	Grade-A	Grade-S
Attendance %	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%
Marks	10	12	14	16	18	20
Performance in Regular Participation in classes : 15						
Performance in Selected Event : 25						

SPORTS AND YOGA FOR ALL BRANCHES-U24VA106

COs	Pos	Justification for mapping(Students will be able to)	Level of mapping
CO1:demonstrate physical fitness by performing Yoga-Asanas	PO11	Performing Yoga Aasanas and make it habituated as a life long process, so that one can improve concentration levels through better mind-body co-ordination.	1
CO2: Demonstrate physical fitness through various games & sports events with defined benchmarks.	PO8	Engage in games and sports regularly thus promotes individual and team work.	1
CO3: demonstrate sportsman spirit and ethics.	PO7	Exhibit Sportsman Spirit and learn ethics through various games & sports to be a worthy citizen.	2
CO4: demonstrate Physical, Psychological, Social and Emotional balance.	PO9	Exhibit proper balance during emotions sportsman can communicate effectively with peers and can demonstrate physical, psychological, social skills effectively.	1
	PO11	Maintain physical, psychological, Social and emotional balance and make it as a lifelong process through Games and Sports.	1

Course Articulation Matrix (CAM):		**U24VA106 Sports / Yoga for all UG Branches**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	PO 8	PO 9	**PO 10**	**PO 11**	**PSO1**	**PSO 2**
CO1	**U24VA106.1**	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	**U24VA106.2**	-	-	-	-	-	-	-	1	-	-	-	-	-
CO3	**U24VA106.3**	-	-	-	-	-	-	2	-	-	-	-	-	-
CO4	**U24VA106.4**	-	-	-	-	-	-	-	-	1	-	1	-	-
U24VA106		-	-	-	-	-	-	2	1	1	-	1	-	-
3–HIGH, 2 –MEDIUM, 1-LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Demonstrate Physical Fitness by performing Yoga Asanas	SDG13, SDG5	Climate Action, Gender Equality	Promoting eco-friendly sports practices, minimal resource usage, outdoor yoga, and sustainable lifestyle habits. Promoting teamwork, leadership, inclusiveness, equal participation, and collaboration in sports and

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				group yoga sessions.
CO2	Demonstrate Physical Fitness through various games & Sports	SDG3	Good Health & Well-being	Designing personalized fitness routines, yoga modules, and wellness programs to meet individual health needs.
CO3	Demonstrate Sportsman spirit and ethics	SDG16	Peace, Justice & Strong Institutions	Encouraging discipline, fairness, inclusivity, respect, mental balance, and ethical conduct through sportsmanship and yogic values.
CO4	Demonstrate Physical, Psychological, Social and Emotional balance	SDG3, SDG11	Good Health & Well-being, Sustainable Cities & Communities	Understanding the role of physical fitness and yoga in improving societal health, work-life balance, and community well-being.

ENGINEERING GRAPHICS THROUGH CAD

Class: B. Tech. I –Semester		**Branch:** IT	
Course Code:	**U24ME107**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**100 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: draw projections of points and straight lines inclined to one plane with Auto CAD.
CO2: develop the projections of planes using Auto CAD
CO3: construct the projections of solids and sections of solids using Auto CAD
CO4: create orthographic and isometric projections and develop the simple electrical and electronic circuit using Auto CAD

LABORATORY COMPONENT

List of Experiments

1. Importance of Engineering Drawing, principles of engineering drawing, dimensioning; introduction to AutoCAD software-GUI, settings, standard toolbar, toolbars - draw, modify, dimension, properties, design centre and tool palettes
2. Introduction to orthographic projections-Vertical Plane, Horizontal plane; Views-Front view, Top view, and Side view and draw the Projection of points in different quadrants.
3. Draw the Projection of straight lines
4. Draw the Projection of planes
5. Draw the Projection of solids- Simple position(Axis perpendicular to HP or VP)
6. Draw the projections of solids inclined to both the planes
7. Draw the Sections of solids
8. Draw the Orthographic projections of given objects
9. Conversion of isometric view to orthographic projections
10. Draw the Isometric view from the given orthographic views
11. Draw the pictorial view (3D) from the given Isometric view
12. AutoCAD application in Electrical and Electronics circuits

Text Book(s):

1. N. D. Bhatt, *Elementary Engineering Drawing*, 1st ed., Anand, India: Charotar Publishing House, 2017
2. D. M. Kulkarni, A. P. Rastogi, and A. Sarkar, *Engineering Graphics with AutoCAD*, Revised ed., New Delhi, India: PHI Learning Pvt. Ltd., 2010

Reference Book(s):

1. D. A. Jolhe, *Engineering Drawing*, 1st ed., New Delhi, India: Tata McGraw-Hill, 2008
2. K. Venugopal, *Engineering Graphics with AutoCAD*, 1st ed., Hyderabad, India: New Age International Publishers Ltd., 2012
3. W. J. Luzadder and J. M. Duff, *Fundamentals of Engineering Drawing*, 1st ed., New Delhi, India: Prentice-Hall of India, 1995

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc20_me79/preview *NPTEL video link for* ***Engineering drawing and computer graphics*** *By Prof. Rajaram Lakkaraju, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Engineering Graphics through CAD Laboratory Manual & Record Book,* Dept. of ME, KITSW.

Course Articulation Matrix (CAM):		U24ME107: ENGINEERING GRAPHICS THROUGH CAD												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	U24ME107.1	2	1	1	-	2	-	1	-	2	-	1	-	-
CO2	U24ME107.2	2	1	1	-	2	-	1	-	2	-	1	-	-
CO3	U24ME107.3	2	1	1	-	2	-	1	-	2	-	1	-	-
CO4	U24ME107.4	2	1	1	-	2	-	1	-	2	-	1	-	-
U24ME107		**2**	**1**	**1**	**-**	**2**	**-**	**1**		**2**	**-**	**1**	**-**	**-**
3–HIGH, 2 –MEDIUM, 1-LOW														

PRACTICUM

Class: B.Tech. I -Semester	**Branch:** Common to all branches		
Course Code:	**U24EL108**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-4-4**	**CIE :**	**100 %**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: synthesize literature survey, identify research gaps anddefine objective & scope of practicum problem

CO2: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system

CO3: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

CO4: create a video pitch on practicumand make an effective oral presentation using PPTs

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24MH101	U24CY102B	U24IT103	U24IT104	U24MH105
Students allotted to different courses	B24IT001	B24IT014	B24IT027	B24IT040	B24IT053
	B24IT002	B24IT015	B24IT028	B24IT041	B24IT054
	B24IT003	B24IT016	B24IT029	B24IT042	B24IT055
	B24IT004	B24IT017	B24IT030	B24IT043	B24IT056
	B24IT005	B24IT018	B24IT031	B24IT044	B24IT057
	B24IT006	B24IT019	B24IT032	B24IT045	B24IT058
	B24IT007	B24IT020	B24IT033	B24IT046	B24IT059
	B24IT008	B24IT021	B24IT034	B24IT047	B24IT060
	B24IT009	B24IT022	B24IT035	B24IT048	B24IT061
	B24IT010	B24IT023	B24IT036	B24IT049	B24IT062
	B24IT011	B24IT024	B24IT037	B24IT050	B24IT063
	B24IT012	B24IT025	B24IT038	B24IT051	B24IT064
	B24IT013	B24IT026	B24IT039	B24IT052	B24IT065

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

CIRCULAR

Allotment of Practicum topics to students

Section : …….

S.No.	Roll number of the student	Practicum topic allotted	Practicum under the course	Course faculty

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetableand alsooutside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

(Signature of class teacher)

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix). A sample rubrics for assessment and evaluation of practicum is as follows:

Literature survey & Identification of research gaps	10 marks
Working model / process / software package / system developed	30 marks
Report writing (subjected to max of 30% plagiarism)	20 marks
Oral presentation with PPT and viva-voce	20 marks
Video pitch	20 marks
Total	100 marks

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(a) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(b) **Working Model**: Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?

- What gaps are identified in your practicum work?
- What improvements or changes you suggestfor addressing the identified gaps for future work?

(d) **Anti-Plagiarism Check:** The practicumreport should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacheras per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce
ii) he/she fails to submit the report in prescribed format
iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

Course Articulation Matrix (CAM):		**U24EL108: PRACTICUM**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	PO 8	PO 9	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EL108.1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**U24EL108.2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**U24EL108.3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**U24EL108.4**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
U24EL108		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
3–HIGH, 2 –MEDIUM, 1-LOW														

Course code U24ELXYY: ***X represents semester, YY represents ETA course serial number***

SOCIAL EMPOWERMENT ACTIVITY / SELF ACCOMPLISHMENT ACTIVITY

(SEA /SAA)

Class: B.Tech. I Semesters		**Branch:** IT	
Course Code:	**U24VA109(SE/SA)ZZZ**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility

CO2: interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner

CO3: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility

CO4: demonstrate the generic competencies in makinga well-documented report and an effective oral presentationwith PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) isintroduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual andsocial aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses,which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (SelfAccomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course
(b) Student must select one activity per semester,through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.
(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA
(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,
(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

(a) **Nodal units:**The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE)shall act as nodal units for activities listed under SEA/SAA.
(b) During the semester period, the student has to**acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems
(c) **Knowledge Acquisition& Skilling**:
    i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity
    ii. For the activities related to social awareness/issues/challenges that affect society, use

the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

iii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

Eminent personalities/ Achievers / Renowned personalities:

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interacteminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

x. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders.Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xi. Student is expected to take care of health and Safety practices for fieldwork and travel

xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xiv. **Feedback:**The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentationand report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every studentshall, identifiesminimum of4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

iii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

iv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

v. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(g) ***Assessment & Evaluation:***There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

Assessment	Maximum marks	Marks to be awarded by
Goal setting, Planning& Knowledge Acquisition	20	Nodal centre
Field work	40	Nodal centre
Demonstration/Presentation	20	Nodal centre
Report submission	20	Faculty counsellor
Total	**100**	**-**

Note:

(a) **Presentation/ Demonstration:**It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
b. scores a minimum of 40 marks in the CIE of the course

(e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Text / Reference book(s):

For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator

Course Code: **U24VA XYY(SE/SA)ZZZ**

X represents semester; YYrepresents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 *SEA/SAA course serial number: 09* *SEA/SAA category: SEA* *course number: 302* The **course code** will be U24VA109SE302	*Semester: 4* *SEA/SAA course serial number: 10* *SEA/SAA category: SAA* *course number: 206* The **course code** will be U24VA410SA206

EXPERT TALK SERIES			
Class: B.Tech. I -Semester		**Branch:** IT	
Course Code:	**U24AE110**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-1-1**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

CO2: identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

CO3: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO4: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples,is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

But how would you know all this without venturing into the industry?

(e) The answer is Industry**Expert Talk Series (ETS)**.Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(f) Through Industry expert talks students get to know so much more that textbooks don't explain.

(g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(k) Through ETS sessions, students get the chance to interact with industry regularly which

helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(m) ETS enhances your learning in many ways for global opportunities for your career.

(n) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(o) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode**by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks(10 MCQs/FiBs;*duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:**At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:**There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

Quiz score (*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*)	60 marks
Attendance (*out of 10 quizzes*)	20 marks
Report in prescribed format (*max 30% plagiarism*)	20 marks
Total	100 marks

i. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

ii. Supplementary Exam:

(a) Student has to register for ETS supplementary examination if he/she scores less than 40 marksin CIE

(b) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks(MCQs/FiBs ; *duration: 2Hrs*)on the content covered in ETS lectures.

(c) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(d) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Articulation Matrix (CAM):		**U24AE110:** EXPERT TALK SERIES											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	U24AE110.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AE110.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AE110.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AE110.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE110		**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**1**
3–HIGH, 2 –MEDIUM, 1-LOW														

Course code U24AEXYY: *X represents semester, YY represents ETA course serial number*

2nd Semester Syllabi

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credit Assigned

II SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	BSC	U24MH201	Matrix Theory and Vector Calculus	2	1	-	-	3	3
2	BSC	U24PY202B	Engineering Physics *(from Pool-II)* *(Common to CSM, CSD, CSN, CSO & IT)*	2	1	2	-	5	4
3	PCC	U24IT203	Computer Architecture and Organization	2	1	-	-	3	3
4	PCC	U24IT204	Data Structures through C	2	1	2	-	5	4
5	ESC	U24EE205B	Basic Electrical Engineering *(from Pool-III)*	2	1	2	-	5	4
6	VAC	U24CY206	Environmental Studies	2	-	-	-	2	-
7	AEC	U24AE207	Idea Lab Makerspace	-	-	2	-	2	1
8	SEC	U24SE208	Programming Skill Development Lab – 1	-	-	2	-	2	1
9	ELC	U24EL209	Practicum-2	-	-	-	4	4	1
10	VAC	U24VA210 XXXXX	SEA-2 / SAA -2	-	-	-	2	2	1
11	AEC	U24AE211	Expert Talk Series-2	-	-	-	1	1	1
			Total:	12	5	10	7	34	23
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-	-

Pool – II (Physics)		
S. No.	Course Code	Course Title
1.	U24PY202A	Engineering Physics *(for Mechanical Engineering)*
2.	U24PY202B	Engineering Physics *(Common to CSM, CSD, CSN, CSO & IT)*

Pool – III (Basic Electrical & Electronics Engineering)		
S. No.	Course Code	Course Title
1.	U24EE205A	Basic Electrical and Electronics Engineering *(for Mechanical Engineering)*
2.	U24EE205B	Basic Electrical Engineering *(Common to CSM, CSD, CSN, CSO & IT)*

MATRIX THEORY AND VECTOR CALCULUS

Class: B.Tech. II –Semester		**Branch:** IT	
Course Code:	**U24MH201**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-6-9**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: analyze eigen value problems using matrix theory

CO2: apply basic concepts of multiple integrals in evaluating physical quantities of real-lifeengineering problems

CO3: apply differential operators on vector and scalar point functions

CO4: solve line, surface, volume integrals and correlate these with applications of Green, Stoke and Gauss divergence theorems

THEORY COMPONENT

UNIT-I — 9 Hrs

Matrices: Rank of a Matrix, Elementary transformations of a matrix,Gauss Jordan method of finding the inverse, Normal form of a matrix, Consistency of linearsystem of equations, System of linear homogenous equations,Eigen values, Eigen vectors, Properties of Eigen values, Cayley Hamilton's theorem, Reduction to diagonal form, Factorization method (LU Decomposition)

Applications of Eigen value problems: Stretching of an elastic membrane, Eigenvalue problems arising from Markov processes, Eigenvalue problems arising from population models, Leslie model

Self-Learning Topics (SLTs): *Review of Matrices (Text 1: topics 2.1 to 2.5), PAQ –Normal form (Text 1, topic 2.7(7)), Solved problems: 2.26, Practice problems: exercise 2.4 (9,10), Additional problems on system of homogeneous and non-homogeneous equations (Text 1: topic 2.18, Solved problems: 2.52, Practice problems: exercise 2.10 (13,14)), Additional problems on Eigen values and eigen vectors (Text 2: topic 8.1, Solved problems: 8.1(1,2), Practice problems: exercise 8.1(4,6)), Nature of quadratic form [Text 1: topic 2.18, Solved problems: 2.52, Practice problems: exercise 2.10 (13,14))*

UNIT-II — 9 Hrs

Multiple Integrals and Beta, Gamma functions: Double Integrals, change of order of integration, Double Integrals in polar coordinates, Area enclosed by plane curves, Triple integrals, Volumes of solids, Calculation of Mass for a plane lamina, Beta function, Gamma function, Relation between Beta and Gamma functions (without proof).

Self-Learning Topics (SLTs): *Review of integrals (Text 1: topic Appendix VII (1)), Additional problems on change of order of integration (Text 1: topic 7.2, Solved problems: 7.4,7.6, Practice problems: exercise 7.1 (9,14)), Centre of gravity of a plane lamina (Text 1: topic 7.10, Solved problems 7.34,7.35, Practice problems: exercise 7.6 (9,10)), Moment of Inertia of plane lamina [Text 1: topic 7.12(1,2), Solved problems: 7.37,7.38, Practice problems: exercise 7.7 (1,4)), Additional problems on volume of solids (Text 1: topic 7.6, Solved problem: 7.21, Practice problems: exercise 7.4 (12,25))*

UNIT-III — 9 Hrs

Vector Calculus and its applications: - Vector Space, Linear dependent and independent vectors, Differentiation of vectors, Curves in space, Tangent, Principal normal, Binormal, Curvature, Torsion, Velocity and acceleration, Scalar and vector point functions, Del applied to scalarpoint functions - Gradient, Geometrical interpretation, Directional derivative, Del applied to vector point functions -Divergence, Curl, Physical interpretation ofdivergence,Physical interpretation of curl, Del applied twice to point functions, Del applied to products of point functions, Decomposition of vector valued functions

Self-Learning Topics (SLTs): *Review of vectors (Text 2: topics 9.1, 9.2, 9.3), Vector identities (Text 1: topic 8.9, Solved problems: 8.22, 8.23, Practice problems: exercise 8.4 (13,14)), Additional problems on Directional derivatives (Text 1: topic 8.5(3), Solved problems: 8.13,8.14, Practice problems: exercise 8.3 (4,6,8,9))*

UNIT-IV	9 Hrs
Integration of vectors: Lineintegral, Surfaces-Surface integral,flux across a surface, Green's theorem in the plane(without proof), Stoke's theorem (Relation between line and surface integrals)(without proof), Volume integral, Gauss divergence theorem (Relation between surface and volume integrals) (without proof), irrotational fields, solenoidal fields ***Self-Learning Topics (SLTs):*** *Additional problems on Green's theorem [Text 1: topic 8.13, Solved problems: 8.33,8.35, Practice problems: exercise 8.8 (1,2,4)]* *Additional problems on Stoke's theorem [Text 1: topics 8.14, Solved problems: 8.39, 8.40, Practice problems: exercise 8.9 (1,2)]* *Additional problems on Gauss Divergence theorem [Text 1: topic 8.16, Solved problems: 8.44,8.46, Practice problems: exercise 8.10 (1,2)]*	
Textbook(s): 1. B. S. Grewal, *Higher Engineering Mathematics*, 44th ed., New Delhi, India: Khanna Publishers, 2017(Chapters 2,7,8) 2. Kreyszig, *Advanced Engineering Mathematics*, 10th ed., UK : John Wiley & Sons Inc., 2020 (Chapter 8(8.2))	
Reference Book(s): 1. M. Spiegel, *Vector Analysis*, 2nd ed., New York, NY, USA: McGraw Hill (Schaum's Outline Series), 2017 2. S. S. Sastry, *Engineering Mathematics*, Vol. II, 3rd ed., New Delhi, India: Prentice Hall of India, 2014 3. G. Strang, *Introduction to Linear Algebra*, 5th ed., Wellesley, MA, USA: Wellesley-Cambridge Press, 2016	
Web and Video link(s): 1. https://youtu.be/L4crGhtEX14?si=hyjAPgDheJOhXtYZ : *NPTEL Video Lecture on Matrix Analysis with Applications/Dr.S.K.Gupta and Dr.Sanjeev Kumar/IIT Roorkee* 2. https://youtu.be/ksS_yOK1vtk?si=CNNA58OIuszubPiX: *NPTEL Video Lecture on Integral and Vector Calculus./Prof.Hari Shankar Mahato / IIT Kharagpur*	

Course Articulation Matrix (CAM):		**U24MH201 MATRIX THEORY AND VECTOR CALCULUS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24MH201.1**	2	2	1	1	-	-	1	-	1	-	1	1	-
CO2	**U24MH201.2**	2	2	1	1	-	-	1	-	1	-	1	1	-
CO3	**U24MH201.3**	2	2	1	1	-	-	1	-	1	-	1	1	-
CO4	**U24MH201.4**	2	2	1	1	-	-	1	-	1	-	1	1	-
U24MH201		**2**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**-**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze eigen value problems using matrix theory	SDG4	Quality Education	If the work focuses on mathematical learning, computational methods, or improving higher education and research in mathematics and engineering.
CO2	apply basic concepts of multiple integrals in evaluating physical quantities of real-life engineering problems	SDG9	Industry, Innovation and Infrastructure	Multiple integrals are applied in engineering fields such as fluid mechanics, thermodynamics, and structural analysis to evaluate physical quantities in real-world

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				systems. In Computer Science and Engineering (CSE) and AI & ML, they are used in image processing, computer graphics, data modeling, probability distributions, and optimization techniques.
CO3	apply differential operators on vector and scalar point functions	SDG9	Industry, Innovation and Infrastructure	Applying differential operators on scalar and vector point functions is essential in fluid dynamics, electromagnetism, engineering analysis, and computational modeling. These mathematical tools are widely used in scientific research, technological development, and modern engineering applications.
CO4	solve line, surface, volume integrals and correlate these with applications of Green, Stoke and Gauss divergence theorems	SDG9	Industry, Innovation and Infrastructure	Line, surface, and volume integrals along with Green's, Stoke's, and Gauss divergence theorems are widely used in engineering, fluid mechanics, electromagnetics, and computational science. In Computer Science and Engineering, these concepts are applied in computer graphics, image processing, simulation techniques, artificial intelligence, and data visualization.

ENGINEERING PHYSICS

Class: B.Tech. II- Semester				**Branch:** IT	
Course Code	**:**	**U24PY202B**	**Credits**	**:**	**4**
Hours/Week (L-T-P-O-E)	**:**	**2-1-2-5-10**	**CIE**	**:**	**60 %**
Total Number of Teaching Hours	**:**	**60 Hrs**	**ESE**	**:**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: evaluate properties of lasers and optical fibre parameters

CO2: calculate the electric field, electric potential, magnetic field and flux density; determine properties of magnetic and superconducting materials

CO3: evaluate the energy values of a particle in an infinite potential well and apply the quantum principles in quantum computing

CO4: analyze V-I characteristics of semiconductor diodes and suggest their applications; determine resistances of transistor biasing circuits

(based on psychomotor skills acquired from laboratory component)

CO5: measure diameter of wire and hollow tubes using Vernier callipers and screw gauge

CO6: determine the width of a narrow slit and wavelength of laser using diffraction phenomenon and numerical aperture of an optical fiber

CO7: calculate the dielectric constant of a material and plot the hysteresis curve of ferromagnetic material

CO8: determine forward voltage and currents from V-I characteristics of semiconductor diodes; identify cut-off, saturation and active regions of NPN transistor

THEORY COMPONENT

UNIT-I — 9 Hrs

Applied Optics and Lasers: Principles of interference,Diffraction phenomena and applications (qualitative), Difference between conventional light and laser,Basic principles and characteristicsof lasers, Absorption,Spontaneous and stimulated emission,Population inversion, Pumping methods, Optical resonator;Types of lasers- Ruby laser, He-Ne laser, Diode laser; Applications of lasers

Fiber Optics: Introduction,Total internal reflection,Optical fiber construction,Numerical aperture and acceptance angle,Types of optical fibers - Step index and graded index, Single and multimode,V-number;Power losses in optical fibers - Attenuation, Dispersion, Bending;Fiber optic communication system,Applications of optical fibers –Endoscopy,Fiber optic sensors (temperature and displacement)

Self Learning Topics (SLTs):*Concept of waveand basic concepts-amplitude, wavelength, frequency, phase, phase angle and general wave equation(Text1: topic1.9),types of waves(Text1: topic 1.10), reflection laws(Text1: topic1.11)*

UNIT-II — 9 Hrs

Electrostatics andMagnetostatics: Electric charges, Coulomb's law, Electric field, Electrostatic potential, Computation of electric field and electrostatic potential due to point and line charges;Magnetic field, Magnetic flux density, Biot-Savart's law, Ampere's law, Faraday's law and Lenz's law

Magnetic and Superconducting materials: Introduction, Permeability, Magnetization, Susceptibility, Origin of magnetism, Bohr magneton,Ferro, Antiferro and ferri magnetic materials, Hysteresis, Soft and hard magnetic materials and their applications; superconductivity, Meissner effect, Transition temperature, Isotope effect, Type-I and type-II superconductors, High T_c superconductors, Applications of superconductors

SelfLearning Topics (SLTs):*magnetisation, susceptibility& their relations (Text1: topic 41.2), London penetration depth (Text1: topics 42.4.7), Solved problems (Text1: Prob 42.9 to 42.14)*

UNIT-III — 9 Hrs

Elements of Quantum Mechanics: Wave-particle duality, de-Broglie wavelength, Physical significance of wave function, Schrodinger time-dependent wave equation, Schrodinger time-independent wave equation, Particle in an infinite potential well (one dimension)

Introduction to Quantum Computing: Observables and operators, Expectation values, Expectation values in operator notation, Dirac Bra-Ket notation, Superposition principle, Concept ofQuantum bits, Classical versus Quantum computing, Quantum parallelism and Quantum entanglement, Applications of quantum computing

Self Learning Topics (SLTs): *Heisenberg's uncertainty principle (Text1: topics 27.2), Observables and operators (Text1: topics 27.19),Solved problems (Text1: Prob 27.13, Prob 27.17)*

UNIT-IV	**9 Hrs**

Semiconductor Physics: Classification of solids based on energy band theory-Conductors, Semiconductors and insulators,Intrinsic semiconductor- carrier generation and recombination;Extrinsic semiconductors- n-type and p-type (qualitative)

Semiconductor Diodes and Bipolar Junction Transistors (BJTs): Formation of a PN junction,Forward and reverse bias, PN junction diode,Diode current equation, Zener diode,Zener diode as voltage regulator and theirV-I characteristics, Light emitting diode (LED), Transistor structure, Representation of NPN and PNP transistors, Transistor action, Transistor configurations- Common base(CB), Common emitter(CE) and Common collector(CC);Corresponding α, β, γparameters and their relations and transistor as an amplifier

Self Learning Topics (SLTs):*drift & diffusion current (Text2: topic 4.9), diode current equation (Text2: topic 4.15), Solved problems (Text2: Prob 4.17 to 4.21)*

LABORATORY COMPONENT

List of Experiments

1. Linear Measurements using Vernier callipers and screw gauge
2. Determination of slit width using He-Ne laser
3. Determination of wavelength of He-Ne laser using reflection and transmissiondiffraction grating
4. Determination of dielectric constant of materials using parallel plate capacitor
5. Magnetic hysteresis- B-H curve tracing using CRO
6. Numerical aperture and acceptance angle of an optical fiber
7. Study of V-I characteristics of PN junction diode
8. Study of V-I characteristics of LED
9. Study of common emitter characteristics of NPN transistor
10. Energy band gap of a semiconductor material
11. Determination of thickness of thin sheet using air-wedge method
12. Determination of Planck's constant

Textbook(s):

1. M. Avadhanulu, K. Kshirsagar, and T. V. S. Arun Murthy, *A Text Book of Engineering Physics*, 11th ed., New Delhi, India: S. Chand & Company Ltd., 2018
2. S. Salivahanan and N. Suresh Kumar, *Electronic Devices and Circuits*, New Delhi, India: McGraw Hill, 2017
3. M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information*, Cambridge, U.K.: Cambridge University Press, 2010

Reference Book(s):

1. N. Gershenfeld, *The Physics of Information Technology*, 1st ed., Cambridge, U.K.: Cambridge University Press, 2000
2. V. Rajendran, *Engineering Physics*, 1st ed., New Delhi, India: McGraw Hill, 2013
3. E. Rieffel and W. Polak, *Quantum Computing: A Gentle Introduction*, 1st ed., Cambridge, MA, USA: The MIT Press, 2011
4. R. K. Gaur and S. L. Gupta, *Engineering Physics*, 1st ed., New Delhi, India: Dhanpat Rai & Sons, 2013
5. D. Halliday, R. Resnick, and J. Walker, *Fundamentals of Physics*, Vol. I & II, 5th ed., New

Delhi, India: Wiley India Ltd., 2014

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_ph28/preview; NPTEL *video lecture on Concepts in Magnetism and Superconductivityby Prof. Arghya Taraphder IIT Kharagpur*
2. https://onlinecourses.nptel.ac.in/noc24_lw07/preview; *NPTEL video lecture onIntroduction to Law on Electricity by Prof. Uday Shankar, IIT Kharagpur*
3. https://onlinecourses.nptel.ac.in/noc24_ph45/preview; *NPTEL Video Lecture on Introduction to LASER - Course by Prof. M. R. Shenoy, IIT Delhi*
4. https://onlinecourses.nptel.ac.in/noc20_ee77/preview;*NPTEL Video Lecture on Semiconductor Devices and Circuits By Prof. Sanjiv Sambandan, IISc Bangalore*
5. https://nptel.ac.in/courses/106106232; *NPTEL Video Lecture on Introduction to Quantum Computing: Quantum Algorithms and Qiskit by Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan, IIT Madras*

Laboratory Manual (for laboratory component):

1. *Engineering Physics Laboratory Manual& Record Book,* Department of PS, KITSW
2. A.K.Katiyar, C.K.Pandey, *Engineering Physics Theory and Practical,* Wiley India Pvt. Ltd,2nd edition, 2017

Course Articulation Matrix (CAM):		**U24PY202B - ENGINEERING PHYSICS**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24PY202B.1**	2	1	-	-	-	1	1	1	1	-	1	1	-
CO2	**U24PY202B.2**	2	1	-	-	-	1	1	1	1	-	1	1	-
CO3	**U24PY202B.3**	2	1	-	-	-	1	1	1	1	-	1	1	-
CO4	**U24PY202B.4**	2	1	-	-	-	1	1	1	1	-	1	1	-
CO5	**U24PY202B.5**	2	1	-	-	1	1	1	1	2	-	1	1	-
CO6	**U24PY202B.6**	2	1	-	-	1	1	1	1	2	-	1	1	-
CO7	**U24PY202B.7**	2	1	-	-	1	1	1	1	2	-	1	1	-
CO8	**U24PY202B.8**	2	1	-	-	1	1	1	1	2	-	1	1	-
U24PY202B		**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1.5**	**-**	**1**	**1**	**-**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyse the phenomena of interference, diffraction and polarization, and the working principles and applications of lasers and optical fibres.	SDG 4	Quality Education	Concepts of interference, diffraction, polarization and laser action (spontaneous/stimulated emission, population inversion) build foundational scientific literacy essential for engineering education. This strengthens access to quality STEM learning and nurtures lifelong learning in photonics.
		SDG 9	Industry, Innovation & Infrastructure	Lasers (Ruby, He-Ne, Diode) and optical fibres (step/graded index, fibre-optic communication, endoscopy, fibre sensors) are core technologies behind modern

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				telecommunication and healthcare infrastructure, directly supporting industrial innovation.
CO2	assess the operation and applications of optical fibre, and interpret the formation and characteristics of special diodes through semiconductor physics principles.	SDG 7	Affordable & Clean Energy	Understanding semiconductor band theory, PN junction formation and LED operation underpins the design of energy-efficient solid-state lighting and photodiode-based sensing, supporting affordable and clean-energy solutions.
		SDG 9	Industry, Innovation & Infrastructure	PN junction diodes, LEDs and photodiodes are fundamental building blocks of electronic circuits and optoelectronic devices, forming the basis of innovation in the electronics and communication industry.
CO3	evaluate the magnetic and superconducting properties of materials and justify their use in engineering applications.	SDG 7	Affordable & Clean Energy	Superconductivity, the Meissner effect, and Type-I/Type-II superconductors enable lossless power transmission, magnetic energy storage and high-field magnets, all of which support efficient, clean-energy infrastructure.
		SDG 9	Industry, Innovation & Infrastructure	Soft and hard magnetic materials, magnetic memories and magnetic levitation underpin transformers, data-storage devices and high-speed transport systems, contributing to resilient industrial infrastructure and technological innovation.
CO4	estimate the energy values of a particle in an infinite potential well and apply quantum mechanical principles to understand quantum computing.	SDG 4	Quality Education	Wave-particle duality, the Schrodinger equation and the particle-in-a-box model, together with the basics of quantum computing (qubits, superposition), expose students to cutting-edge STEM concepts, promoting inclusive, high-quality, future-ready technical education.
		SDG 9	Industry, Innovation & Infrastructure	Quantum computing concepts (superposition, entanglement, quantum parallelism) represent frontier computational technology with transformative applications in cryptography, optimization and drug discovery, driving next-generation digital infrastructure.
		SDG 17	Partnerships for the Goals	Quantum computing is an inherently interdisciplinary, global research effort; exposure to open platforms such as Qiskit fosters

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				international academic and industry collaboration needed to achieve shared technological and sustainable-development goals.

COMPUTER ARCHITECTURE AND ORGANIZATION

Class: B.Tech. II –Semester		**Branch:**IT	
Course Code :	**U24IT203**	**Credits :**	**3**
Hours/Week (L-T-P-O-E) :	**2-1-0-4-7**	**CIE :**	**60 %**
Total Number of Teaching Hours :	**36 Hrs**	**ESE :**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

This course will develop students' knowledge in /on…

CO1: identify functional units of a computer and compare the different addressing modes of instructions for execution

CO2: develop the control sequence for execution of an instruction

CO3: solve the problems on pipelining and implement synchronous and asynchronous schemes for transferring data

CO4: analyze memory access time to fetch instructions from main memory and basic input/output operations

UNIT-I	**9 Hrs**

Basic Structure of Computers: Functional units, Basic operational concepts, Performance **Instruction Set Architecture:** Memory locations and addresses, Memory operations, Instructions and instruction sequencing, Addressing modes, Assembly language

Self Learning Topics (SLTs): *Register transfer notation, Assembly language notation (Text1: topics 2.3.1, 2.3.2), Practice problems (Text1: Prob 1.1, Prob 1.2,Prob 2.4), Solved problems on performancecomputation(Text1: Prob 1.9.1, Prob 1.9.2)*

UNIT-II	**9 Hrs**

Basic Processing Unit: Fundamental concepts, Instruction execution, Hardwarecomponents, Instruction fetch and execution steps, Control signals, Hard-wired control, CISC- style processors

Self Learning Topics (SLTs): *Program controlled I/O (Text1: topic 3.1.2), An example of a CISC-style I/O program(Text1: topic 3.1.4),Some fundamental concepts of processing unit (Text1: topic 5.1), Solved problems (Text1: 5.9)*

UNIT-III	**9 Hrs**

Pipelining: Basic concept, Pipeline organization, Pipelining issues, Data dependencies, Memory delays, Branch delays, Resource limitations, Performance evaluation, Superscalar operation, Pipelining in CISC processors

Self Learning Topics (SLTs): *Introduction to pipelining (Text1: topic 6.1), Effect of stalls and penalties (Text1: topic 6.8.1), Solved problems (Text1: topic 6.12)*

UNIT-IV	**9 Hrs**

BasicInput / Output: AccessingI/Odevices,Interrupts

Input / Output Organization: Bus structure, Bus operation, Arbitration, Interface circuits, Interconnection standards

The Memory System: Basic concepts, Semiconductor RAM, Read-only memories, Direct memory access, Memory hierarchy, Cache memories, Performance considerations

Self Learning Topics (SLTs): *Single bus structure (Text1: topic 7.1), SATA, SAS,PCI Express (Text1: topics 7.5.4, 7.5.5, 7.5.6), Concepts of memory system (Text1: topic 8.1), Practice problems (Text1: topic 8.7)*

Text Book(s):

1. C. Hamacher, Z. Vranesic, S. Zaky, and N. Manjikian, *Computer Organization and Embedded Systems*, 6th ed., New York, NY, USA: McGraw-Hill Education, 2012

Reference Book(s):

1. M. M. Mano, *Computer System Architecture*, 3rd ed., Delhi, India: Pearson Education, 2007

2. V. Rajaraman and T. Radhakrishnan, *Computer Architecture and Organization*, 4th ed., New Delhi, India: PHI Learning, 2011
3. R. B. Ram and S. Kumar, *Computer Fundamentals: Architecture and Organization*, 5th ed., New Delhi, India: New Age International Publishers, 2018

Web and Video link(s):

1. https://www.youtube.com/channel/UC2GUBG_WsP0OO5tXXocwp3Q/videos;*NPTEL Video Lectures on Computer Organization and Architecture- A Pedagogical Aspect by Dr.Arnab Sarkar, Professor of CSE, IIT Guwahati*
2. https://archive.nptel.ac.in/courses/106/105/106105163/;*NPTEL Video Lectures on Computer Architecture and Organization by Prof. Indranil Sengupta, Professor of CSE, IIT Kharagpur*
3. https://archive.nptel.ac.in/courses/106/106/106106092/; *NPTEL Video Lectures on Computer Organization by Prof. S. Raman, Professor of CSE, IIT Chennai*

Course Articulation Matrix (CAM): U24IT203: COMPUTER ARCHITECTURE AND ORGANIZATION

CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	**U24IT203.1**	2	2	-	-	-	-	1	-	1	-	1	1	1
CO2	**U24IT203.2**	2	2	1	1	-	-	1	-	1	-	2	1	2
CO3	**U24IT203.3**	2	2	2	2	1	-	1	-	1	-	2	2	1
CO4	**U24IT203.4**	2	2	2	2	1	-	1	-	1	-	2	2	2
U24IT203		**2**	**2**	**1.66**	**1.66**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**1.5**	**1.5**

CO–SDG Alignment Matrix

CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	identify functional units of a computer and compare the different addressing modes of instructions for execution	SDG4	Quality Education	Develops foundational knowledge and technical competencies essential for engineering education and lifelong learning.
CO2	develop the control sequence for execution of an instruction	SDG4, SDG9	Quality Education; Industry, Innovation and Infrastructure	Enhances students' ability to design and understand processor operations, supporting innovation in computing infrastructure.
CO3	solve the problems on pipelining and implement synchronous and asynchronous schemes for transferring data	SDG9	Industry, Innovation and Infrastructure	Focuses on improving computational efficiency and performance, contributing to technological innovation and resilient digital infrastructure.
CO4	analyze memory access time to fetch instructions from main memory and basic input/output operations	SDG9, SDG12	Industry, Innovation and Infrastructure; Responsible Consumption and Production	Efficient memory and I/O system design optimizes resource utilization and energy efficiency in computing systems.

DATA STRUCTURES THROUGH C

Class: B.Tech. II –Semester		**Branch:**IT	
Course Code:	**U24IT204**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE :**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE :**	**40%**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

- **CO1:** analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities
- **CO2:** analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities
- **CO3:** analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities
- **CO4:** develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies

(based on psychomotor skills acquired from laboratory component)

- **CO5:** develop and test basic data structures and array operations, including dynamic memory allocation to evaluate their performance and complexity
- **CO6:** apply the linear data structures such as stacks and queues and perform various operations using LIFO or FIFO order respectively
- **CO7:** solve problems using various linked list representations for efficiently storing and retrieving the data
- **CO8:** apply different sorting techniques on unsorted data and sort them in an order, able to store the data using hashing techniques to retrieve the data very effectively

THEORY COMPONENT

UNIT-I — 9 Hrs

Data Structures: Basic terminology, Classification of data structures, Applications and operations on data structures, Time and space complexity

Arrays: Operations on arrays-traversing an array, Inserting an element in an array, Deleting an element from an array, Searching an element using binary search and their complexities,

Dynamic Memory Allocation: Memory allocation functions, Dynamic memory allocation for single and two dimensional arrays

Self Learning Topics (SLTs): *Three dimensional and n-dimensional arrays (Text1: topics 2.4.3), passing arrays to functions and pointers (Reference1: topics 3.6, 3.7), Practice problems (Text1: Prob 2.3, Reference1: Prob 1,Prob2,Prob 3, Prob 4)*

UNIT-II — 9 Hrs

Stacks:stacks, Array representation of stacks, Operations on a stack–push and pop; Multiple stacks, Applications of stacks- recursion, Fibonacci series, Tower of hanoi, Evaluation of expressions (Infix to postfix conversion, Evaluation of postfix expression)

Queues: Queues, Array representation of queues, Double ended queues, Circular queues

Self Learning Topics (SLTs): *Infix to prefix (Reference1: topics 7.7.3), priority Queue(Reference1:*

8.4.3),Solved problems (Reference1: Prob 7.7.1, Prob 7.7.2), Practice problems (Text1: Prob 4.5, Prob 4.11, Prob 5.7, Prob 5.9)

UNIT-III	**9 Hrs**

Linked Lists: Basic terminologies, Linked list versus arrays, Memory allocation and de-allocation for a linked list, Singly linked list, Circular linked list, Doubly linked list, Circular doubly linked list (Linked list operations- traversing,searching, inserting, deleting), Representing stack and queue using linked list

Self Learning Topics (SLTs): *Merging (Text1: topics 3.3), Skiplist (weblink: https://www.geeksforgeeks.org/skip-list/), Deallocation strategy(Text1: topic 3.9), Solved problems (Text1: Prob 3.6.1, Prob 3.6.2), Practice problems (Reference1: Prob 5.5, Prob 5.7, Prob 5.9)*

UNIT-IV	**9 Hrs**

Sorting Techniques: Selection sort, Insertion Sort, Shell sort and Radix sort, Time complexities of sorting

Hashing: Hashing techniques, Collision resolution techniques, Closed hashing, Open hashing, Comparison of collision resolution techniques

Self Learning Topics (SLTs): Two way insertion sort *(Text1: topics 10.3.4), Comparison of sorting techniques(Reference1: topics 14.16) Solved problems (Reference1: Prob 15.5, Prob 15.6, Prob 15.7), Practice problems (Text1: Prob 6.4)*

LABORATORY COMPONENT

List of Experiments

Experiment-I

1. Program to implement initialization of array and perform traversal operations in both the directions
2. Program to implement searching operation on array using Linear Search
3. Program to display the count of occurrences of every number in an array

Experiment-II

4. Program to implement searching operation on array using Binary Search
5. Program to implement insertion operation on array
6. Program to implement deletion operations on array

Experiment-III

7. Program to implement initialization of arrays and traversal operation with DMA
8. Program to implement matrix addition and subtraction with DMA

Experiment-IV

9. Program to implement matrix multiplication with DMA
10. Program to implement stack operations
11. Program to convert infix expression into postfix

Experiment-V

12. Program to evaluate given postfix expression
13. Program to define recursive function to solve tower of hanoi puzzle
14. Program to display the Fibonacci series with the help of recursive function
15. Program to implement MultiStack

Experiment-VI

16. Program to implement queue operations using arrays
17. Program to implement circular queue operations using arrays
18. Program to implement double ended queue operations using arrays

Experiment-VII

19. Program to create single linked list and implement its operations

Note:-Linked list Operations**:** i) traversing ii) inserting iii) deleting iv) searching v) reversing vi) concatenation

Experiment-VIII

20. Program to create circular linked list and implement its operations
21. Program to create double linked list and implement its operations

Experiment-IX

22. Program to create circular double linked list and implement its operations

Experiment-X

23. Program to implement stack operations using linked list
24. Program to implement queue operations using linked list

Experiment-XI

25. Program to implement selection sort
26. Program to implement insertion sort

Experiment-XII

27. Program to implement shell sort
28. Program to implement radix sort
29. Program to implement hash table.

Textbook(s):

1. D. Samanta, *Classic Data Structures*, 2nd ed., New Delhi, India: Prentice Hall India, 2009

Reference Book(s):

1. R. Thareja, *Data Structures Using C*, 2nd ed., New Delhi, India: Oxford University Press, 2014
2. E. Balagurusamy, *Data Structure Using C*, 1st ed., New Delhi, India: McGraw Hill Education, 2017
3. R. F. Gilberg and B. A. Forouzan, *Data Structures: A Pseudocode Approach with C*, 2nd ed., Boston, MA, USA: Cengage Learning, 2007

Web and Video link(s):

1. https://nptel.ac.in/courses/106106130; *NPTEL Video Lecture on Programming and Data StructuresDr. N. S. Narayana Swamy, CSE, IIT Madras.*

Laboratory Manual (for laboratory component):

1. *Data Structures through C Laboratory Manual and Record Book,* Department of IT, KITSW.

Course Articulation Matrix (CAM):		U24IT204 DATA STRUCTURES THROUGH C												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24IT204.1	2	2	2	1	-	-	1	-	1	-	1	2	1
CO2	U24IT204.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24IT204.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24IT204.4	2	2	2	2	-	-	1	-	1	-	2	2	2
CO5	U24IT204.5	2	2	2	1	-	-	1	1	1	-	1	2	1
CO6	U24IT204.6	2	2	2	2	-	-	1	1	1	-	2	2	2
CO7	U24IT204.7	2	2	2	2	-	-	1	1	1	-	2	2	2
CO8	U24IT204.8	2	2	2	2	-	-	1	1	1	-	2	2	2
U24IT204		2	2	2	1.75	-	-	1	1	1	-	1.75	2	1.75

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities	SDG 4	Quality education	Developsfoundationalcomputational thinking, programming proficiency, and problem-solving skills essential for quality technical education.
CO2	analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities	SDG 9	Industry, Innovation and Infrastructure	Enhances skills required for designing efficient software systems and digital infrastructure used in industry applications
CO3	analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities	SDG 9	Industry, Innovation and Infrastructure	Supports the design of robust and scalable software systems through effective data organization and processing techniques.
CO4	develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies	SDG 9	Industry, Innovation and Infrastructure	Promotes technological innovation through the development of optimized algorithms and high-performance computing solutions

BASIC ELECTRICAL ENGINEERING

Class: B.Tech. II –Semester		**Branch:** IT	
Course Code :	**U24EE205B**	**Credits :**	**4**
Hours/Week (L-T-P-O-E) :	**2-1-2-5-10**	**CIE :**	**60 %**
Total Number of Teaching Hours :	**60 Hrs**	**ESE :**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: determine voltage, current & power in electrical circuits using network reduction techniques, mesh & nodal analysis

CO2: apply suitable network theorems to analyze DC circuits

CO3: determine impedance, voltage, current, and power in 1- Ø AC circuits & determine line and phase quantities in 3- Ø AC circuits

CO4: select a suitable electrical machine for given applications and determine the energy consumed by a lighting load.

(based on psychomotor skills acquired from laboratory component)

CO5: validate mesh and nodal analysis

CO6: validate network theorems

CO7: determine the impedance of series RL & RC circuits at various operating frequencies

CO8: determine the efficiency of a transformer by conducting a load test

THEORY COMPONENT

UNIT-I — 9 Hrs

DC circuits: Network elements, Linear & non-linear elements, Active & passive elements, Unilateral & bilateral elements, Ohm's law, Power, Energy, Kirchhoff's laws, Resistances connected in series and parallel, Voltage divider rule & Current divider rule

DC Circuit analysis: Source transformation, Star-Delta conversion, Mesh analysis & Nodal analysis (T & π networks only)

Self-Learning Topics (SLTs)*: Definitions of charge, current, & voltage (Text1: Topics1.2,), Solved problems (Text1: Prob 3.10,3.11 &3.12), Practice problems (Text1: Chap-3,Prob4,5,7&8)*

UNIT-II — 9 Hrs

DC network theorems (Independent sources only): Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem (T & π networks only)

Self-Learning Topics (SLTs): *Condition for maximum power transfer(Text1: Topics 3.9), Solved problems (Text1: Prob 3.15,3.18,3.23 & 3.25), Practice problems (Text1: Chap-3,Prob9,10,13 & 14)*

UNIT-III — 9 Hrs

1-Ø **AC circuits:** R.M.S value, Average value, Peak factor and form factor of a sine wave, Concept of phasor, Phase and phase difference, Rectangular and polar form representation, Sinusoidal steady state analysis of R, L, C, Series RL, RC, RLC circuits, Concept of Reactance, Impedance, Complex power, Real Power, Reactive power and Power factor

3- Ø AC circuits: Generation of 3**-** Ø voltages, Advantages, Disadvantages, Applications of a three-phase system, Voltage & current relationships of line and phase values for balanced star and delta connections

Self-Learning Topics (SLTs): *Expression for RMS & Average value (Text1: Topic,4.4 & 4.5) Solved problems (Text1: Prob4.10,4.12,4.13 & 4.14), Practice problems (Text1: Chap-4,Prob8,9,12&12)*

UNIT-IV	**9 Hrs**

Electrical Machines & Electrical Lighting (Qualitative treatment):

Construction, Principle of operation, Characteristics & applications of 1- Ø transformer, 3- Ø induction motor, 1- Ø induction motor and DC motor and Types of DC motor.

Electrical lighting sources and Energy calculations:

Lighting sources-incandescent, Fluorescent, CFL & LED lamps, Elementary calculations for energy consumption.

Self-Learning Topics (SLTs): *EMF equation of a Transformer (Text1: Part-II Topic,4.4.2) Solved problems (Text1: Part-II Prob 4.5, 4.6 & 4.7), Practice problems (Text1: Part-II Prob 5.2, 5.3 & 5.4), Practice problems (Text1: Part-II Prob 6, 7 & 8)*

LABORATORY COMPONENT

List of Experiments

1. Verification of voltage divider rule and current divider rule
2. Verification of Mesh Analysis
3. Verification of Nodal Analysis
4. Verification of Superposition Theorem
5. Verification of Thevenin's Theorem
6. Verification of Maximum power transfer Theorem
7. Determination of internal parameters of a choke coil
8. Impedance calculations and phasor representation of RL series circuit
9. Impedance calculations and phasor representation of RC series circuit
10. Load test on 1-phase transformer
11. Verification of Kirchoff's laws using PSPICE/MATLAB
12. **Interfacing Sensors with Arduino using TINKER CAD**
    i. LED blinking
    ii. IR Sensor
    iii. Ultrasonic Sensor
    iv. Voltage Sensor
    v. Current Sensor
    vi. Speed Sensor

Textbook(s):

1. K. U. Rao, *Basic Electrical Engineering*, 1st ed., New Delhi, India: Pearson Education, 2011

Reference Book(s):

1. B. L. Theraja and A. K. Theraja, *Electrical Technology Vol. I & II*, 1st ed., New Delhi, India: S. Chand & Company Ltd., 2005
2. E. Hughes, *Electrical & Electronics Technology*, 10th ed., New Delhi, India: Pearson Education, 2010.

3. D. P. Kothari and I. J. Nagrath, *Basic Electrical Engineering*, 4th ed., New Delhi, India: Tata McGraw Hill, 2010.
4. A. Chakravarthy, S. Nath, and C. Kumar, *Basic Electrical Engineering*, 2nd ed., New Delhi, India: Tata McGraw Hill Ltd., 2009.

Web and Video link(s):

https://nptel.ac.in/courses/108/105/108105112//; *NPTEL Video Lecture on Fundamentals of Electrical Engineering by Prof. Debapriya Das, Professor of EED, IITK Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Basic Electrical Engineering Laboratory Manual and Record Book,* Department of EEE, KITSW.

Course Articulation Matrix (CAM):		**U24EE205B: BASIC ELECTRICAL ENGINEERING**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	PO 8	PO 9	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**U24EE205B.1**	2	1	-	-	-	-	1	1	1	1	**1**	1	1
CO2	**U24EE205B.2**	2	2	-	-	-	-	1	1	1	1	**1**	1	1
CO3	**U24EE205B.3**	3	3	1	1	1	1	1	1	1	1	**1**	1	1
CO4	**U24EE205B.4**	3	3	1	1	1	1	1	1	1	1	**1**	1	1
CO5	**U24EE205B.5**	2	1	-	-	-	-	1	1	1	1	**1**	1	1
CO6	**U24EE205B.6**	2	2	-	-	-	-	1	1	1	1	**1**	1	1
CO7	**U24EE205B.7**	3	3	1	1	1	1	1	1	1	1	**1**	1	1
CO8	**U24EE205B.8**	3	3	1	1	1	1	1	1	1	1	**1**	1	1
U24EE205B		**2.5**	**2.25**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	1

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply network reduction, Kirchhoff's laws, nodal and mesh analysis to determine resistance, voltage, current & power in electrical circuits.	**SDG 9**	Industry, Innovation and Infrastructure	Mastering fundamental DC circuit analysis techniques (Ohm's law, KVL/KCL, mesh/nodal analysis) is essential for designing reliable and efficient power distribution networks. This foundational knowledge supports the development of resilient industrial infrastructure and fosters innovation in electrical systems.
CO2	Evaluate impedance, voltage, current, and power in 1-Ø AC circuits & select suitable motor for given application.	**SDG 7**	Affordable and Clean Energy	**SDG 7:** Analysis of AC circuits (phasors, power factor, RLC analysis) is crucial for optimizing power transmission and distribution, which directly enables reliable and affordable clean energy access. **SDG 9:** Selecting the appropriate motor (1-Ø IM, DC, Stepper, BLDC) for specific applications like pumps, EVs, and industrial drives improves overall energy efficiency and supports innovation in

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				sustainable automation and infrastructure.
CO3	Evaluate the voltage and current characteristics of PN junction diode and Zener diode.	**SDG 9**	Industry, Innovation and Infrastructure	Understanding the V-I characteristics of PN junction and Zener diodes is fundamental to modern electronics. This knowledge is critical for designing power supplies, rectifiers, and protection circuits, which are key components in developing innovative industrial electronics and communication systems, thereby driving infrastructure modernization.
CO4	Evaluate the voltage and current characteristics of transistors and select suitable sensor for given application.	**SDG 7**	Affordable and Clean Energy	Evaluating BJT characteristics (CE, CB, CC configurations) is foundational for analog and digital electronics. Furthermore, the ability to select suitable sensors (Thermocouple, RTD, Hall Effect, LDR, Ultrasonic) is crucial for creating smart systems and IoT applications. This directly contributes to industrial innovation and the development of intelligent infrastructure.

ENVIRONMENTAL STUDIES

Class: B.Tech.IISemester		**Branch:** IT	
CourseCode:	**U24CY206**	**Credits :**	**0**
Hours/Week(L-T-P-O-E) :	**2-0-0-2-4**	**CIE :**	**60%**
TotalNumberofTeachingHours:	**24Hrs**	**ESE :**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: identify the natural resources and practice their usage more equitably

CO2: develop an action plan for sustainable alternatives and conserving biodiversity

CO3: examine and perceive the solutions for the environmental pollution

CO4: adapt issues involved in enforcement of environmental legislation and green methodology

UNIT-I	**6Hrs**

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and importance

Natural Resources: Forest Resources-Use and overexploitation of forests, Deforestation, Timber extraction, Mining, Dams and their effects on forests and tribal people**;** Water Resources-Use and over-utilization of surface and ground water, Floods, Drought, Conflicts over water**;** Mineral Resources-Environmental effects of extracting and using mineral resources**;** Energy Resources-Renewable and non-renewable energy sources, Use of alternate energy sources

Self Learning Topics (SLTs): *Use and over-utilization of surface and ground water(Text1: unit 2, topic: 2.2.2) world food problems(Text1: unit 2, topic 2.2.2)*

UNIT-II	**6Hrs**

Ecosystem and Biodiversity:

Ecosystem: Concepts of an ecosystem, Food chain, Food webs, Ecological pyramids, Energy flow in the ecosystem and ecological succession

Biodiversity and its Conservation: Introduction, Definition, Genetic, Species and ecosystem diversity, Value of biodiversity, Biodiversity in India, Hot spots of biodiversity, Man-wildlife conflicts, Endangered and endemic species of India; In-situ and Ex-situ conservation

Self Learning Topics (SLTs): *Introduction and definition of biodiversity (Text1: unit 4, topic 4.1)*

UNIT-III	**6Hrs**

Environmental Pollution: Global issues**-**Global climatic change, Greenhouse gases, Effects of global warming, Ozone layer depletion

International Conventions/Protocols: Earth summit, Kyoto protocol, Montreal protocol**Environmental Pollution-**Causes and effects of air, Water, Soil, Marine and noise pollution with case studies

Solid and Hazardous Waste Management: Introduction, Types, Effects of urban industrial and nuclear waste

Natural Disaster Management: Introduction to disaster, Management of disaster, Disaster management of flood, earthquake, cyclone and landslides

Role of information technology in environment and human health

Self Learning Topics (SLTs): *Role of individual in prevention of pollution (Text1: unit 5, topic 5.10)*

UNIT-IV	6Hrs

Social Issues and the Environment: Role of Individual and Society, Water conservation, Rain water harvesting

Environmental Protection/Control Acts: Air (prevention and control of pollution) act 1981, Forest conservation act (1980 and 1992), Wildlife protection act 1972, Environment protection act 1986, Issues involved in enforcement of environmental legislations

Green Methodology: Principles of green chemistry, Green methods in electronic production, Impact of electronic waste on public health and environment; United nations goals of sustainable development

SelfLearningTopics(SLTs):*Water (prevention and control of pollution) act 1974(Text1: unit 6, topics 6.10), Water pollution cess act 1977(Text1: unit 6, topics 6.11)*

Text Book(s):

1. E. Bharucha, *Text Book of Environmental Studies for Under Graduate Courses*, 2nd ed., Hyderabad, India: Universities Press (India) Pvt. Ltd., 2013

ReferenceBook(s):

1. Y. Anjaneyulu, *Introduction to Environmental Science*, 1st ed., Hyderabad, India: B.S. Publications, 2004
2. G. M. Masters, *Introduction to Environmental Engineering & Science*, 3rd ed., New Delhi, India: Prentice Hall of India, 1991
3. A. Kaushik and C. P. Kaushik, *Environmental Studies*, 4th ed., New Delhi, India: New Age International Publishers, 2014
4. R. Rajagopalan, *Environmental Studies: From Crisis to Cure*, 2nd ed., New Delhi, India: Oxford University Press, 2011

Weband Videolink(s):

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ch27/ *videolectureon renewable energy resources by Prof. Vaibhav. V. Goud and Dr. R. Anandalakshmi, Dept. of Chemical Engineering, Guwahati.*

CourseArticulationMatrix(CAM):		U24CY206-ENVIRONMENTAL STUDIES												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24CY206.1	2	1	2	1	-	2	-	1	-	-	-	-	-
CO2	U24CY206.2	-	-	2	-	-	1	-	1	-	-	-	-	-
CO3	U24CY206.3	1	2	1	-	-	1	1	1	-	-	-	-	-
CO4	U24CY206.4	-	-	1	-	-	1	-	1	-	-	-	-	-
U24CY206		1.50	1.50	1.50	1	-	1.25	1	1	-	-	-	-	-

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	identify the natural resources and practice their usage more	SDG 7 and 13	Affordable and Clean Energy and	Natural Resources and their usage creates awareness about conservation and equitable use of natural resources.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	equitably		Climate Action	It promotes sustainable practices that help reduce environmental degradation and climate change impacts.
CO2	develop an action plan for sustainable alternatives and conserving biodiversity	SDG14 and 15	Life below water &; Life on Land	Conserving biodiversity focuses on conserving terrestrial, marine and aquatic ecosystems biodiversity through protection of forests, wildlife, and natural habitats. The action plan encourages sustainable land use and restoration of ecosystems, ensuring long-term conservation of biodiversity and environmental stability.
CO3	examine and perceive the solutions for the environmental pollution	SDG3	Good Health and Well-Being	Environmental pollution and its direct impact on human health such as respiratory diseases, waterborne infections, and toxicity-related disorders. It promotes awareness of pollution control measures that reduce exposure to harmful pollutants in air, water, and soil.
CO4	adapt issues involved in enforcement of environmental legislation and green methodology	SDG13	Climate Action	Environmental legislation and green methodology, promotes awareness of environmental legislation and green methodologies that help reduce pollution and greenhouse gas emissions. It encourages effective enforcement of environmental laws to mitigate climate change impacts and ensure sustainable practices.

IDEA Lab Makerspace

Class: B.Tech. II –Semester		**Branch:** Common to all branches	
Course Code:	**U24AE207**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**100%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to …
(based on psychomotor skills acquired from laboratory component)

CO1: produce wooden joints and intricate articles using carpentry and CNC wood router respectively

CO2: implement procedures to prepare the mould cavity for sand casting and arc welding joints

CO3: produce innovative prototypes using laser engraving and 3D printing

CO4: design and develop systems based on PCB and IoT for given applications

LABORATORY COMPONENT

S. No.	Creative Fabrication Technology	List of Experiments
1.	Carpentry	Prepare a half lap dovetail joint
2.	CNC Wood Router	Perform wood carving using CNC Wood Router
3.	Foundry	Prepare a sand mould using single piece pattern
4.	Welding	Prepare a single V-butt joint on mild steel plates using AC arc welding machine
5.	Injection Moulding	Prepare a plastic product using Injection moulding machine
6.	Laser Engraving	Perform key chain by using CO_2 laser cutting machine
7.	3D Printing	Prepare a key chain on 3D printer with the given dimensions
8.		Prepare a Spur Gear on 3D printer with the given dimensions
9.	Robotics	Perform basic pick-and-place operation using robot
10.	Printed Circuit Board (PCB)	Design and fabricate a PCB for a given application
11.	Internet of Things (IoT)	Measure the temperature and humidity by using DHT11 sensor and Arduino UNO
12.		Create a smart plant watering system using IoT
Course Project		• Students are required to create an affordable prototype as their course project, based on the knowledge and skills acquired during the course. • Students have to present and submit their prototypes to demonstrate their ability to apply classroom learning practically, showcasing their creativity and technical aptitude.

Laboratory Manual:

1. ***IDEA Lab Makerspace*** *Laboratory Manual & Record Book (LMRB) prepared by the faculty of department of Mechanical Engineering, KITSW, Revised version 4, August-2024.*

Text/ Reference Book(s):

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy., "*Elements of Workshop Technology*", Media Promoters and publishers Pvt. Ltd, India, Vol-I-2008 &Vol-II-2010.
2. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "*Additive Manufacturing Technologies-3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*" Springer Nature, 2nd Edition 2021.
3. R.S. Khandpur, "*Printed Circuit Boards: Design, Fabrication, Assembly and Testing*", New Delhi Tata Mc Graw Hill-2008.
4. Sudeep Mishra, Anandarupmukherjee and Arijit Roy, "*Introduction to IoT*", New Delhi: University Cambridge Press, 2021.

Course Articulation Matrix (CAM):		**U24AE207-IDEA Lab Makerspace**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AE207.1**	2	2	1	1	2	1	1	2	2	-	1	-	-
CO2	**U24AE207.2**	2	2	1	1	2	1	1	2	2	-	1	-	-
CO3	**U24AE207.3**	2	2	1	1	2	1	1	2	2	-	1	-	-
CO4	**U24AE207.4**	2	2	1	1	2	1	1	2	2	-	1	-	-
U24AE207		**2**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**-**	**1**	**-**	**-**

PRACTICUM

Class: B.Tech. II –Semester		**Branch:** IT	
Course Code:	**U24EL209**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-4-4**	**CIE :**	**100 %**
Total Number of Teaching Hours:	**-**	**ESE :**	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: synthesize literature survey, identify research gaps anddefine objective & scope of practicum problem

CO2: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system

CO3: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

CO4: create a video pitch on practicumand make an effective oral presentation using PPTs

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24PY202B	U24IT203	U24IT204	U24EE205B	U24CY206	U24MH201
Students allotted to different courses	B24IT001	B24IT012	B24IT023	B24IT034	B24IT045	B24IT056
	B24IT002	B24IT013	B24IT024	B24IT035	B24IT046	B24IT057
	B24IT003	B24IT014	B24IT025	B24IT036	B24IT047	B24IT058
	B24IT004	B24IT015	B24IT026	B24IT037	B24IT048	B24IT059
	B24IT005	B24IT016	B24IT027	B24IT038	B24IT049	B24IT060
	B24IT006	B24IT017	B24IT028	B24IT039	B24IT050	B24IT061
	B24IT007	B24IT018	B24IT029	B24IT040	B24IT051	B24IT062
	B24IT008	B24IT019	B24IT030	B24IT041	B24IT052	B24IT063
	B24IT009	B24IT020	B24IT031	B24IT042	B24IT053	B24IT064
	B24IT010	B24IT021	B24IT032	B24IT043	B24IT054	B24IT065
	B24IT011	B24IT022	B24IT033	B24IT044	B24IT055	

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

CIRCULAR

Allotment of Practicum topics to students

Section : …….

S.No.	Roll number of the student	Practicum topic allotted	Practicum under the course	Course faculty

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetableandalsooutside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

(Signature of class teacher)

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix). A sample rubrics for assessment and evaluation of practicum is as follows:

Literature survey & Identification of research gaps	10 marks
Working model / process / software package / system developed	30 marks
Report writing (subjected to max of 30% plagiarism)	20 marks
Oral presentation with PPT and viva-voce	20 marks
Video pitch	20 marks
Total	100 marks

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(h) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(i) **Working Model**: Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(j) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggestfor addressing the identified gaps for future work?

(k) **Anti-Plagiarism Check:** The practicumreport should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(l) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacheras per the schedule notified by the department

(m) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(n) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce

ii) he/she fails to submit the report in prescribed format

iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

Course Articulation Matrix (CAM):		**U24EL208 PRACTICUM**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EL208.1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**U24EL208.2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**U24EL208.3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**U24EL208.4**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
U24EL208		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

Course code U24ELXYY: ***X represents semester, YY represents ETA course serial number***

SOCIAL EMPOWERMENT ACTIVITY / SELF ACCOMPLISHMENT ACTIVITY (SEA /SAA)

Class: B.Tech.II Semesters	**Branch:** Common to all branches		
Course Code:	**U24VA210(SE/SA)ZZZ**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility

CO2: interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner

CO3: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility

CO4: demonstrate the generic competencies in makinga well-documented report and an effective oral presentationwith PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) isintroduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual andsocial aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses,which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (SelfAccomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester,through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

(f) **Nodal units:**The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE)shall act as nodal units for activities listed under SEA/SAA.

(g) During the semester period, the student has to**acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(h) **Knowledge Acquisition& Skilling**:

i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(i) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

iii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

Eminent personalities/ Achievers / Renowned personalities:

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

i. **For appointment to interacteminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ii. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

iii. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders.Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

iv. Student is expected to take care of health and Safety practices for fieldwork and travel

v. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

vi. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction &practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

vii. **Feedback:**The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentationand report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(j) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(k) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every studentshall, identifiesminimum of4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

iii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

iv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity.

After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

v. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(l) ***Assessment &Evaluation:***There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA.* The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

Assessment	Maximum marks	Marks to be awarded by
Goal setting, Planning& Knowledge Acquisition	20	Nodal centre
Field work	40	Nodal centre
Demonstration/Presentation	20	Nodal centre
Report submission	20	Faculty counsellor
Total	**100**	**-**

Note:

(m) **Presentation/ Demonstration:**It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(n) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(o) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(p) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**

b. scores a minimum of 40 marks in the CIE of the course

(q) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Text / Reference book(s):

For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator

Course Code: **U24VA XYY(SE/SA)ZZZ**

X represents semester; YYrepresents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 *SEA/SAA course serial number: 09* *SEA/SAA category: SEA* *course number: 302* The **course code** will be U24VA109SE302	*Semester: 4* *SEA/SAA course serial number: 10* *SEA/SAA category: SAA* *course number: 206* The **course code** will be U24VA410SA206

EXPERT TALK SERIES

Class: B.Tech.II –Semester		**Branch:** Common to all branches	
Course Code:	**U24AE211**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-1-1**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

CO2: identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

CO3: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO4: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples,is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

But how would you know all this without venturing into the industry?

(e) The answer is Industry**Expert Talk Series (ETS)**.Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(f) Through Industry expert talks students get to know so much more that textbooks don't explain.

(g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(m) ETS enhances your learning in many ways for global opportunities for your career.

(n) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(o) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode**by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks(10 MCQs/FiBs;*duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:**At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:**There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

Quiz score (*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*)	60 marks
Attendance (*out of 10 quizzes*)	20 marks
Report in prescribed format (*max 30% plagiarism*)	20 marks
Total	100 marks

ii. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marksforattendance = \frac{Numberofexperttalksattendedfully}{10} * 20$$

iii. Supplementary Exam:

(e) Student has to register for ETS supplementary examination if he/she scores less than 40 marksin CIE

(f) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks(MCQs/FiBs ;*duration: 2Hrs*)on the content covered in ETS lectures.

(g) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(h) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Articulation Matrix (CAM):		**U24AE211** EXPERT TALK SERIES											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	U24AE211.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AE211.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AE211.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AE211.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE211		**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**1**

Course code U24AEXYY: ***X represents semester, YY represents ETA course serial number***

1st Year Exit Courses Syllabi

Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute
OR
Successful completion of two suitable skill based courses (external) to qualify for Certification

A. After First Year: (UG Certificate in IT)

(i) The candidate should pass any two of the following additional courses (ITI Level) during the 2-Months internship at institute

Exit Option to Qualify UG Certificate in IT: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24IT212X	PC Software	2	-	2	-	4	3
2	PCC	U24IT213X	Digital Marketing	2	-	2	-	4	3
3	PCC	U24IT214X	Web Designing	2	-	2	-	4	3
4	PCC	U24IT215X	Hardware and Networking	2	-	2	-	4	3
5	PCC	U24IT216X	Any other course approved by BoS Chair and Dean AA						

(OR)

(ii) Any two suitable skill based courses to qualify for Certification.

Exit Option to Qualify UG Certificate in IT: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE212X	UNIX/LINUX Programming https://www.udemy.com/course/complete-linux-training-course-to-get-your-dream-it-job/?couponCode=ST3MT72524	-	-	6	-	6	3
2	SEC	U24SE213X	Java Programming https://learn.oracle.com/ols/learning-path/java-fundamentals/55593/55578	-	-	6	-	6	3
3	SEC	U24SE214X	Advanced Data Structures https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java/?couponCode=ST3MT72524	-	-	6	-	6	3
4	SEC	U24SE215X	SQL and PL/SQL Programming https://www.udemy.com/course/the-ultimate-mysql-bootcamp-go-from-sql-beginner-to-expert/?couponCode=ST3MT72524	-	-	6	-	6	3
5	SEC	U24SE216X	Any other skill based course approved by BoS Chair and Dean, AA	-	-	6	-	6	3

PC SOFTWARE

Class: B.Tech. II –Semester (Exit)		**Branch:** IT	
Course Code :	**U24IT212X**	**Credits :**	**3**
Hours/Week (L-T-P-E) :	**2-0-2-4**	**CIE :**	**40%**
Total Number of Teaching Hours :	**32 Hrs**	**ESE :**	**60%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: design word documents with rich text formatting features

CO2: apply excel mathematical function in various calculations

CO3: design database & apply sorting filters to the data tables and create various charts to for the given data

CO4: create good presentation using various text animations , sound effects and videos

(based on psychomotor skills acquired from laboratory component)

CO5 : implement documents using office formatting tools

CO6 : solve various numerical problems using excel functions

CO7 : create tables in excel and apply various filtering mechanisms to sort the tables

CO8 : design and create presentations using video and audio tools

THEORY COMPONENT

UNIT-I	4 Hrs

Getting to Know Office: Start and exit an application, Ribbon, File menu operations

Creating a Word Document: Start a new document, Choose between manual and style-based text formatting, Change the text font, Size, Apply text-color, effects, formatting, Check spelling and grammar, Email a document to others, Save document in various formats, Print your work

Paragraph Formatting: Adjust paragraph spacing, Border, Background, Creating bullets and numbers lists, Apply styles, Modify styles

Formatting Sections, Pages, and Documents: Set-margins, Page size and orientation, Multicolumn document

Working with Tables and Graphics in Word

Reference and Mail Merges in Word

UNIT-II	4 Hrs

Creating Basic Excel Worksheets: Understanding the excel interface, Move between cells, Select cells and ranges, Enter and edit text in cells, Use autofill to fill cell content, Copy and move data between cells, Insert and delete rows, columns, and cells, Create and manage multiple worksheets

Creating Excel Formulas and Functions: Write basic formulas, Copy and move formulas, Insert functions, Show the current date or time with a function, Calculate loan terms, Perform math calculations, Evaluate a condition with an *if* function, Formatting and printing excel worksheet

UNIT-III	4 Hrs

Storing and Managing Databases in Excel: Create an excel database, Sort a table, Filter a table, Add a total row to a table, Create queries, Remove duplicates from a dataset, Restrict data entry with validation rules

Creating Charts in Excel: Choose the correct chart type, Create a chart, Move and resize a

chart, Switch rows and columns, Modify the data range for a chart, Change the axis scale of a chart, Apply a chart style, Change a chart's color, Add or remove chart elements, Format a chart element

UNIT-IV	4 Hrs

Formatting a Presentation: Understanding templates versus themes, Change the theme, Change the presentation colors and fonts, Modify the theme in slide master view, Enable footer placeholders, Format text boxes and placeholders, Create smart art graphics, Modify the structure of a smart art graphic, Format a smart art graphic

Adding Movement and Sound to a Presentation: Add slide transition effects, Set slides to advance manually or automatically, Animate objects, Insert a sound clip, Insert a video clip on a slide

Presenting a Slide Show: Display a slide show onscreen, Annotate slides with the pen tools, Use Presenter view, Print handouts, Export handouts to word

LABORATORY COMPONENT

List of Experiments

1. Create a word document about the importance of ms-office tools in the daily life, by applying various word formatting tools - font, size, text color, specific formatting styles
2. Create a document and apply various paragraph features like specified spacing, border, background, and bullet or number list style
3. Create a table and apply all the features related to the tables, split, merge, insert, insert an image to the cell
4. Scenario: You are an administrator at a school and have been tasked with notifying parents about their child's attendance shortage. You have a list of 20 students who have not met the minimum attendance requirements. Prepare a mail merge document with suitable fields and text
5. Describe the process of moving between cells in an Excel worksheet using both mouse and keyboard methods. How would you select a range of cells that are not adjacent to each other
6. Describe how to use the AutoFill feature to populate a series of dates in a column. Additionally, detail the steps required to copy data from one cell to another non-adjacent cell, and describe how to insert a new row between existing rows in a worksheet
7. Loan Term Evaluation Using IF Condition-You have a spreadsheet with loan amounts listed in column A. You need to determine the loan term based on the amount borrowed and calculate the monthly payment for each loan. The loan terms are as follows:
   If the loan amount is less than 50,000, the term is 5 years
   If the loan amount is between 50,000 and 100,000, the term is 10 years
   If the loan amount is more than 100,000, the term is 15 years
8. Create an excel database of customer transactions, apply various filter to sort the database. How would you sort the table to display the most recent transactions first, filter the table to show only transactions above 50000 rupees, and then remove any duplicate entries
9. After analyzing sales data, you decide to create a chart in excel to present the information. Which chart type would be most appropriate for showing monthly sales trends, and how would you customize the chart's colors and format the axis scale to reflect thousands of rupees
10. Using the PowerPoint interface, create a presentation on 'The Evolution of Renewable

Energy'. Start by selecting an appropriate theme and customizing it with your preferred colors and fonts in the Slide Master view. Ensure you include a variety of slide layouts. Populate your slides with relevant content, including text, graphics, and images. Add transitions between slides, animate key objects, and insert audio clips to enhance your points. Finally, prepare the presentation for delivery by setting up the slides to advance manually. How would you structure your presentation to maintain a logical flow and engage your audience effectively

Text Book:

1. F. Wempen, *Microsoft Office 2016 At Work for Dummies*, 1st ed., New York, USA: John Wiley & Sons, Inc., 2016

Reference Book(S):

1. S. Goel, *PC Software*, 1st ed., Delhi, India: Nat Raj Publishing House
2. A. Leon and M. Leon, *Introduction to Computers with MS-Office 2000*, 2001
3. L. Bali, *Microsoft Office 2016: Word, Excel, OneNote Book*, 1st ed., Delhi, India: Notion Press, 2021

Web and Video link(s):

1. **https://www.youtube.com/playlist?list=PLLy_2iUCG87CUBbhq5BEAiC--fF6lEOe1** NPTEL Video Lectures on Decision Making with Spreadsheet, by Prof. Ramesh Abanandam, IIT Roorkee

Laboratory Manual (for laboratory component):

1. *PC Software Laboratory Manual and Record Book,* Department of IT, KITSW

Course Articulation Matrix (CAM):		**U24IT212X PC SOFTWARE**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT212X.1**	2	2	2	2	-	-	1	-	1	-	1	2	2
CO2	**U24IT212X.2**	2	2	2	2	-	-	1	-	1	-	1	2	2
CO3	**U24IT212X.3**	2	2	2	2	-	-	1	-	1	-	1	2	2
CO4	**U24IT212X.4**	2	2	2	2	-	-	1	-	1	-	1	2	2
CO5	**U24IT212X.5**	1	1	2	1	-	-	1	1	1	-	1	2	2
CO6	**U24IT212X.6**	1	1	2	2	-	-	1	1	1	-	1	2	2
CO7	**U24IT212X.7**	1	1	2	3	-	-	1	1	1	-	1	1	1
CO8	**U24IT212X.8**	1	1	2	3	-	-	1	1	1	-	1	1	1
U24IT214X		**1.5**	**1.5**	**2**	**2.12**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**1.75**	**1.75**

DIGITAL MARKETING

Class: B.Tech. II –Semester (Exit)		**Branch:** IT	
Course Code :	**U24IT213X**	**Credits :**	**3**
Hours/Week (L-T-P-E) :	**2-0-2-4**	**CIE :**	**40 %**
Total Number of Teaching Hours :	**32 Hrs**	**ESE :**	**60 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: illustratethe different types of digital platforms and digital media to marketing, evaluate the advantages and challenges of digital media and identify the key differences between customer communications digital marketing and traditional marketing

CO2: identify the elements of an organisation's online marketplace, evaluate techniques for reviewing the importance of different actors in the micro environment, review changes to business and revenue models enabled by digital market

CO3: identify how the macro-environment affects an organisation's digital marketing strategy, planning, implementation and performancethat able to relate business strategy

CO4: Identify opportunities and threats arising from digital media and technology platforms and Evaluate alternative strategic approaches for using digital platforms

(based on psychomotor skills acquired from laboratory component)

CO5: develop a case study on how eBay successfully thrives in the global marketplace

CO6: identify Boo.com – insights from the largest European dot-com failure

CO7: develop a case study on Zopa's launch of a new lending model

CO8: analyze how Tesco's online development strategy supports its global expansion.

THEORY COMPONENT

UNIT-I	**4 Hrs**

Introducing Digital Marketing: Introduction – How have digital technologies transformed marketing,Definitions – What are digital marketing and multichannel marketing, Introduction to digital marketing strategy,Introduction to digital marketing communications

UNIT-II	**4 Hrs**

Online Marketplace Analysis: Micro-environment-situation analysis for digital marketing,Digital marketing environment,Understanding customer journeys,Consumer choice and digital influence,Online consumer behaviour and implications for marketing,Competitors,Suppliers,New channel structures,Business models for e-commerce

UNIT-III	**4 Hrs**

The Online Macro-Environment: The rate of environment change,Technological forces,Economic forces,Political forces,Legal forces,Social force,Cultural force

UNIT-IV	**4 Hrs**

Digital marketing strategy:The need for an integrated digital marketing strategy,How to structure a digital marketing strategy,Situation analysis,Setting goals and objectives for digital marketing,Strategy formulation for digital marketing,Strategy implementation.

LABORATORY COMPONENT
List of Experiments-Case studies 1. Case Study on eBay thrives in the global marketplace 2. Case Study on boo hoo – learning from the largest european dot-com failure 3. Case Study on Zopa launches a new lending model 4. Case Study on Tesco online development strategy supports global expansion
Textbook(s): 1. D. Chaffey and F. Ellis-Chadwick, *Digital Marketing: Strategy, Implementation and Practice*, 6th ed., Harlow, England: Pearson, 2016
Reference Book(s): 1. A. Charlesworth, *Digital Marketing: A Practical Approach*, 3rd ed., London, UK: Routledge, 2018 2. P. Kotler, H. Kartajaya, and I. Setiawan, *Marketing 4.0: Moving from Traditional to Digital*, 1st ed., Hoboken, NJ: Wiley, 2017 3. D. Ryan, *Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation*, 3rd ed., London, UK: Kogan Page Limited, 2014
Web and Video link(s): 1. Digital Marketing - Course (swayam2.ac.in); *NPTEL Video Lecture on Digital Marketing by Digital Marketing*
Laboratory Manual (for laboratory component): 1. *Digital Marketing Laboratory Manual and Record Book,* Department of IT, KITSW.

Course Articulation Matrix (CAM):		U24IT213X DIGITAL MARKETING												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24IT213X.1	2	1	-	-	-	-	1	-	-	-	1	2	2
CO2	U24IT213X.2	2	2	2	1	-		1	-	-	-	1	2	2
CO3	U24IT213X.3	2	2	2	2	1		1	-	-	-	1	2	2
CO4	U24IT213X.4	2	2	2	2	1		1	-	-	-	1	2	2
CO5	U24IT213X.5	2	1	-	-	-		1	1	1	-	1	2	2
CO6	U24IT213X.6	2	2	2	1	-		1	1	1	-	1	2	2
CO7	U24IT213X.7	2	2	2	2	1		1	1	1	-	1	2	2
CO8	U24IT213X.8	2	2	2	2	1		1	1	1	-	1	2	2
U24IT213X		**2**	**2**	**1.75**	**2**	**1.66**		**1**	**1**	**1**	**-**	**1**	**2**	**2**

WEB DESIGNING

Class: B.Tech. II –Semester (Exit)		**Branch:** IT	
Course Code :	**U24IT214X**	**Credits :**	**3**
Hours/Week (L-T-P-E) :	**2-0-2-4**	**CIE :**	**40 %**
Total Number of Teaching Hours :	**32 Hrs**	**ESE :**	**60 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: construct HTML documents from scratch, incorporating text, images, links, tables, forms, and embedded media

CO2: utilize CSS to control the layout, appearance, and behavior of HTML elements

CO3: utilize JavaScript libraries and frameworks and apply tools to enhance developmentand create complex applications

CO4: implement image best practices to integrate images effectively into web pages, considering factors like accessibility and SEO

(based on psychomotor skills acquired from laboratory component)

CO5: create functional and informative web pages, design effective layouts, and implement interactive forms

CO6: apply CSS styling to modify the appearance of text, background, and images on a web page

CO7: understand JavaScript fundamentals and grasp the core concepts, syntax, and structure of JavaScript programming

CO8: create scalable and interactive graphics for web applications and integrate images into web pages

THEORY COMPONENT

UNIT-I	**4 Hrs**

Creating a Simple Page: A web page step-by-step, Launch a text editor, Step 1: start with content, Step 2: give the HTML document structure, Step 3: identify text elements, Step 4: add an image, Step 5: change the look with a style sheet, When good pages go bad, Validating your documents

Marking Up Text: Paragraphs, Headings, Thematic breaks (horizontal rule), Lists, More content elements, Organizing page content, The inline element roundup, Generic elements (div and span), Improving accessibility with ARIA, Character escapes

Adding Links: The href attribute, Linking to pages on the web, Linking within your own site, Targeting a new browser window, Mail links, Telephone links

Adding Images: First, a word on image formats, The img element, Adding SVG images, Responsive image markup

Table Markup: How to use tables, Minimal table structure, Table headers, Spanning cells, Table accessibility, Row and column groups, Wrapping up tables

Forms: How forms work, The form element, Variables and content, The great form control roundup, Form accessibility features, Form layout and design

Embedded Media: Window-In-A-Window (iframe), Multipurpose Embedder (object), Video and Audio, Canvas

UNIT-II	**4 Hrs**

Introducing Cascading Style Sheets: The benefits of CSS, How Style Sheets Work, The big concepts, CSS units of measurement, Developer tools right in your browser, Moving forward with CSS

Formatting Text: Basic Font Properties, Advanced Typography with CSS3, Changing Text Color, A few more selector types, Text line adjustments, Underlines and other "decorations", Changing capitalization, Spaced out, Text shadow, Changing List Bullets and Numbers
Colors and Backgrounds: Specifying color values, Foreground color, Background color, Clipping the background, Playing with opacity, Pseudo-class selectors, Pseudo-element selectors, Attribute selectors, Background images, The shorthand background property, Like a rainbow (gradients), Finally, external style sheets
Thinking Inside the Box: The element box, Specifying box dimensions, Padding, Borders, Margins, Assigning display types, Box drop shadows
Floating and Positioning: Normal flow, Floating, Fancy text wrap with CSS shapes, Positioning basics, Relative positioning, Absolute positioning, Fixed positioning
CSS Layout with Flexbox and Grid: Flexible boxes with CSS flexbox, CSS grid layout
Responsive Web Design: Why RWD?, The responsive recipe, Choosing breakpoints, Designing responsively, A few words about testing, More RWD resources
Transitions, Transforms, and Animation: Ease-y does it (CSS transitions), CSS transforms, Keyframe animation
More CSS Techniques: Styling forms, Styling tables, A clean slate (reset and normalize.css), Image replacement techniques, CSS sprites, CSS feature detection, Wrapping up style sheets
Modern Web Development Tools: Getting cozy with the command line, CSS power tools (processors), Build tools (grunt and gulp), Version control with Git and GitHub

UNIT-III	**4 Hrs**

Introduction to JavaScript: What Is JavaScript?Adding JavaScript to a page, The anatomy of a script, The browser object, Events
Using JavaScript: Meet the DOM, Polyfills, JavaScript libraries, Big finish

UNIT-IV	**4 Hrs**

Web Image Basics: Image sources, Meet the formats, Image size and resolution, Image asset strategy, Favicons
Image Asset Production: Saving images in web formats, Working with transparency, Responsive image production tips, Image optimization
SVG: Drawing with XML, Features of SVG as XML, SVG tools, SVG production tips, Responsive SVGs, Further SVG exploration

LABORATORY COMPONENT

List of Experiments

1. Design a home page that displays information about your college departments using headings, HTML entities, and paragraphs
2. Design a timetable and display it in tabular format.
3. Design an admission form for any course in your college with text, password fields, drop-down list, check-boxes, radio buttons, submit and reset button etc.
4. Create a website for online book store with Home, Login, Catalogue, Registration page with links to all these pages in a menu on top of every page. Embed heading, paragraph, images, video, iframe, form controls, table, list in this website.
5. Design a web page of your home town with an attractive background color, text color, an image, font face by using Inline CSS formatting.
6. Write a JavaScript program to remove a character at the specified position of a given string and return the new string.
7. Write a JavaScript program to compute the sum of elements of a given array of integers.
8. Develop and demonstrate a HTML file that includes JavaScript script for taking a number n as input using prompt and display first n Fibonacci numbers in a paragraph.
9. Develop and demonstrate a HTML file that includes JavaScript script for taking full name in a text field and display first, middle, last name in 3 different labels. Middle and last name may be optional, thus message like "NA" should be displayed in corresponding labels. If the

input contains 2 words, then they should be considered as first and last names.

10. Develop and demonstrate a HTML file that includes JavaScript script for switching an image source for a image on click of "change" and "original" button.
11. Design HTML form for keeping student record, apply JavaScript validation in it for restriction of mandatory fields, numeric field, email-address field, specific value in a field etc.
12. Write a JavaScript code that displays text "Bigger Text" with increasing font size in the interval of 10ms in red color, when the font size reaches 50pt it displays "Smaller Text" in green color. Then the font size should decrease to 5pt and then stop.

Text Book:

1. J. N. Robbins, *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, 5th ed., Sebastopol, CA: O'Reilly Media, 2018

Reference Book(s):

1. U. K. Roy, *Web Technologies*, 1st ed., New Delhi, India: Oxford University Press, 2016
2. Kogent Learning Solutions Inc., *Web Technologies: HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML*, 1st ed., New Delhi, India: Dreamtech Press, 2013

Web and Video link(s):

1. https://onlinecourses.swayam2.ac.in/nou24_cs12/preview;*NPTEL Video Lecture on CIT-003: Web Based Technologies and Multimedia Applications by Prof.P. V. Suresh, Indira Gandhi National Open University*

Laboratory Manual (for laboratory component):

1. *Web Designing Laboratory Manual and Record Book,* Department of IT, KITSW

HARDWARE AND NETWORKING

Class: B.Tech. II –Semester (Exit)		**Branch:** IT	
Course Code :	**U24IT215X**	**Credits :**	**3**
Hours/Week (L-T-P-E) :	**2-0-2-4**	**CIE :**	**60 %**
Total Number of Teaching Hours :	**32 Hrs**	**ESE :**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: make use of computer hardware for effective maintenance of peripherals
CO2: apply troubleshooting techniques in real time problems
CO3: illustrate the types of networks, protocol models to configure the network
CO4: analyze network architecture and troubleshooting for managing the network

(based on psychomotor skills acquired from laboratory component)

CO5: test for assembled PC and inspect the installed operating system working condition
CO6: experiment with mobile hardware
CO7: test for switches and routers working condition
CO8: analyze network protocols and ensure the network security

THEORY COMPONENT

UNIT-I	**4 Hrs**

Computer Hardware and Maintenance: Study of maintenance kit, Computer peripheral, Reassembling computer system, Disk drive performance, File system, Unlock USB port, Speaker, Web camera.

UNIT-II	**4 Hrs**

PC Assembling and Troubleshooting: Troubleshooting & repairing of motherboard & components on motherboard, Software & Hardware troubleshooting, Use basic hand tools effectively, Able to perform basic troubleshoots of PC, Able to install & maintain software for PC.

UNIT-III	**4 Hrs**

Networking Fundamentals: Introduction to networking, Network Fundamentals :TCP/IP, HTTP, FTP, Network Topologies: LAN, WAN, MAN
Network Devices and Protocols: Network Devices: Router, Switch, Hub**,** Network Protocols: DHCP, DNS, NAT
Network Security and Wireless Networking: Network security :Firewall, VPN, Encryption**,** Wireless networking :Wi-Fi, Bluetooth

UNIT-IV	**4 Hrs**

Internet and Network Architecture: Internet concepts : ISP, Domain name, Web hosting**;** Network architecture : Client-Server, Peer-to-Peer
Network Management and Troubleshooting: Network management**,** Network troubleshooting

LABORATORY COMPONENT

List of Experiments

Hardware:

1. Assembling a PC: Assemble a PC from scratch and install the operating system.
2. BIOS Settings and Configuration: Explore and configure BIOS settings (boot order, time, date).

3. Expansion Card Installation: Install and test expansion cards (graphics, sound, network).
4. Hard Drive Installation and Partitioning: Install and partition a hard drive.

5. Printer and Scanner Installation: Install and test printers and scanners.
6. Mobile Device Hardware Troubleshooting: Troubleshoot common mobile device hardware issues (display, battery, charging).

Networking:

7. Configuring a Switch: Configure and test a switch (VLAN, trunking, spanning tree).
8. Implementing a Firewall: Implement and test a firewall (rule-based, NAT, port forwarding).
9. Setting up a Wireless Access Point: Configure and test a wireless access point (SSID, WPA2, MAC filtering).
10. Network Monitoring and Troubleshooting: Use tools like Nagios or Wireshark to monitor and troubleshoot a network.
11. Implementing a VPN: Set up and test a virtual private network (VPN).
12. Configuring a Router: Configure and test a router (static routing, RIP, OSPF).

Text Book(s):

1. V. Gupta, *Comdex Information Technology Course Tool Kit*, 1st ed.,New Delhi, India: WILEY Dreamtech, 2005

Reference Book(s):

1. C. A. Schmidt, *The Complete Computer Upgrade and Repair Book*, 3rd ed., New Delhi, India: Dreamtech Press, 2002
2. ITL Education Solutions, *Introduction to Information Technology*, 2nd ed., New Delhi, India: Pearson Education, 2012.
3. K. J. Chase, *PC Hardware - A Handbook*, New Delhi, India: PHI (Microsoft), 2004.
4. F. Mittelbach and M. Goossens, *The LaTeX Companion*, 2nd ed., Boston, MA: Addison-Wesley, 2013.
5. D. Anfinson and K. Quamme, *IT Essentials: PC Hardware and Software Companion Guide*, 3rd ed., Indianapolis, IN: CISCO Press, 2018.
6. P. Regan, *IT Essentials: PC Hardware and Software Labs and Study Guide*, 3rd ed., Indianapolis, IN: CISCO Press, 2018

Web and Video link(s):

1. https://www.udemy.com/course/computer-hardware-operating-system-and-networking-r/?utm_source=adwords&utm_medium=udemyads&utm_campaign=Search_DSA_Beta_Prof_la.EN_cc.India&campaigntype=Search&portfolio=India&language=EN&product=Course&test=&audience=DSA&topic=&priority=Beta&utm_content=deal4584&utm_term=_._ag_160270535665_._ad_696202838337_._kw__._de_c_._dm__._pl__._ti_dsa-1677053911888_._li_9301462_._pd__._&matchtype=&gad_source=1&gclid=Cj0KCQjwtsy1BhD7ARIsAHOi4xausSWGyKwWZyTCmMEE4qnMTv5bAtDDA9f05yIlbPP4pHRmeK1MpasaAslGEALw_wcB&couponCode=IND21PM

Laboratory Manual (for laboratory component):

1. *Hardware and Networking Laboratory Manual and Record Book,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT215X - HARDWARE NETWORKING												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24IT215X.1	2	1	-	-	-	-	1	-	1	-	1	1	1
CO2	U24IT215X.2	2	2	1	-	-	-	1	-	1	-	1	1	1
CO3	U24IT215X.3	2	2	1	-	-	-	1	-	1	-	1	1	1
CO4	U24IT215X.4	2	2	1	-	-	-	1	-	1	-	1	1	1
CO5	U24IT215X.5	2	1	-	-	-	-	1	1	1	-	1	1	1
CO6	U24IT215X.6	2	2	1	-	-	-	1	1	1	-	1	1	1
CO7	U24IT215X.7	2	2	1	-	-	-	1	1	1	-	1	1	1
CO8	U24IT215X.8	2	2	1	-	-	-	1	1	1	-	1	1	1
U24IT215X		**2**	**1.75**	**1**	**-**	**-**	**-**	**-**	1	**1**	**-**	**1**	**1**	**1**

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
DEPARTMENT OF INFORMATION TECHNOLOGY

3rd Semester Syllabi

B. Tech (IT) –CURRICULUM & SYLLABUS (KITSW-URR24)

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credit Assigned

III SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	ESC	U24IT301	Artificial Intelligence	2	1	-	-	3	3
2	PCC	U24IT302	Advanced Data Structures	2	1	2	-	5	4
3	PCC	U24IT303	Software Engineering	2	1	-	-	3	3
4	PCC	U24IT304	Database Management Systems	2	1	2	-	5	4
5	PCC	U24IT305	Object Oriented Programming through Java	2	1	2	-	5	4
6	VAC	U24VA306B	Soft and Interpersonal Skills Laboratory *(from Pool-IV)*	-	-	2	-	2	1
7	SEC	U24SE307	Programming Skill Development Lab –2	-	-	2	-	2	1
8	ELC	U24EL308	Practicum-3	-	-	-	4	4	1
9	VAC	U24VA309 XXXXX	SEA-3 / SAA -3	-	-	-	2	2	1
10	AEC	U24AE310	Expert Talk Series-3	-	-	-	1	1	1
			Total:	**10**	**5**	**10**	**7**	**32**	**23**
			Additional Learning@:Maximum credits allowed for Honours/Minor	-	-	-	-	-	**5**
			Total credits for Honours/Minor students:	-	-	-	-	-	**28**
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-	-

T&P Basket (Pool-IV)		
S. No.	**Course Code**	**Course Title**
1.	U24VA306A	Quantitative Aptitude and Logical Reasoning
2.	U24VA306B	Soft and Interpersonal Skills

ARTIFICIAL INTELLIGENCE

Class: B.Tech. III –Semester			**Branch**	:	IT
Course Code	:	**U24IT301**	**Credits**	:	**3**
Hours/Week (L-T-P-O-E)	:	**2-1-0-4-7**	**CIE**	:	**60 %**
Total Number of Teaching Hours	:	**36 Hrs**	**ESE**	:	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: analyze various AI problem domains, search strategies, and heuristic techniques to **evaluate** their effectiveness in solving complex real-world problems

CO2: build the knowledge representation system using predicate logic for the given problem domain and apply the reasoning techniques to infer new knowledge

CO3: analyze game-playing strategies and expert system architectures by examining search optimization methods and rule-based inference mechanisms for effective problem-solving

CO4: apply probabilistic and symbolic reasoning frameworks such as Bayesian networks, abduction, and ATN parsers to assess their effectiveness in handling uncertainty and language comprehension in AI systems

THEORY COMPONENT

UNIT-I — 9 Hrs

Introduction to Artificial Intelligence: The AI problem domains, The underlying assumption, An AI technique, The level of the model, Criteria for success

Problems, Problem Spaces and Search: Defining the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs

Heuristic Search Techniques: Generate-and-Test, Hill climbing, Best-first-search, Problem reduction, Constraint satisfaction, Means-Ends Analysis

Self Learning Topics (SLTs): *State space search problems (Text1: topic 2.1), Practice problems (Text1: prob 2.6)*

UNIT-II — 9 Hrs

Knowledge Representation Issues: Knowledge representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The frame problem

Using Predicate Logic: Representing simple facts in logic, Representing instance and is-a relationships, Computable functions and predicates, Resolution, Natural deduction

Representing Knowledge Using Rules: Procedural versus declarative knowledge, Forward versus backward reasoning

Self Learning Topics (SLTs): *Introduction to knowledge representation (Text1: topic 4.1)*

UNIT-III — 9 Hrs

Weak Slot and Filler Structures: Semantic nets, Frames

Strong Slot and Filler Structures: Conceptual dependencies, Scripts, CYC

Game Playing: The Min-Max search procedure, Adding alpha-beta cutoffs, Iterative deepening

Strong Method Problem Solving: Overview of expert system technology, Rule-based expert systems

Self Learning Topics (SLTs): *Introduction to game playing (Text1: topic 12.1)*

UNIT-IV	9 Hrs

Reasoning in Uncertain Situations: Introduction to non-monotonic reasoning, Logic-based abductive inference, Abduction - Alternative to logic

Understanding Natural Language: Role of knowledge in language understanding**,** Deconstructing language: A symbolic analysis, Syntax, Syntax and knowledge with ATN parsers

Statistical Reasoning: Bayesian networks, Dempster-Shafer theory

Self Learning Topics (SLTs): *Natural language applications (Text2: topic 14.1), Fuzzy logic (Text2: topic 8)*

Textbook(s):

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, *Artificial Intelligence*, New Delhi: Tata McGraw-Hill, 3rd edition, 2012 (Chapters: 1 to 6, 8 to 10 & 12)
2. George F Luger, *Artificial Intelligence*, London: Pearson Education Asia, 4th edition, 2003 (Chapters 8, 9 & 15)

Reference Book(s):

1. Stuart Russell and Peter Norvig, *Artificial Intelligence* (*A Modern Approach*), USA: Pearson Education, 3rd edition, 2002
2. Eugene Charniak and Drew Mc Dermott, *Introduction to Artificial Intelligence*, Noida: Pearson Education, 3rd edition, 2000
3. S.S. Vinod Chandra, S. Anand Hareendran, *Artificial Intelligence and Machine Learning*, New Delhi: PHI Learning Pvt Ltd, 2014

Web and Video link(s):

1. *https://nptel.ac.in/courses/108/105/108105112//; NPTEL Video Lecture on Artificial Intelligence by Prof. Sudeshna Sarkar, Professor of CSED, IITK Kharagpur.*
2. *https://nptel.ac.in/courses/106102220//; NPTEL Video Lecture on Artificial Intelligence by Prof. Mausam, Professor of CSED, IIT Delhi.*
3. *https://nptel.ac.in/courses/106106226//; NPTEL Video Lecture on Artificial Intelligence by Prof. Deepak Khemani, Professor of CSED, IIT Madras.*
4. *http://kcl.digimat.in/nptel/courses/video/106105077/L27.html; NPTEL Video Lecture on Artificial Intelligence by Prof. D.Anuupam Basu, Professor of CSED, IITK Kharagpur.*

Course Articulation Matrix (CAM):		**U24IT301 ARTIFICIAL INTELLIGENCE**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24IT301.1**	2	1	1	1	-	-	-	-	-	-	1	2	1
CO2	**U24IT301.2**	1	1	2	1	-	-	1	1	-	-	1	2	1
CO3	**U24IT301.3**	1	2	1	1	-	-	-	1	1	1	1	2	2
CO4	**U24IT301.4**	2	2	2	2	-	-	1	-	-	-	1	2	2
U24IT301		**1.5**	**1.5**	**1.5**	**1.25**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**1.5**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze various AI problem domains, search strategies, and heuristic techniques to evaluate their effectiveness in solving complex real-world problems	SDG 9	Industry, Innovation and Infrastructure	AI search and heuristic techniques enable intelligent problem-solving, optimization, automation, and innovation in industrial and technological systems.
CO2	build the knowledge representation system using predicate logic for the given problem domain and apply the reasoning techniques to infer new knowledge	SDG 4	Quality Education	Knowledge representation and reasoning form the foundation of intelligent tutoring systems, adaptive learning environments, and knowledge-based educational technologies.
CO3	analyze game-playing strategies and expert system architectures by examining search optimization methods and rule-based inference mechanisms for effective problem-solving	SDG 9	Industry, Innovation and Infrastructure	Expert systems and intelligent decision-support systems improve industrial automation, process optimization, and innovative technological solutions.
CO4	apply probabilistic and symbolic reasoning frameworks such as Bayesian networks, abduction, and ATN parsers to assess their effectiveness in handling uncertainty and language comprehension in AI systems	SDG 9	Industry, Innovation and Infrastructure	Probabilistic reasoning and natural language understanding support advanced AI applications such as healthcare analytics, intelligent assistants, language technologies, and smart infrastructure.

ADVANCED DATA STRUCTURES

Class: B.Tech. III–Semester			**Branch**	:	IT
Course Code	:	**U24IT302**	**Credits**	:	**4**
Hours/Week (L-T-P-O-E)	:	**2-1-2-5-10**	**CIE**	:	**60%**
Total Number of Teaching Hours	:	**60 Hrs**	**ESE**	:	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

- **CO1:** analyze the performance and behavior of advanced sorting/searching algorithms and tree structures to determine their suitability for different data organization and access scenarios
- **CO2:** apply operations on binary search trees, threaded binary trees, AVL trees, and red-black trees to efficiently manage hierarchical data structures
- **CO3:** analyze the structural and functional differences among heap trees, trie trees, multiway search trees, and graphs to determine their suitability for various indexing, sorting, and traversal operations
- **CO4:** analyze the efficiency and applicability of graph traversal and string matching algorithms by comparing their computational complexities and use-case scenarios

(based on psychomotor skills acquired from laboratory component)

- **CO5:** develop programs using sorting techniques on unsorted data and searching techniques to retrieve the data very effectively
- **CO6:** develop programs using binary search tree, AVL tree, Red black tree and heap trees to allow fast lookup, addition and removal of data item
- **CO7:** build various balanced search trees such as B-trees and B+-trees, Tries for efficiently storing and retrieving the data
- **CO8:** construct the graphs and string manipulation algorithms for organizing and retrieving the data

THEORY COMPONENT

UNIT-I — 9 Hrs

Sorting: Quick sort, Merge sort, Bitonic generator sort

Searching: Fibonacci search, Interpolation search, Time complexities of searching and sorting techniques

Trees: Basic terminologies, Types of trees

Binary Tree: Representation of binary tree, Operations on binary tree-insertion, deletion, recursive and non recursive traversal

Self Learning Topics (SLTs): *Formation of binary tree from its traversals (Text1: topic 7.4.3.2), Practice problems (Text1: Prob 7.5, Reference1: Prob 9.11, Prob 9.12, Prob 9.13)*

UNIT-II — 9 Hrs

Binary Search Tree: Operations- insertion, deletion, searching, traversals

Threaded Binary Trees: Representation of threaded binary trees, Advantages

Height Balanced Binary Tree: AVL rotations, Insertion operation

Red-Black Trees: Properties, Operations on a red black tree-insertion

Self Learning Topics (SLTs): *Splay trees (Text1: topic 7.5.7), Interval tree*

(https://www.dgp.toronto.edu/public_user/JamesStewart/378notes/22intervals/), Hash tree (https://stackoverflow.com/questions/36590599/reading-a-3-candidate-hash-tree-structure), Solved problems (Text1: Prob 7.79), Practice problems (Text1: Prob 7.17, Prob 7.19, Reference1: Prob 10.18, 10.19)

UNIT-III	9 Hrs

Heap Tree: Representation of heap, Operations on a heap tree- insertion, deletion, Heap sort
Trie Tree Indexing: Trie structure, Operations on tries- searching, inserting, deleting
Multiway Search Trees: Introduction to m-way search trees. B-Tree indexing, Operations on B-Trees- searching, inserting, B+-trees indexing, searching, inserting

Graphs: Introduction, Graph terminology, Representation of graphs, Graph traversal methods- depth first search, breadth first search
Self Learning Topics (SLTs):*Priority queue (Reference1: topic 8.4.3), B-Tree vs. B+-Tree (Text1: topic 7.8), Solved problems (Text1: Prob 8.1), Practice problems (Reference1: Prob 11.10, Prob 13.7, Prob 13.8. Prob 13.9)*

UNIT-IV	9 Hrs

Application of Graph Structures: Topological sorting, Minimum spanning trees- Kruskal's algorithm, Prim's algorithm; Connectivity in a graph-Kosaraju's algorithm
String Matching Algorithms: Naive algorithm, Knuth morris pratt algorithm, Boyer moore algorithm, Rabin karp algorithm

Self Learning Topics (SLTs): *String manipulations (https://www.programiz.com/cprogramming/string-handling-functions), String compression -Run Length Encoding(https://www.naukri.com/code360/library/run-length-encoding). Practice problems (Reference1: Prob 13.18)*

LABORATORY COMPONENT

List of Experiments

Experiment-I

1. Program to implement initialization of array and perform array operations
2. Program to implement searching operation on array using Binary Search
3. Program to implement sort operation on array using Bubble sort

Experiment-II

4. Program to implement Quick sort
5. Program to implement Merge sort

Experiment-III

6. Program to implement Bitonic generator sort
7. Program to implement Fibonacci search
8. Program to implement interpolation search

Experiment-IV

9. Program to perform following binary tree operations
   i) creation ii) insertion of a node iii) traversal using recursion

Experiment-V

10. Program to perform following binary tree traversal operations without recursion.
    i) Inorder ii) Preorder iii) Postorder

Experiment-VI

11. Program to perform following binary search tree operations

i) insertion ii) deletion of a node.

Experiment-VII

12. Program to implement AVL tree construction

Experiment-VIII

13. Program to implement search and insert operations on Trie

Experiment-IX

14. Program to implement heap sort

Experiment-X

15. Program to implement Graph Representations
16. Program to implement the following graph traversal techniques
    a) Depth first search b) Breadth first search

Experiment-XI

17. Program to implement Topological sort
18. Program to implement Kruskal's Algorithm

Experiment-XII

19. Program to implement Knuth - Morris - Pratt (KMP) Algorithm
20. Program to implement Boyer Moore Algorithm
21. Program to implement Rabin Karp Algorithm

Textbook(s):

1. Debasis Samanta, *Classic Data Structures*, Prentice Hall India, 2nd edition, 2009

Reference Book(s):

1. Reema Thareja, *Data Structures Using C*, Oxford University Press, 2nd edition, 2014
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C*, Pearson Education India, 2nd edition, 2002
3. E Balagurusamy, *Data Structure Using C*, McGraw Hill Education, 1st edition, 2017
4. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudo code Approach with C*, Cengage Learning, 2nd edition, 2007

Web and Video link(s):

1. https://nptel.ac.in/courses/106102064; *NPTEL Video Lecture on Data Structures and Algorithms Prof. Naveen Garg, IIT Delhi*
2. https://nptel.ac.in/courses/106106130; *NPTEL Video Lecture on Programming and Data Structures Dr. N. S. Narayana Swamy, CSE, IIT Madras*

Laboratory Manual (for laboratory component):

1. *Advanced Data Structures using C Laboratory Manual and Record Book,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT302 ADVANCED DATA STRUCTURES												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24IT302.1	2	2	2	1	-	-	-	-	-	-	2	2	2
CO2	U24IT302.2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO3	U24IT302.3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	U24IT302.4	3	3	3	2	-	1	-	-	-	-	2	3	3
CO5	U24IT302.5	2	2	2	2	-	-	1	1	1	-	2	2	2
CO6	U24IT302.6	2	2	2	2	-	-	1	1	1	-	2	2	2
CO7	U24IT302.7	3	3	3	2	-	-	1	1	1	-	2	3	3
CO8	U24IT302.8	3	3	3	2	-	1	1	1	1	-	2	3	3
U24IT302		2.5	2.5	2.5	1.87	-	1	1	1	1	-	2	2.5	2.5

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	Analyze the performance and behavior of advanced sorting/searching algorithms and tree structures to determine their suitability for different data organization and access scenarios.	SDG 4	Quality Education	Students analyze and evaluate advanced sorting, searching, and tree-based algorithms, strengthening computational thinking and problem-solving skills. The knowledge gained contributes to quality technical education (SDG 4) and supports the development of efficient software and digital infrastructure (SDG 9)
CO2	Apply operations on binary search trees, threaded binary trees, AVL trees, and red-black trees to efficiently manage hierarchical data structures	SDG 9	Industry, Innovation and Infrastructure	Binary search trees, threaded trees, AVL trees, and red-black trees are fundamental data structures used in databases, file systems, and search engines. Applying these structures enables efficient data management and supports innovation in computing infrastructure and information systems.
CO3	Analyze the structural and functional differences among heap trees, trie trees, multiway search trees, and graphs to determine their suitability	SDG 9	Industry, Innovation and Infrastructure	The study of heaps, tries, multiway search trees, and graphs develops analytical skills and a deeper understanding of data organization techniques. These structures form the foundation of indexing, retrieval, and

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	for various indexing, sorting, and traversal operations.			storage systems used in modern technological infrastructure, thereby supporting both quality education and innovation.
CO4	Analyze the efficiency and applicability of graph traversal and string matching algorithms by comparing their computational complexities and use-case scenarios.	SDG 9	Industry, Innovation and Infrastructure	Graph traversal and string matching algorithms are essential in communication networks, transportation systems, navigation applications, search engines, and smart-city solutions. Their analysis helps in designing efficient systems for information processing and urban infrastructure management, contributing to sustainable and connected communities.

SOFTWARE ENGINEERING

Class: B.Tech. III –Semester		**Branch :** IT	
Course Code :	**U24IT303**	**Credits :**	**3**
Hours/Week (L-T-P-O-E) :	**2-1-0-4-7**	**CIE :**	**60 %**
Total Number of Teaching Hours :	**36 Hrs**	**ESE :**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: apply software engineering principles and process models to develop, maintain, and enhance software solutions across different application domains and legacy systems

CO2: analyze various requirements modeling approaches and architectural styles to evaluate their impact on the quality, feasibility, and scalability of the software design

CO3: identify appropriate user interface design and software testing strategies for development of software

CO4: utilize user interface design principles and software testing strategies to develop functional, user-friendly, and reliable software applications

UNIT-I	**9 Hrs**

The Nature of Software: The nature of software, Software application domains, Legacy software

Software Engineering : Software process, Software development myths

Process Models: Prescriptive process models, Specialized process models

Principles That Guide Practice: Communication principles, Planning principles, Modeling principles, Construction principles

Self-Learning Topics (SLTs)*: Unified process (Text1: topic 4.3), Personal and team process models (Text1: topic 4.4), Deployment principles (Text1: topic 7.3.5)*

UNIT-II	**9 Hrs**

Understanding Requirements: Requirement engineering, Establishing the groundwork, Eliciting requirements, Developing use cases, Building the analysis model, Negotiating requirements, Validating requirements

Requirements Modeling: Requirements analysis, Scenario-based modeling, UML models that supplement the use case

Architectural Design: Software architecture, Architectural styles

Self-Learning Topics (SLTs): *Architectural design (Text1: topic 13.6)*

UNIT-III	**9 Hrs**

User Interface Design: The golden rules, User interface analysis and design, Web app and mobile interface design

Software Testing Strategies: Test strategies for conventional software, validation testing

Testing Conventional Applications: Software testing fundamentals, White box testing, Basis path testing, Control structure testing

Self-Learning Topics (SLTs): *System testing (Text1: topic 22.8), Black-box testing (Text1: topic 23.6)*

UNIT-IV	**9 Hrs**

Product Metrics: Measures, Metrics and indicators, Metrics for the requirements model, Metrics for the design model, Metrics for source code, Metrics for testing, Metrics for maintenance

Process and Project Metrics: Metrics in the process and project domains, Software measurement, Metrics for software quality
Project Scheduling: Project scheduling

Self-Learning Topics (SLTs): *Integrating metrics within the software process (Text1: topic 32.4), Earned value analysis(Text1: topic 34.6)*

Textbook(s):

1. Roger S. Pressman, *Software Engineering*, Tata McGraw Hill, 8th edition, 2019

Reference Book(s):

1. IAN Somerville, *Software Engineering*, Pearson Education, 6th edition, 2002
2. Deepak Jain, *Software Engineering*, Melbourne: Oxford University Press, 2008
3. Jalote and Pankaj, *Integrated Approach to Software Engineering*, New Delhi: Narosa, 1993

Web and Video link(s):

https://archive.nptel.ac.in/courses/106/105/106105182; NPTEL Video Lecture on Software Engineering by Prof. Rajib Mall, Professor of CSE, IIT Kharagpur

Course Articulation Matrix (CAM):		U24IT303 SOFTWARE ENGINEERING												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24IT303.1	2	2	-	-	-	-	-	1	-	1	1	1	-
CO2	U24IT303.2	2	2	1	1	-	-	-	1	-	1	1	-	2
CO3	U24IT303.3	2	2	2	2	1	-	-	1	-	1	2	2	-
CO4	U24IT303.4	2	2	2	2	1	-	-	1	-	1	2	2	2
U24IT303		**2**	**2**	**1.66**	**1.66**	**1**	**-**	**-**	**1**	**-**	**1**	**1.5**	**1.66**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply software engineering principles and process models to develop, maintain, and enhance software solutions across different application domains and legacy systems	SDG9	Industry, Innovation and Infrastructure	Software engineering practices and process models promote systematic software development, technological innovation, and reliable digital infrastructure across industries
CO2	Analyze various	SDG9	Industry,	Requirements engineering and

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	requirements modeling approaches and architectural styles to evaluate their impact on quality, feasibility, and scalability of software design		Innovation and Infrastructure	software architecture support scalable, efficient, and innovative software systems essential for modern industrial and technological advancement.
CO3	Identify appropriate user interface design and software testing strategies for development of software	SDG4	Quality Education	User-centred interface design and software testing strategies contribute to the development of accessible, reliable, and effective software systems used in education, training, and digital learning environments.
CO4	utilize project metrics, software quality metrics & earned value analysis for project management	SDG9	Industry, Innovation and Infrastructure	Software metrics, quality measurement, and earned value analysis support effective project planning, monitoring, quality assurance, and efficient software development practices, contributing to innovation and sustainable industrial infrastructure.

DATABASE MANAGEMENT SYSTEMS

Class: B.Tech. III –Semester		**Branch :**	IT
Course Code :	**U24IT304**	**Credits :**	**4**
Hours/Week (L-T-P-O-E) :	**2-1-2-5-10**	**CIE :**	**60 %**
Total Number of Teaching Hours :	**60 Hrs**	**ESE :**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: construct the database management system using relational data model

CO2: design the databases using ER model for the given real world problem

CO3: design the database by using normalization techniques to reduce redundancy

CO4: apply locking techniques for concurrent transactions and recover the database from failures

(based on psychomotor skills acquired from laboratory component)

CO5: evaluate SQL queries using DDL/DML/TCL/DCL commands to create and manipulate data in database by enforcing constraints

CO6: design various database objects like indices and sequence using SQL queries

CO7: develop block structured programming using cursors to retrieve, update or modify the records in the database

CO8: develop PL/SQL programs that handle exceptions, implement stored procedures & functions and create database triggers to enhance the reliability, modularity, and automation of database operations

THEORY COMPONENT

UNIT-I	**9 Hrs**

Databases and Database Users: Introduction, Characteristics of the database approach, Actors on the scene, Workers behind the scene, Advantages of using a DBMS, When not to use a DBMS

Database System Concepts and Architecture: Data models, Schemas and instances, Three-schema architecture and data independence, Database languages and interfaces, Classification of database management systems

The Relational Data Model, Relational Database Constraints: Relational model concepts, Relational constraints and the Relational database schemas, Update operations and dealing with constraint violations

Self Learning Topics (SLTs): *The database system environment (Text1: chapter 1)*

UNIT-II	**9 Hrs**

Data modeling using the Entity-Relationship Model: Using high-level conceptual data models for database design, Entity types, Entity sets, Attributes and keys, Relationships types, Relationship sets, Roles and structural constraints, Weak entity types, ER diagrams

Relational Database Design by ER-to-Relational Mapping: Relational database design using ER-to-Relational mapping

The Relational Algebra and Relational Calculus: Basic relational algebra operations, Examples of queries in relational algebra, The tuple relational calculus

Self Learning Topics (SLTs): *Enhanced entity-relationship (Text1: chapter 8), Domain relational calculus (Text1: chapter 8)*

UNIT-III	9 Hrs

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Boyce-Codd normal form, Algorithms for relational database schema design

Query Processing and Optimization: Translating SQL queries into relational algebra, Using heuristics in query optimization

Self Learning Topics (SLTs): *Multivalued dependency and fourth normal form, Join dependencies and fifth normal form (Text1: chapter 15)*

UNIT-IV	9 Hrs

Introduction to Transaction Processing Concepts and Theory: Introduction to transaction processing, Transaction and system concepts, Desirable properties of transactions, Characterizing schedules based on serializability

Concurrency Control Techniques: Two-phase locking techniques for concurrency control, Concurrency control based on timestamp ordering

Database Recovery Techniques: Recovery concepts, NO-UNDO/REDO recovery based on deferred update, Recovery techniques based on immediate update, Shadow paging

Self Learning Topics (SLTs): *Database Security and Authorization: Introduction to database security issues, Discretionary access control based on granting and revoking privileges (Text1: chapter 24)*

LABORATORY COMPONENT

List of Experiments

1. Queries on DDL and DML statements
2. Queries on TCL and DCL commands
3. Queries on column level and table level constraints
4. Queries using built-in functions of NUMBER, CHARACTER, DATE Data types
5. Queries on single row functions and operators and aggregate functions
6. Queries on joins and nested queries
7. Develop SQL statements to create simple, composite indexes, user-defined data types, views, sequences
8. Develop sample PL/SQL programs using conditional and iterative statements
9. Develop PL/SQL programs using cursors and parameterized cursors
10. Develop PL/SQL programs to handle exceptions
11. Develop PL/SQL programs using stored procedures and functions
12. Develop PL/SQL programs for creating triggers

Textbook(s):

1. Ramez Elmasri and Shamkanth B. Navathe, *Fundamentals of Database Systems*, Pearson Education, 6th edition, 2010

Reference Book(s):

1. Raghu Ramakrishnan and Johannes Gehrke, *Database Management Systems*, McGraw-Hill

Education, 3rd edition, 2002

2. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, *Database System Concepts*, McGrawHill Education, 3rd edition, 1997
3. Thomas Connolly and Carolyn Begg, *Database Systems*, Pearson Education, 3rd edition, 2003

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview; *NPTEL Video Lecture: DataBase Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur*

Laboratory Manual (for laboratory component):

1. *Database Management Systems Laboratory Manual and Record Book,* Department of IT, KITSW

Course Articulation Matrix (CAM):		**U24IT304 DATABASE MANAGEMENT SYSTEMS**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24IT304.1**	2	1	2	1	-	-	-	-	-	-	-	2	1
CO2	**U24IT304.2**	2	1	2	1	-	-	-	-	-	-	-	2	1
CO3	**U24IT304.3**	2	1	2	2	-	-	-	-	-	-	-	2	1
CO4	**U24IT304.4**	2	1	1	1	-	-	-	-	-	-	-	1	1
CO5	**U24IT304.5**	2	1	2	1	1	1	1	-	-	-	-	2	1
CO6	**U24IT304.6**	2	1	2	1	1	1	1	-	-	-	-	2	1
CO7	**U24IT304.7**	1	1	1	1	1	1	1	-	-	-	-	1	1
CO8	**U24IT304.8**	2	1	2	1	1	1	1	-	-	-	-	2	2
U24IT304		**1.87**	**1**	**1.75**	**1.2**	**1**	**1**	**1**	-	-	-	-	**1.75**	**1.12**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	construct DBMS using relational data model	SDG 9	Industry, Innovation and Infrastructure	Building efficient databases supports digital infrastructure and innovation in industries by enabling reliable data storage and retrieval
CO2	design databases using ER model for real-world problems	SDG 11	Sustainable Cities & Communities	ER modeling helps design systems for urban management (transport, healthcare, utilities), contributing to smart and sustainable cities
CO3	design databases using normalization techniques to reduce redundancy	SDG 9	Industry, Innovation and Infrastructure	Normalization ensures optimal resource use (storage, processing), reducing waste and promoting sustainable data management practices

CO4	apply locking techniques for concurrent transactions and recover databases from failures	SDG 9	Industry, Innovation and Infrastructure	Reliable transaction management ensures integrity, transparency, and trust in institutional data systems (e.g., banking, governance)

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Class: B.Tech. III –Semester			**Branch**	**:**	IT
Course Code	**:**	**U24IT305**	**Credits**	**:**	**4**
Hours/Week (L-T-P-O-E)	**:**	**2-1-2-5-10**	**CIE**	**:**	**60%**
Total Number of Teaching Hours	**:**	**60 Hrs**	**ESE**	**:**	**40%**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: examine the strengths and limitations of various programming paradigms, including object-oriented and modular programming, to determine their suitability for solving different types of programming problems in Java

CO2: evaluate the advantages and limitations of different string handling classes (String, StringBuffer, StringBuilder, StringTokenizer) and object-oriented concepts to optimize performance and memory management in Java applications

CO3: utilize inheritance, interfaces, and packages in Java to design modular, reusable, and maintainable code by implementing object-oriented principles and managing class relationships

CO4: apply different exception handling mechanisms and multithreading approaches in Java to determine their impact on application stability, error management, and performance

(based on psychomotor skills acquired from laboratory component)

CO5: develop solutions using for-each loops, exception handling, and other Java features to create functional programs for data manipulation, user input processing, and matrix operations

CO6: develop java programs using classes, constructors and various string operations to solve practical problems

CO7: develop java programs that demonstrate the use of inheritance method overriding, dynamic method dispatch, abstract classes, and interfaces, along with practical application of the super keyword, equals() method, and nested interfaces to design modular and reusable code

CO8: develop java programs that demonstrate package creation and importing, exception handling using try-catch, throw, and throws clauses, file I/O operations with byte and character streams, multithreading with synchronization, and implement real-world problems like producer-consumer and thread synchronization for concurrent programming

THEORY COMPONENT

UNIT-I	**9 Hrs**

Programming Paradigms: Procedural programming, Modular programming, Object oriented programming (OOP), Generic programming

Java Basics: An overview of java, Data types, Variables and arrays, Operators, Control statements

Introducing Classes: Class fundamentals, Declaring objects, Object reference variables, Introducing methods

Self Learning Topics (SLTs): *The history and evolution of Java, Lexical issues like keywords, identifiers, literals and comments (Text1: Chapter 2), Type conversions and casting (Text1: Chapter 3)*

UNIT-II	9 Hrs

Classes and Methods: Overloading methods, *this* keyword, Passing and returning objects, Recursion, Variable length arguments, Constructors, Overloading constructors, Garbage collection, Static variables, Static blocks, Static methods, Nested and inner classes, Command line arguments, Wrapper classes

Strings: Exploring String, StringBuffer, StringBuilder and StringTokenizer classes

Self Learning Topics (SLTs): *Overloading vararg methods, Varargs and ambiguity(Text1: Chapter 7), Anonymous inner classes(Text1: Chapter 25)*

UNIT-III	9 Hrs

Inheritance: Inheritance basics, Types of inheritance, Using *super*, Method overriding, Order of constructors execution, Dynamic method dispatch, Abstract classes, *final* with inheritance, Object class

Interfaces: Defining an interface, Implementing interfaces, Nested interfaces, Variables in interfaces, Extending interfaces

Packages: Defining a package, Packages and member access, Importing packages

Self Learning Topics (SLTs): *Accessing implementations through interface references*, *Default interface methods, Use static methods in an interface, private interface methods (Text1: Chapter 9)*

UNIT-IV	9 Hrs

Using I/O: I/O basics, Reading, Writing and copying files using byte and character streams

Exception Handling: Fundamentals, Exception types, Uncaught exceptions, Using *try* and *catch*, Multiple catch clauses, Nested try statement, *throw*, *throws*, *finally* keywords, Creating your own exception subclasses.

Multithreading: Creating a thread, Creating multiple threads, Thread priorities, Synchronization, Inter-thread communication

Self Learning Topics (SLTs): *try-with resource, multi catch, chained exception, precise rethrow (Text1: Chapter 10), Serialization: Writing and reading objects to and from the file-(Text1: Chapter 22)*

LABORATORY COMPONENT

List of Experiments

Experiment-I

1. Develop a program to demonstrate different operators in java
2. Develop a program to demonstrate control structures i.e. different forms of if statement and switch statement in java.

Experiment-II

3. Develop a program to read an array, calculate sum of those elements and display input array along with the result using *for-each* loop
4. Develop a program to read a matrix and display whether it is an identity matrix or not. Use *civilized form* of *break* statement
5. Develop a program to define a two dimensional (2D) array where each row contains different number of columns i.e. jagged array & display the 2D-array using *for-each loop*.

Experiment-III

6. Develop a program to define a student class with data members rollno, name, branch, total marks and member functions to read and display the student details
7. Develop a program to demonstrate *this* keyword

8. Develop a program to demonstrate object reference variable
9. Develop a program to illustrate overloading of methods
10. Develop a program to demonstrate passing and returning objects

Experiment-IV

11. Develop a program to demonstrate variable length argument (using array and ellipsis notation)
12. Develop a program to illustrate constructors overloading and garbage collection
13. Develop a program to demonstrate nested and inner classes
14. Develop a program to demonstrate *static* variables, *static* methods, and *static* blocks

Experiment-V

15. Develop a program to read at least five strings from command line argument and display them in sorted order

16. Develop a program to demonstrate wrapper class by reading N number of integers from command line and display their sum
17. Develop a program to demonstrate wrapper class by reading N floating point numbers from command line and display their average

Experiment-VI

18. Develop a program to accept a string, count number of vowels and remove all vowels
19. Develop a program to accept a string, count number of vowels and remove all vowels using *StringBuffer* class
20. Develop a program to accept a line of text, tokenize the line using *StringTokenizer* class and print the tokens in reverse order

Experiment-VII

21. Develop a program to demonstrate single level-inheritance
22. Develop a program to demonstrate multilevel-inheritance using *super* keyword
23. Develop a program to demonstrate method overriding

Experiment-VIII

24. Develop program to demonstrate dynamic method dispatch
25. Develop a program to demonstrate use of abstract class
26. Develop a program to demonstrate the use of overriding *equals()* method of an Object class

Experiment-IX

27. Develop a program to demonstrate interfaces and extending interfaces
28. Develop a program to demonstrate implementation of nested interfaces

Experiment-X

29. Develop a program to create a package and demonstrate to import that *package* into any java program (Consider the behavior of all access specifiers)

Experiment-XI

30. Develop a program to demonstrate *try-catch* block
31. Develop a program to demonstrate *throw* clause
32. Develop a program to demonstrate *throws* clause
33. Develop a program to demonstrate *re-throw* an exception, and *finally* block

Experiment-XII

34. Develop a program to demonstrate read/write/copy a file using *byte stream* and also using

character stream

35. Create two threads using Thread class or Runnable interface. One thread displays "Hello" for every half second and another thread displays "Hai" for every second
36. Create an Account class which implements deposit, withdrawal and getBalance operations. Provide locking such that account details are consistent when these operations are invoked by the account holders simultaneously who have shared account
37. Develop a solution for producer-consumer problem using thread synchronization and communication, where a producer produces a set of integers and consumer consumes those integer

Textbook(s):

1. Herbert Schildt, *Java The Complete Reference*, McGraw-Hill Education, New Delhi, 13th edition, 2019

Reference Book(s):

1. Herbert Schildt, Dale Skrien, *Java Fundamentals (A Comprehensive Introduction)*, McGraw-Hill Education, New Delhi, national edition, 2013
2. Balaguruswamy, *Programming with Java: A Primer*, McGraw-Hill Education India Pvt. Ltd., New Delhi, 7th edition, 2019
3. KathySierra and BertBates, *Head First Java*, O'Reilly Publications, 2nd edition, 2005
4. Harvey Deitel, Paul J. Deitel, *Java How to Program*, Pearson Publications, 11th edition, 2018

Web and Video link(s):

1. https://nptel.ac.in/courses/106105191; *NPTEL Video Lecture on Java Programming* by Prof. Debasis Samanta, Professor of CSE, IIT Kharagpur

Laboratory Manual (for laboratory component):

1. *Object Oriented Programming through Java Manual and Record Book,* Department of IT, KITSW

Course Articulation Matrix (CAM):		**U24IT305 OBJECT ORIENTED PROGRAMMING THROUGH JAVA**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24IT305.1**	2	2	2	-	-	-	-	-	-	-	1	1	1
CO2	**U24IT305.2**	2	2	2	-	-	-	-	-	-	-	1	1	1
CO3	**U24IT305.3**	2	2	3	-	-	-	-	-	-	-	1	2	2
CO4	**U24IT305.4**	2	2	3	-	-	-	-	-	-	-	1	2	2
CO5	**U24IT305.5**	1	1	1	-	1	-	1	1	1	-	1	1	1
CO6	**U24IT305.6**	1	2	2	-	2	-	1	1	1	-	1	1	1
CO7	**U24IT305.7**	1	2	3	-	2	-	1	1	1	-	1	2	2
CO8	**U24IT305.8**	1	2	3	-	2	-	1	1	1	-	1	2	2
U24IT305		**1.5**	**1.87**	**2.37**	**-**	**1.75**	**-**	**1**	**1**	**1**	**-**	**1**	**1.5**	**1.5**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	examine the strengths and limitations of various programming paradigms, including object-oriented and modular programming, to determine their suitability for solving different types of programming problems in Java	SDG 9	Industry, Innovation and Infrastructure	Selecting appropriate paradigms fosters innovative, efficient, and scalable software solutions, strengthening digital infrastructure and industrial innovation
CO2	evaluate the advantages and limitations of different string handling classes (String, StringBuffer, StringBuilder, StringTokenizer) and object-oriented concepts to optimize performance and memory management in Java applications	SDG 9	Industry, Innovation and Infrastructure	Efficient string handling and memory management reduce computational waste, promoting sustainable resource use in software systems
CO3	utilize inheritance, interfaces, and packages in Java to design modular, reusable, and maintainable code by implementing object-oriented principles and managing class relationships	SDG 11	Sustainable Cities & Communities	Designing reusable and maintainable code enhances productivity, supports scalable enterprise applications, and contributes to economic growth through better work practices
CO4	apply different exception handling mechanisms and multithreading approaches in Java to determine their impact on application stability, error management and performance	SDG 9	Industry, Innovation and Infrastructure	Robust error management and stable multithreaded applications ensure trustworthy digital systems, supporting transparency, reliability, and strong institutional frameworks

SOFT AND INTERPERSONAL SKILLS

Class: B.Tech. III –Semester		**Branch :**	IT
Course Code :	**U24VA306B**	**Credits :**	**1**
Hours/Week (L-T-P-O-E) :	**0-0-2-0-2**	**CIE :**	**100 %**
Total Number of Teaching Hours :	**24 Hrs**	**ESE :**	**-**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: introspect to convert strengths into opportunities, identify weaknesses, and bypass threats
CO2: present views on various issues confidently in a group
CO3: make effective PPT presentations, synthesize videos
CO4: prepare a professional resume; communicate effectively to attain better opportunities

Old		Revised
Activity 1	Team interaction	Reading Comprehension
Activity 2	SWOT analysis	Video Synthesis
Activity 3	Debate	GD1
Activity 4	Group Discussion	Presentations through PPTs
Activity 5	Presentations through PPTs	Self-Introduction
Activity 6	Video Synthesis	JAM
Activity 7	Resume Writing	Email Etiquette
Activity 8	Email Etiquette	Resume Writing
Activity 9	Self-Introduction	Interview Etiquette
Activity 10	Oral presentation	"My Career Plan" SWOT Analysis

Text Book(s):

1. Krishna Mohan & Meera Benerji, *Developing Communications Skills* , Mcmillan Publications, New Delhi, 2005
2. Alex.K, *Soft Skills,* S. Chand Publications, New Delhi, 2010
3. Raman &Meenakshi, *Soft skills Cornerstone of Professional success* , Jain Brothers Publications, New Delhi, 2009

Reference Book(s):

1. https://onlinecourses.nptel.ac.in/noc19_hs20/preview
2. https://onlinecourses.nptel.ac.in/noc18_hs30/preview

Course Articulation Matrix (CAM) :		U24VA306B - SOFT AND INTERPERSONAL SKILLS												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2
CO1	U24VA306B.1	-	-	-	-	-	-	-	-	2	3	-	-	-
CO2	U24VA306B.2	-	-	-	-	-	-	-	2	3	3	-	-	-
CO3	U24VA306B.3	-	-	-	-	-	-	-	-	2	3	-	-	-
CO4	U24VA306B.4	-	-	-	-	-	-	-	1	2	3	-	-	-
U24VA306B		-	-	-	-	-	-	-	1.5	2.25	3	-	-	-

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	introspect to convert strengths into opportunities, identify weaknesses, and bypass threats	SDG 4	Quality Education	Self-awareness and introspection foster lifelong learning and personal growth
CO2	present views on various issues confidently in a group	SDG 16	Peace, Justice & Strong Institutions	Confident group communication builds participatory decision-making, inclusivity, and strong institutions through dialogue and collaboration
CO3	make effective PPT presentations, synthesize videos	SDG 9	Industry, Innovation and Infrastructure	Effective use of digital tools and multimedia enhances innovation, knowledge dissemination, and supports modern infrastructure in education and industry
CO4	prepare a professional resume; communicate effectively to attain better opportunities	SDG 8	Decent Work & Economic Growth	Resume building and communication skills directly contribute to employability, career advancement, and economic growth through better access to decent work opportunities

PRACTICUM

Class: B.Tech. III –Semester			**Branch**	**:** IT	
Course Code	**:**	**U24EL308**	**Credits**	**:**	**1**
Hours/Week (L-T-P-O-E)	**:**	**0-0-0-4-4**	**CIE**	**:**	**100 %**
Total Number of Teaching Hours	**:**	**-**	**ESE**	**:**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: synthesize literature survey, identify research gaps and define objective & scope of practicum problem

CO2: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system

CO3: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

CO4: create a video pitch on practicum and make an effective oral presentation using PPTs

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i) Practicum is a mandatory semester project work.

(ii) Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii) Allotment of Practicum topics for students:

- **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24IT301	U24IT302	U24IT303	U24IT304	U24IT305
Students allotted to different courses	B24IT001	B24IT014	B24IT027	B24IT040	B24IT053
	B24IT002	B24IT015	B24IT028	B24IT041	B24IT054
	B24IT003	B24IT016	B24IT029	B24IT042	B24IT055
	B24IT004	B24IT017	B24IT030	B24IT043	B24IT056
	B24IT005	B24IT018	B24IT031	B24IT044	B24IT057
	B24IT006	B24IT019	B24IT032	B24IT045	B24IT058
	B24IT007	B24IT020	B24IT033	B24IT046	B24IT059
	B24IT008	B24IT021	B24IT034	B24IT047	B24IT060
	B24IT009	B24IT022	B24IT035	B24IT048	B24IT061
	B24IT010	B24IT023	B24IT036	B24IT049	B24IT062
	B24IT011	B24IT024	B24IT037	B24IT050	B24IT063
	B24IT012	B24IT025	B24IT038	B24IT051	B24IT064
	B24IT013	B24IT026	B24IT039	B24IT052	

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

CIRCULAR

Allotment of Practicum topics to students

Section : …….

S.No.	Roll number of the student	Practicum topic allotted	Practicum under the course	Course faculty

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the class work time table and also outside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

(Signature of class teacher)

****

(iv) ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the class work timetable and outside the class work hours during weekdays.***

(v) There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi) The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii) The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii) Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix) A sample rubrics for assessment and evaluation of practicum is as follows:

Literature survey & Identification of research gaps	10 marks
Working model / process / software package / system developed	30 marks
Report writing (subjected to max of 30% plagiarism)	20 marks
Oral presentation with PPT and viva-voce	20 marks
Video pitch	20 marks
Total	100 marks

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(a) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(b) **Working Model**: Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and PPT presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggest for addressing the identified gaps for future work?

(d) **Anti-Plagiarism Check:** The practicum report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacher as per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce
ii) he/she fails to submit the report in prescribed format
iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

Course Articulation Matrix (CAM):		**U24EL308 PRACTICUM**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EL308.1**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	**U24EL308.2**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	**U24EL308.3**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	**U24EL308.4**	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL308		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course code U24ELXYY: ***X represents semester, YY represents ETA course serial number***

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Synthesize literature survey, identify research gaps, and define objective & scope of practicum problem	SDG 4	Quality Education	Literature surveys and gap identification strengthen research and analytical skills, directly contributing to quality education. Defining objectives and scope fosters innovation and supports sustainable infrastructure development
CO2	Apply knowledge to design & conduct experiments, utilize	SDG 8	Decent Work & Economic	Practical experimentation and tool usage enhance

	modern tools for solution of practicum problem, and develop working model/process/system		Growth	employability and productivity, aligning with decent work. Developing models and systems promotes innovation and industrial advancement
CO3	Demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum	SDG 4	Quality Education	Preparing structured reports improves communication and documentation skills, essential for quality education
CO4	Create a video pitch on practicum and make an effective oral presentation using PPTs	SDG 4	Quality Education	Effective presentations and video pitches foster collaboration, partnerships, and dissemination of knowledge. These communication skills strengthen education outcomes and enable cross-sector partnerships

SOCIAL EMPOWERMENT ACTIVITY / SELF ACCOMPLISHMENT ACTIVITY (SEA/SAA)			
Class: B.Tech. III Semesters	**Branch:** Common to all branches		
Course Code :	**U24VA309(SE/SA)ZZZ**	**Credits :**	**1**
Hours/Week (L-T-P-O-E) :	**0-0-0-2-2**	**CIE :**	**100%**
Total Number of Teaching Hours :	**-**	**ESE :**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility

CO2: interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner

CO3: analyze the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility

CO4: demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) is introduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual and social aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses, which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (Self Accomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester, through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfill performance requirements, he/she shall be dropped from the course and shall have to enroll in the forthcoming semesters.

Monitoring SEA/SAA:

(a) **Nodal units:** The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE)shall act as nodal units for activities listed under SEA/SAA.

(b) During the semester period, the student has to **acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) **Knowledge Acquisition& Skilling**:

i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyze the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

iii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

Eminent personalities/ Achievers / Renowned personalities:

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interact eminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ix.

x. On fieldwork, student is expected to demonstrate solid time management,

organizational and note taking skills during fieldwork

xi.

xii. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xiii.

xiv. Student is expected to take care of health and Safety practices for fieldwork and travel

xv. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xvi.

xvii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practice sessions, if any) shall be appended as annexure in the report to be submitted for course evaluation.

xviii.

xix. **Feedback:** The learning, the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counselor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counselor approval***: In week (-1), in consultation with faculty counselor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii.

iii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action

plan (oriented workflow) for attaining the identified goals.

iv.

v. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counselor and the nodal centre.

vi.

vii. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

viii.

ix. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counselor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

x.

(g) ***Assessment & Evaluation:*** There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counselors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

Assessment	Maximum marks	Marks to be awarded by
Goal setting, Planning& Knowledge Acquisition	20	Nodal centre
Field work	40	Nodal centre
Demonstration/Presentation	20	Nodal centre
Report submission	20	Faculty counselor
Total	**100**	**-**

Note:

(a) **Presentation/ Demonstration:** It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in

consultation with the coordinator with due permission from Head of the department.

(b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**

b. scores a minimum of 40 marks in the CIE of the course

(e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Text / Reference book(s):

For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator

Course Code: **U24VA XYY(SE/SA)ZZZ**

X represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 *SEA/SAA course serial number: 09* *SEA/SAA category: SEA* *course number: 302* The **course code** will be U24VA109SE302	*Semester: 4* *SEA/SAA course serial number: 10* *SEA/SAA category: SAA* *course number: 206* The **course code** will be U24VA410SA206

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility	SDG 4	Quality Education	Demonstrating social sensibility strengthens education outcomes by fostering empathy and inclusivity
CO2	Interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner	SDG 10	Reduced Inequalities	Effective, culturally sensitive communication reduces inequalities by respecting diversity

CO3	Analyze the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility	SDG 10	Reduced Inequalities	Addressing social empowerment issues promotes equality and justice. Problem-solving and solution articulation contribute to reducing inequalities and strengthening institutions through socially responsible practices
CO4	Demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning	SDG 4	Quality Education	Preparing reports and presentations enhances communication and documentation skills, vital for quality education

EXPERT TALK SERIES

Class: B.Tech. III –Semester			**Branch**	:	Common to all branches
Course Code	:	**U24AE310**	**Credits**	:	**1**
Hours/Week (L-T-P-O-E)	:	**0-0-0-1-1**	**CIE**	:	**100 %**
Total Number of Teaching Hours	:	**-**	**ESE**	:	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

CO2: identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

CO3: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO4: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples, is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximized if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

But how would you know all this without venturing into the industry?

(e) The answer is Industry **Expert Talk Series (ETS)**.Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(f) Through Industry expert talks students get to know so much more that textbooks don't explain.

(g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(h) Our competency- focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(m) ETS enhances your learning in many ways for global opportunities for your career.

(n) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(o) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks(10 MCQs/FiBs; *duration: 10-15 mins*), on the contents covered in the expert talk.

(vii)

(viii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(ix)

(x) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(xi) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(xii) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xiii) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

Quiz score (*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*)	60 marks
Attendance (*out of 10 quizzes*)	20 marks
Report in prescribed format (*max 30% plagiarism*)	20 marks
Total	100 marks

i. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

ii. Supplementary Exam:

(a) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE

(b) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; *duration: 2Hrs*)on the content covered in ETS lectures.

(c) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(d) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Articulation Matrix (CAM):		**U24AE310 EXPERT TALK SERIES**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	U24AE310.1	1	1	1	1	1	1	1	2	1	2	1	1	1
CO2	U24AE310.2	1	1	1	1	1	1	1	2	1	2	1	1	1
CO3	U24AE310.3	1	1	1	1	1	1	1	2	1	2	1	1	1
CO4	U24AE310.4	1	1	1	1	1	1	1	2	1	2	1	1	1
U24AE310		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course code U24AEXYY: ***X represents semester, YY represents ETA course serial number***

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new	SDG 8	Decent Work & Economic Growth	Awareness of industry requirements and emerging roles enhances employability and supports economic growth

	opportunities by staying up-to-date with industry knowledge, trends and technology			
CO2	Identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement	SDG 4	Quality Education	Recognizing and improving employability skills contributes to lifelong learning and quality education
CO3	Interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects	SDG 4	Quality Education	Improved communication and confidence strengthen educational outcomes and open pathways to internships and jobs
CO4	Demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks	SDG 4	Quality Education	Preparing structured reports enhances documentation and reflective learning, supporting quality education

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
Estd-1980 KITSW
DEPARTMENT OF INFORMATION TECHNOLOGY

4th Semester Syllabi

B. Tech (IT) –CURRICULUM & SYLLABUS (KITSW-URR24)

IV SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	BSC	U24MH401D	Discrete Mathematics and Probability Statistics *(from Pool-V)*	2	1	-	3	3
2	PCC	U24IT402	Design and Analysis of Algorithms	2	1	-	3	3
3	PCC	U24IT403	Python Programming	2	1	-	3	3
4	PCC	U24IT404	Operating Systems	2	1	-	3	3
5	PCC	U24IT405	Computer Networks	2	1	-	3	3
6	VAC	U24VA406A	Quantitative Aptitude and Logical Reasoning	2	-	-	2	2
7	SEC	U24SE407	Programming Skill Development Lab – 3	-	-	2	2	1
8	PCC	U24IT408	Design and Analysis of Algorithms Laboratory	-	-	2	2	1
9	PCC	U24IT409	Python Programming Laboratory	-	-	2	2	1
10	PCC	U24IT410	Operating Systems Laboratory	-	-	2	2	1
11	VAC*	U24CY411*	Environmental Studies*	2*	-	-	2*	-
			Total:	12	5	8	25	21
			Additional Learning@:Maximum credits allowed for Honours/Minor	-	-	-	-	5
			Total credits for Honours/Minor students:	-	-	-	-	26
			Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)	-	-	-	-	-

For Lateral Entry Students Only

T&P Basket		
S. No.	**Course Code**	**Course Title**
1.	U24VA406A	Quantitative Aptitude and Logical Reasoning
2.	U24VA406B	Soft and Interpersonal Skills

Branch Specific Mathematics (Pool-V)		
S. No.	**Course Code**	**Course Title**
1.	U24MH401A	Numerical and Statistical Methods *(for Civil Engineering)*
2.	U24MH401B	Applied Mathematics *(for Mechanical Engineering)*
3.	U24MH401C	Applied Mathematics *(Common to ECI, EEE & ECE)*
4.	U24MH401D	Discrete Mathematics and Probability Statistics *(Common to CSE, CSN, CSO & IT)*
5.	U24MH401E	Essential Mathematics and Statistics for Machine learning *(for CSM)*
6.	U24MH401F	Essential Mathematics and Statistics for Data science *(for CSD)*

DISCRETE MATHEMATICS AND PROBABILITY STATISTICS

Class: B.Tech. IV –Semester		**Branch: IT**	
Course Code:	**U24MH401D**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : *apply fundamentals of logic to solve various engineering problems*

CO2 : *solve different types of enumeration problems and apply them to real-life scenarios*

CO3 : *solve various graph theory problems and apply them to real-world applications*

CO4 : *interpret the data using various statistical measures and probability distributions*

UNIT-I	**9 Hrs**

Foundation: Sets and operations on sets, Relations, Binary relations, Equivalence relations, Partial order relations, Hasee diagram and lattices, Digraphs, Adjacency matrices of binary relations.

Fundamentals of Logic: Propositions and connectives, Truth tables, Propositional functions, Logical inferences, First order logic, Predicate calculus and quantified logic.

Application: Transitive closure of a relation using Warshal's algorithm.

Self-Learning Topics (SLTs): *Monoids, Groups. (Ref 2: topic 3.2), Pigeonhole principle (Text 1: topic 1.7, problems1.7.13(2, 3, 4)), Mathematical Induction (Text 1: topic 1.10, problems 1.10.1, 1.10.3, 1.10.6)*

UNIT-II	**9 Hrs**

Elementary Combinatorics and Recurrence Relations: Basic concepts of permutations and combinations, Enumeration with unlimited repetition and applications, Enumeration with constrained repetitions and applications.

Generating function of sequences: Coefficients of generating function, Recurrence relations and its applications, Solutions of recurrence relations by method of substitution, Characteristic roots, Solving non-linear recurrence relations**.**

Application: Using recurrence relations find the computational complexity of binary search, Towers of Hanoi problem, and Sorting.

Self-Learning Topics (SLTs):

Solutions of recurrence relations by generating function method (Text 1, topic:3.4, problems: 3.4.4, 3.4.5)

Additional problems on recurrence relations (Text 1, topics:3.5 and 3.6, problems:3.5.5, 3.5.6, 3.6.6, 3.6.8, 3.6.10)

UNIT-III	**9 Hrs**

Graphs:

Basic concepts, Isomorphism, Sub graphs, Trees and their properties, Spanning trees, Binary trees, Planner graphs, Euler's formula, Multi graphs and Eulerian circuits, Hamiltonian graphs, Chromatic number, Four color problem.

Applications: Find the shortest path of a network problem.

Self-Learning Topics (SLTs): *Additional problems on* isomorphism *of two graphs (Text 1, topic:5.2, problems:5.2.3, 5.2.4, 5.2.5)*

UNIT-IV	**9 Hrs**

Statistics: Correlation, Rank correlation, Regression – Linear regression equations.

Curve Fitting: Method of least squares –fitting of (i) Straight line (ii) Second degree parabola.

Probability: Random variables, Discrete and continuous probability distributions, mean and variance of a distribution, Binomial distribution, Poisson distribution, Normal and Exponential distributions.

Applications: Fitting of Binomial distribution, Poisson distribution to the given real time data.

Self-Learning Topics (SLTs):

Review of the concepts of probability (Text2, topic:26.4 and 26.5, problems:26.15, 26.20, 26.25), Conditional probability and Bayes theorem (Text 2, topic:26.6, problems: 26.26, 26.27), Normal distribution (Text 2, topic:26.16, problems:26.45, 26.47, 26.48), Uniform, exponential distributions (Text 2, topic:26.19)

Textbook(s):

1. Mott. J.L, Kandel. K and, Baker. T.P., *Discrete Mathematics for Computer Scientists*, PHI 2/e, New Delhi,1999. (*Unit I, Unit II and Unit III*)
2. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, 44/e, Delhi, 2017. (*Unit IV)*

Reference Book(S):

1. Gupta. S.C and Kapoor. V. K, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi, 2020.
2. Tremblay, J, P, Manohar.R *Discrete Mathematical Structures with Applications to Computer Science*, MGH New York, 1977.
3. Zohar Manna., *Mathematical Theory of Computation*, , MGH, New Delhi
4. C. L. Liu , *Elements of Discrete mathematics*, 3/e, Tata Mc. Graw Hill,2008.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc25_cs26/course: *NPTEL Video Lecture on Discrete Mathematics by Prof. Sudarshan Iyengar, IIT Ropar*
2. https://onlinecourses.nptel.ac.in/noc25_ma33/preview?user_email=dsreddy.hari@gmail.com: *NPTEL Video Lecture on Introduction to Probability Theory and Statistics by Prof. S Dharmaraja, IIT Delhi*

Course Articulation Matrix (CAM):		**U24MH401D : DISCRETE MATHEMATICS AND PROBABILITY STATISTICS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24MH401D.1**	2	2	1	1	-	-	-	1	1	-	1		
CO2	**U24MH401D.2**	2	2	1	1	-	-	-	1	1	-	1		
CO3	**U24MH401D.3**	2	2	1	1	-	-	-	1	1	-	1		
CO4	**U24MH401D.4**	2	2	1	1	-	-	-	1	1	-	1		
U24MH401D		**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**		
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply fundamentals of logic to solve various engineering problems	SDG9	Industry, Innovation and Infrastructure	Using logical, analytical, and computational skills (algorithms, systems modeling) is essential for developing new technologies, automation, and AI-driven solutions.
CO2	Solve different types of enumeration problems and apply them to real-life	SDG9	Industry, Innovation and Infrastructure	Enumerative combinatorics (counting possibilities) is critical for optimization, efficiency, and resource

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	scenarios			allocation in industrial and logistical processes.
CO3	Solve various graph theory problems and apply them to real-world applications	SDG9	Industry, Innovation and Infrastructure	Graph theory is used to model and optimize transportation networks, power grids, and communication systems.
CO4	Interpret the data using various statistical measures and probability distributions.	SDG4 & SDG9	Quality Education & Industry, Innovation and Infrastructure	Interpreting data using statistical measures and probability distributions involves summarizing dataset characteristics using descriptive metrics, determining the underlying distribution that generated the data, and justifying the choice by mapping the data type to the appropriate theoretical probability model.

DESIGN AND ANALYSIS OF ALGORITHMS

Class: B.Tech. IV –Semester		**Branch**	**:** IT
Course Code :	**U24IT402**	**Credits :**	**3**
Hours/Week (L-T-P-O-E) :	**2-1-2-5-10**	**CIE :**	**60%**
Total Number of Teaching Hours :	**60 Hrs**	**ESE :**	**40%**

Course Learning Outcomes (COs):
This course will develop students' knowledge in /on…

CO1: examine the efficiency of algorithms by analyzing time, space, and amortized complexities, and evaluate the effectiveness of divide and conquer strategies and disjoint set operations in solving computational problems
CO2: analyze problem-solving approaches based on greedy and dynamic programming strategies to determine their applicability, correctness, and efficiency in optimizing computational tasks
CO3: develop algorithmic solutions using dynamic programming and backtracking techniques to address complex problems such as optimal binary search trees, TSP, string editing, and constraint satisfaction problems like 8-Queens and graph coloring
CO4: develop algorithmic strategies using branch and bound for solving optimization problems such as 0/1 knapsack and traveling salesperson, and simulate nondeterministic approaches to address NP-complete problems.

UNIT-I	**9 Hrs**

Introduction: Algorithm specification, Performance analysis: Space complexity, Time complexity, Amortized complexity, Asymptotic notation (O, Ω, Θ), Practical complexities, Performance measurement
Elementary Data Structures: Sets and disjoint set union: Introduction, Union and find operations
Divide and Conquer: General method, Defective chessboard, Finding the maximum and minimum, Performance Measurement, Randomized sorting algorithms, Strassen's matrix multiplication

Self Learning Topics (SLTs): *Introduction to algorithms (Reference1: topics 1.1 to 1.6), Merge sort, Quick sort methods (Reference1: topics 8.2, 8.3)*

UNIT-II	**9 Hrs**

Greedy Method: The General method, Container loading, Knapsack problem, Tree vertex splitting, Job sequencing with deadlines, Optimal storage on tapes, Optimal merge patterns, Single source shortest paths
Dynamic Programming: The General method, Multistage graphs, All-pairs shortest paths, Single source shortest paths: General weights

Self Learning Topics (SLTs): *Greedy method and its applications (Reference2: chapter 19), Spanning trees (Text1: chapter 4, topic 4.6), Shortest path methods (Text1: chapter 5)*

UNIT-III	**9 Hrs**

Dynamic Programming: Optimal binary search trees, String editing, 0/1 knapsack, Reliability design, The traveling salesperson problem, Flow shop scheduling
Backtracking: The general method, 8–Queens problem, Sum of subsets, Graph coloring, Hamiltonian cycles, Knapsack problem

Self Learning Topics (SLTs): *Binary search trees (Reference2: chapter 13), Backtracking and applications (Text1: chapter 7)*

UNIT-IV	9 Hrs

Branch and Bound: The method: Least cost (LC) search, The 15-puzzle: An example, Control abstractions for LC-search, 0/1 knapsack problem, Traveling salesperson

NP-Hard and NP-Complete Problems: Basic concepts: Nondeterministic algorithms, The classes NP-hard and NP-complete, NP-Hard graph problems: Clique decision problem (CDP), Node cover decision problem (NCDP), Traveling salesperson decision problem (TSP)

Self Learning Topics (SLTs): *Graph coloring methods (Text1: chapter 7), Introduction to NP-Hard and NP-Complete problems (Text1: chapter 11), Introduction to COOK's theorem (Text1: chapter 11, topic.11.2)*

Textbook(s):

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Universities Press, 2nd edition, 2008

Reference Book(s):

1. S. Sridhar, *Design and Analysis of Algorithms*, Oxford University Press, 1st edition, 2014
2. Gajendra Sharma, *Design & Analysis of Algorithms*, Khanna Books Publishing, 4th edition, 2019

Web and Video link(s):

1. https://nptel.ac.in/courses/106101060; *NPTEL Video Lecture on Design and Analysis of Algorithms by Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan, IIT Bombay*
2. https://nptel.ac.in/courses/106106131; *NPTEL Video Lecture on NOC:Design and Analysis of Algorithms by Prof. Madhavan Mukund, Chennai Mathematical Institute*

Course Articulation Matrix (CAM):		U24IT402 : DESIGN AND ANALYSIS OF ALGORITHMS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT402.1	2	2	2	-	-	-	-	-	-	-	1	1	1
CO2	U24IT402.2	2	2	2	-	-	-	-	-	-	-	1	1	1
CO3	U24IT402.3	2	2	3	-	-	-	-	-	-	-	1	2	2
CO4	U24IT402.4	2	2	3	-	-	-	-	-	-	-	1	2	2
U24IT402		**2**	**2**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1.5**	**1.5**

3 – HIGH, 2 – MEDIUM, 1 – LOW

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Examine the efficiency of algorithms by analyzing time, space, and amortized complexities, and evaluate the effectiveness of divide and conquer strategies and disjoint set operations in solving computational problems	SDG 9	Industry, Innovation and Infrastructure	Efficient algorithm design and analysis support the development of reliable computational systems, optimized software solutions, and innovative digital infrastructure essential for modern industries and technological advancement.

CO2	Analyze problem-solving approaches based on greedy and dynamic programming strategies to determine their applicability, correctness, and efficiency in optimizing computational tasks	SDG 9	Industry, Innovation and Infrastructure	Optimization techniques such as greedy and dynamic programming contribute to efficient resource utilization, intelligent decision-making, and scalable computing solutions that enhance industrial innovation and infrastructure development.
CO3	Develop algorithmic solutions using dynamic programming and backtracking techniques to address complex problems such as optimal binary search trees, TSP, string editing, and constraint satisfaction problems like 8-Queens and graph coloring	SDG 4	Quality Education	Developing advanced algorithmic problem-solving skills promotes computational thinking, analytical reasoning, and innovation-oriented learning, thereby strengthening quality technical education and research capabilities.
CO4	Develop algorithmic strategies using branch and bound for solving optimization problems such as 0/1 knapsack and traveling salesperson, and simulate nondeterministic approaches to address NP-complete problems	SDG 9	Industry, Innovation and Infrastructure	Advanced optimization and computational problem-solving techniques support intelligent systems, operational efficiency, and innovative technologies required for sustainable industrial growth and modern infrastructure solutions.

PYTHON PROGRAMMING

Class: B.Tech. IV-Semester		**Branch**	**:**	IT
Course Code :	**U24IT403**	**Credits**	**:**	**3**
Hours/Week (L-T-P-E) :	**2-1-0-3**	**CIE**	**:**	**60 %**
Total Number of Teaching Hours :	**36 Hrs**	**ESE**	**:**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: develop python programs using syntax, control statements, operators and functions

CO2: develop programs using collections, namespaces, packages, strings and regular expressions

CO3: develop python programs using object-oriented programming principles , files and database handling mechanisms

CO4: build visualization graphs with Matplotlib and adapt packages like Numpy or Pandas for statistical analysis & data handling

UNIT-I	**9 Hrs**

Introduction: Features of Python, The future of Python, Writing and executing Python programs

Python Preliminaries: Literal constants, Variables and identifiers, Data types, Input operation, Comments, Reserved words, Indentation, Operators, Expressions in Python, Type conversion

Decision Control Statements: Selection/Conditional branching statements, Loop structures/ iterative statements, Nested loop, the continue statement, the pass statement, the else statement used with loops

Functions: Function definition, Function call, Variable scope and lifetime, the return statement, Advances in defining in functions, Lambda functions, Recursive functions

Real world applications : Student grading system using control structures and functions

Self Learning Topics (SLTs): *More on Defining Functions (Text1 : chapter 5)*

UNIT-II	**9 Hrs**

Modules and Name Spaces: The from…import statement, Naming module, the dir() function, Packages in Python, Standard library modules, globals(), locals(), and reload(), Function redefinition

Python Strings: String operations, String formatting operator, Built-in string methods and functions, slice operation, ord() and Chr() functions, in and not in operators, Comparing strings, Regular expressions and meta characters

Data Structures: Lists, Tuple, Sets, Dictionaries

Real world applications : Shopping cart in an e-commerce site, Storing fixed sets of values in GPS coordinates, **Common tags between articles** in a content management system

Self Learning Topics (SLTs): *List comprehension and tuples, Variable-length argument tuples, The zip() function (Text1 : chapter 8)*

UNIT-III	**9 Hrs**

Python Object Oriented Programming: Classes and objects, Class method and self-argument, The __init__() method, Class variables and object variables, The __del__() method, Public and private data members, Private methods, Calling a class method from another class method, Built-in class attributes, Class methods, Static methods, Inheritance and polymorphism, Operator overloading

Error and Exception handling: Introduction to errors and exceptions, Handling exceptions, Multiple exception blocks, Built-in and user-defined exceptions, The finally block

File Handling: Opening and closing files, Reading and writing files, File positions, Renaming and deleting files, Directory methods

Database Connectivity: SQLite, Creating a database table, Insert and retrieve data from database

Real world applications : Student Management System for collecting and storing student data

Self Learning Topics (SLTs): *Abstract classes and interfaces, Garbage collection (Text1 : chapter 9), Multiple exceptions in a single block, Serialization, Database browser for SQLite (Text1 : chapter 12)*

UNIT-IV	**9 Hrs**

NumPy: The basics of NumPy arrays, Array indexing, Array slicing, Reshaping of array, Concatenation and splitting arrays, Introducing UFuncs

Data Manipulation with Pandas: Installing and using pandas, Introducing pandas objects, data indexing and selection, Handling missing data, Combining datasets, Merge and join, Aggregation and grouping

Visualization with Matplotlib: Importing Matplotlib, Saving figures to files, Simple line plots, Simple scatter plots, Histograms, Binnings and density

Real world applications : Sales Data Analysis System for a Retail Store which includes collecting sales data, cleaning it, analyzing patterns, and visualizing insights

Self Learning Topics (SLTs): *Plotting data on maps (Text2 : topic 4), Python advanced libraries introduction: Scikit-learn, Seaborn, SciPy (Text2 : topic 4)*

Textbook(s):

1. Reema Thareja, *Python Programming using problem solving approach*, 1st ed., New Delhi: Oxford University Press, 2017 (Chapter 1 to 7)
2. Jake VanderPlas, *Python Data Science Handbook- Essential Tools for Working with Data*, 1st ed., California, USA : O'Reilly Media Inc., 2016 (Chapter: 2 to 4)

Reference Book(s):

1. Dr. Charles R. Severance, *Python for Everybody-Exploring Data Using Python 3*, 1st ed., USA: Charles Severance, 2016.
2. D. Beazley and B. K. Jones, *Python Cookbook: Recipes for Mastering Python 3*, 3rd ed., USA: O'Reilly Media, 2013
3. Caleb Hattingh, *20 Python Libraries You Aren't Using (But Should)*, 2nd ed., USA: O'Reilly Media, 2016
4. Magnus Lie Hetland, *Beginning: from Novice to Professional*, 1st ed., USA: Apress, 2005

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc23_cs99/ : *NPTEL Video Lecture on Python For Data Science by By Prof. Ragunathan Rengasamy, IIT Madras.*
2. https://onlinecourses.nptel.ac.in/noc25_cs17 : *NPTEL Video Lecture on Data Analytics with Python By Prof. A Ramesh, IIT Roorkee.*
3. https://onlinecourses.nptel.ac.in/noc25_cs69/ : *NPTEL Video Lecture on The Joy of Computing using Python By Prof. Sudarshan Iyengar , IIT Ropar*

Course Articulation Matrix (CAM):		**U24IT403: PYTHON PROGRAMMING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24 IT403.1**	1	1	1	1	2	1	1	1	1	-	2	1	2
CO2	**U24 IT403.2**	1	1	1	1	2	1	1	1	1	-	2	2	2
CO3	**U24 IT403.3**	2	2	2	2	3	1	1	1	1	-	2	2	2
CO4	**U24 IT403.4**	2	2	2	2	3	1	1	1	1	-	2	2	2
U24 IT403		1.5	1.5	1.5	1.5	2.5	1	1	1	1	-	2	1.75	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop python programs using syntax, control statements, operators and functions	SDG 4, SDG 8	Quality Education and Decent Work and Economic Growth	Learning programming fundamentals builds strong computational thinking and problem-solving skills (SDG 4) and prepares students for employment in software development and IT industries (SDG 8).
CO2	Develop programs using collections, namespaces, packages, strings and regular expressions	SDG 4	Quality Education	Advanced programming concepts enhance technical knowledge and improve analytical and coding skills, contributing to quality education and skill development.
CO3	Develop python programs using object-oriented programming principles , files and database handling mechanisms	SDG 8	Decent Work and Economic Growth	OOP and database handling skills enhance employability by preparing students for real-world software development and industry applications.
CO4	Build visualization graphs with Matplotlib and adapt packages like Numpy or Pandas for statistical analysis & data handling	SDG 4, SDG 11	Quality Education and Sustainable Cities and Communities	Data analysis and visualization skills support learning (SDG 4) and enable solving real-world problems such as urban data analysis and sustainable development planning (SDG 11).

OPERATING SYSTEMS

Class: B. Tech. IV – Semester		**Branch:** IT	
Course Code:	**U24IT404**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40 %**

Course Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : apply operating system functions including process, memory, and storage management in various computing environments

CO2 : analyse process scheduling algorithms and synchronization mechanisms to solve real world problems

CO3 : apply deadlock handling methods and memory management strategies including paging and segmentation to improve system performance

CO4 : analyse file system structures, disk scheduling algorithms, and protection mechanisms to determine their impact on system efficiency

UNIT-I	**9 Hrs**

Introduction: Operating-system operations, Process management, Memory management, Storage management, Protection and security, Computing environments

System Structures: Operating-system services, System calls, Types of system calls, System programs, Operating-system structure, System boot

Process Concept: Process concept, Process scheduling, Interprocess communication

Self Learning Topics (SLTs): *What operating systems do, Computer-system organization(Text1: chapter 1), Threads: Overview, multicore programming, multithreading models (Text1: chapter 4)*

UNIT-II	**9 Hrs**

Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms – First-Come First Served, Shortest-Job-First, Priority, Round-Robin

Synchronization: Background**,** The critical-section problem, Peterson's solution, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, and Monitors

Self Learning Topics (SLTs)*: Multilevel queue, Multilevel feedback queue (Text1: chapter 6)*

UNIT-III	**9 Hrs**

Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock detection, Recovery from deadlock

Memory Management: Background, Swapping, Contiguous memory allocation, Segmentation, paging

Virtual-Memory Management: Background, Demand paging, Page replacement, Allocation of frames, Thrashing

Self Learning Topics (SLTs)*: Structure of page table-Hierarchical paging, Hashed page tables, Inverted page tables. (Text1: chapter 8)*

UNIT-IV	**9 Hrs**

File System: File concept, Access methods, Directory, and Disk structure.

Implementing File-Systems: File-system structure, File-system implementation, Allocation Methods, Free-space management

Mass-Storage Structure: Overview of mass-storage structure, Disk structure, Disk scheduling, Disk management, Swap-space management

***Self Learning Topics (SLTs)**: Goals of protection, Principle of protection, Domain of protection, Access matrix, Implementation access matrix (Text1: chapter 14)*

Textbook(s):

1. Abraham Silberschatz, Peter B Galvin and Gerg Gagne, *Operating System Concepts*, Wiley, 9th edition, 2016*(Chapters 1 to 14)*

Reference Book(S):

1. Ekta Walia, *Operating Systems*, Khanna Publishing House, Delhi, 2nd edition, 2015
2. Dhananjay and M. Dhamdhere, *Operating Systems A Concept-Based Approach*, McGraw Hill Education, 2008
3. William Stalling, *Operating Systems*, Maxwell, McMillan International Editions, 1992

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc20_cs04/preview; *NPTEL Video Lecture: Operating Systems by Prof. Sorav Bansal, IIT Delhi.*

Course Articulation Matrix (CAM):		**U24IT404: OPERATING SYSTEMS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT404.1**	2	1	2	1	-	-	-	-	-	-	1	2	1
CO2	**U24IT404.2**	2	1	2	2	-	-	-	-	-	-	1	2	1
CO3	**U24IT404.3**	2	1	2	2	-	-	-	-	-	-	1	2	1
CO4	**U24IT404.4**	2	1	2	1	-	-	-	-	-	-	1	2	1
U24IT404		2	1	2	1.5	-	-	-	-	-	-	1	2	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply operating system functions including process, memory, and storage management in various computing environments	SDG9	Good Health and Well-being	Understanding operating system functions helps build efficient and reliable computing infrastructure that supports innovation and technological advancement.
CO2	Analyse process scheduling algorithms and synchronization mechanisms to solve real world problems	SDG9	Industry, Innovation and Infrastructure	Process scheduling and synchronization improve resource utilization and system performance, contributing to the development of innovative and efficient digital infrastructure.
CO3	Apply deadlock handling methods and memory management strategies including	SDG12	Responsible Consumption and Production	Efficient memory management and deadlock prevention optimize computing resources, reducing wastage of processing power and energy.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	paging and segmentation to improve system performance			
CO4	Analyse file system structures, disk scheduling algorithms, and protection mechanisms to determine their impact on system efficiency	SDG9	Industry, Innovation and Infrastructure	File systems, storage management, and security mechanisms are essential components of modern digital infrastructure and sustainable technological growth.

COMPUTER NETWORKS

Class: B.Tech. IV –Semester		**Branch:** IT	
Course Code:	**U24IT405**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply the principles of data communication, including the OSI model and TCP/IP protocol suite, to design and implement network systems, and utilize switching techniques to optimize data transmission across guided and unguided media

CO2 : apply digital and analog transmission techniques to convert and transmit data, implement error detection and correction methods (block coding, cyclic codes), and utilize data link layer protocols to ensure reliable communication between devices

CO3 : analyze the performance and scalability of various Ethernet protocols (Standard, Fast, Gigabit) and MAC mechanisms, and evaluate the impact of IPv4 and IPv6 addressing on network layer efficiency and next-generation IP protocol implementation

CO4 : apply routing algorithms and protocols to configure unicast and multicast routing, implement transport layer protocols like UDP and TCP, and develop client-server applications using application layer protocols such as HTTP, FTP, and DNS to facilitate efficient communication

UNIT-I	**9 Hrs**

Introduction: Data Communications, Networks, Network types, TCP/IP protocol suite, The OSI model

Physical Layer: Introduction, Data and Signals, Periodic analog signals, Digital signals, Transmission impairment, Performance, Guided Media, Unguided media: Wireless

Switching: Circuit switched networks and Packet switching

Real world applications : Traditional telephone network and LAN with multiple PCs

Self Learning Topics (SLTs): *Network types (Text1: topics 1.3), Practice problems (Text1: Prob 1.7.3)*

UNIT-II	**9 Hrs**

Digital Transmission: Digital to digital conversation

Analog Transmission: Digital to analog conversion

Data Link Layer: Link layer addressing

Error Detection and Correction: Introduction, Block coding, Cyclic codes, Forward error correction

Data Link Control(DLC): DLC Services, Data link layer protocols : Simple Protocol, Stop-and-Wait Protocol, Piggybacking

Real world applications : Digital data transmission in Ethernet cable/USB devices and MAC addresses for identifying devices on a local network

Self Learning Topics (SLTs): *Data Link Layer: Introduction (Text1: topics: 9.1), Practice problems (Text1: Prob 10.7.3)*

UNIT-III	**9 Hrs**

Wired LAN: Ethernet protocol, Standard ethernet, Fast ethernet, Gigabit ethernet

Medium Access Control(MAC): Random access and channelization

Network Layer: Network layer performance, IPv4 addresses

Next Generation IP: IPv6 addressing, The IPv6 protocol, ICMPv6 protocol

Real world applications : Case study on IP configuration and Ethernet connections in any computer lab

Self Learning Topics (SLTs): *Network Layer: Services (Text1: topics 18.1), Practice problems (Text1: Prob 20.5.3)*

UNIT-IV	9 Hrs
Unicast Routing: Routing algorithms, Unicast routing protocols **Multicast Routing:** Introduction, Multicasting basics, Intra – inter domain multicast protocols **Transport-Layer:** Introduction, Transport layer protocols, User datagram protocol, Transmission control protocol **Application Layer:** Introduction, Application layer protocols : HTTP, FTP, Electronic mail, Telnet, Domain Name System (DNS), Client server programming **Wireless Networks:** Introduction **Real world applications :** Interconnecting computers, switches, and routers within buildings or campuses and Email communication protocols *Self Learning Topics (SLTs): World Wide Web (WWW) (Text1: topics 26.1), Secure Shell (SSH) (Text1: topics 26.5)*	
Textbook(s): 1. Behrouz A.Forouzan, *Data Communications and Networking*, 5th ed., New Delhi, India: McGraw-Hill Education (India), 2017	
Reference Book(S): 1. A. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 5th ed., New Delhi, India: Pearson Education, 2016. 2. W. Stallings, *Data and Computer Communications*, 10th ed., New Delhi, India: Pearson Education, 2014	
Web and Video link(s): 1. https://onlinecourses.nptel.ac.in/noc25_cs15/preview; *NPTEL Video Lecture on Computer Networks by Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty, IIT Kharagpur*	

Course Articulation Matrix (CAM):

U24IT405-COMPUTER NETWORKS

CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	**U24IT405.1**	3	2	1	-	-	1	-	-	1	-	1	2	1
CO2	**U24IT405.2**	3	2	2	-	-	1	-	-	1	-	1	2	1
CO3	**U24IT405.3**	2	2	1	-	-	1	-	-	1	-	1	2	1
CO4	**U24IT405.4**	3	1	1	-	-	1	-	-	1	-	1	2	1
U24IT405		**2.75**	**1.75**	**1.25**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**2**	**1**

3 - HIGH, 2 - MEDIUM, 1 - LOW

CO–SDG Alignment Matrix

CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the principles of data communication, including the OSI model and TCP/IP protocol suite, to design and implement network systems, and utilize switching techniques to optimize data transmission across guided and unguided media	SDG 4	Quality Education	Provides foundational knowledge of networking technologies required for digital literacy and technical education.
CO2	apply digital and analog transmission techniques to	SDG 9	Industry, Innovation	Ensures reliable communication systems

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	convert and transmit data, implement error detection and correction methods (block coding, cyclic codes), and utilize data link layer protocols to ensure reliable communication between devices		and Infrastructure	through efficient transmission and error control techniques.
CO3	analyze the performance and scalability of various Ethernet protocols (Standard, Fast, Gigabit) and MAC mechanisms, and evaluate the impact of IPv4 and IPv6 addressing on network layer efficiency and next-generation IP protocol implementation	SDG 11	Sustainable Cities and Communities	Efficient networking and next-generation Internet technologies support smart-city applications and connected communities.
CO4	apply routing algorithms and protocols to configure unicast and multicast routing, implement transport layer protocols like UDP and TCP, and develop client-server applications using application layer protocols such as HTTP, FTP, and DNS to facilitate efficient communication	SDG 9	Industry, Innovation and Infrastructure	Enables secure and efficient communication services essential for digital infrastructure and e-governance.

QUANTITATIVE APTITUDE AND LOGICAL REASONING			
Class: B.Tech. III –Semester		**Branch:** IT	
Course Code:	**U24VA406A**	**Credits:**	**2**
Hours/Week (L-T-P-O-E):	**2-0-0-2**	**CIE**	**60 %**
Total Number of Teaching Hours:	**24 Hrs**	**ESE**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: apply arithmetic concepts such as averages, percentages, ratios, and time-based calculations to solve real-life quantitative problems

CO2: analyze and solve problems involving financial, arithmetic and probability using structured quantitative methods

CO3: identify patterns and apply deductive reasoning to solve series, coding-decoding, and arrangement-based logical problems

CO4: evaluate logical statements, assess validity, and draw conclusions using tools like syllogisms, Venn diagrams, and argument analysis

UNIT-I	**6 Hrs**

Quantitative Aptitude-I: Number system, Averages, Percentages, Ratios & proportions, Time, Speed & distance, Time and work

UNIT-II	**6 Hrs**

Quantitative Aptitude-II: Simple interest, Compound interest, Profit & loss, Ages, Permutations & Combinations, Probability

UNIT-III	**6 Hrs**

Logical Reasoning-I: Series completion, Analogy, Coding and decoding, Blood relations, Number, Ranking & Time sequence test, Linear & Circular arrangements

UNIT-IV	**6 Hrs**

Logical Reasoning-II: Data sufficiency, Logical Venn diagram, Syllogisms, Statement & Arguments, Statement & Assumptions, Direction sense test

Note: Students should go through the QALR course supplementary material made available on online learning platform

- *Contents covered in class shall be practiced through the material available on the online learning platform. At home practice problems and practice tests shall be made available on the online learning platform*
- *Tutorial classes shall be conducted on the online learning platform and hence students shall attend the tutorial classes with laptop/tab*
- *All assessments shall be conducted through online learning platform*

Textbook(s):

1. **R S Agarwal**, *Quantitative Aptitude for Competitive Examinations*, 3rd ed., New Delhi: S. Chand Publications, 2019. *(Chapters 1,6,7,8,10,11,12,15,17,21,22,30,31 - for Unit I & II)*
2. **R S Agarwal**, *A Modern Approach to Verbal and Non-Verbal Reasoning*, 3rd ed., New Delhi: S. Chand Publications, 2019. *(Chapters Section I: 1,3,4,5,6,8,16, Section II: 2,3 - for Unit III & IV)*

Reference Book(s):

1. **Dinesh Khattar**, *Quantitative Aptitude for Competitive Examinations*, 1st ed., New Delhi: Pearson India, 2019.
2. **Nishit K Sinha**, *Reasoning for Competitive Examinations*, 1 st ed., New Delhi: Pearson India, 2019.
3. **R. N. Thakur**, *General Intelligence and Reasoning*, 1st ed., New Delhi: McGraw Hill Education, 2017.

Course Articulation Matrix (CAM):		U24VA406A : QUANTITATIVE APTITUDE AND LOGICAL REASONING												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA406A .1	1	2	-	1	-	-	-	-	-	-	1	1	-
CO2	U24VA406A.2	1	2	-	1	-	-	-	-	-	-	1	1	-
CO3	U24VA406A.3	-	1	-	2	-	2	-	-	-	-	1	1	-
CO4	U24VA406A.4	-	1	-	2	-	2	-	-	-	-	1	1	-
U24VA406A		1	1.5	-	1.5	-	2	-	-	-	-	1	1	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Programming Skill Development Lab - 3

Class: B.Tech. IV –Semester		**Branch:** IT	
Course Code:	**U24SE407**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2**	**CIE :**	**100%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to …

(based on psychomotor skills acquired from laboratory component)

CO1: develop and test various java programming paradigms and java fundamental programs

CO2: develop and test java programs using classes, constructors and various string concepts

CO3: analyze how reusability concepts such as inheritance, interfaces, and packages are utilized in building efficient, maintainable java programs

CO4: develop and test java programs using streams (Input/Output), exception handling and multithreading concepts

LABORATORY COMPONENT

S. No.	List of Experiments
1.	a) Develop a Java program using a class named Arithmetic. Read two numbers from the command line arguments and perform all basic arithmetic operations: addition, subtraction, multiplication, division, and modulus. Use separate methods for each operation: add() for addition, sub() for subtraction, mul() for multiplication, div() for division, mod() for modulus. b) Develop a Java program using a class named Matrix to perform the multiplication of two matrices. The matrix values should be read from the keyboard. The program should: i. Read two matrices (of user-defined size) from the keyboard. ii. In the Matrix class, implement a method mul() to multiply two matrices. iii. Before performing multiplication, check whether the multiplication condition is satisfied (i.e., the number of columns in the first matrix must be equal to the number of rows in the second matrix). iv. If the condition is satisfied, compute and display the product of the two matrices. v. Otherwise, display a message indicating that matrix multiplication is not possible with the given matrix dimensions. c) Develop a Java program to demonstrate wrapper class by read five numbers using command line arguments and print the prime numbers from the given numbers.
2.	a) Develop a Java program to recursively linearly search an element in an array. b) Develop a Java program to interchange elements of first and last in a matrix across rows and interchange elements of first and last in a matrix across columns. **Note:** Read the first matrix from user input for the second program take the first program output as input. c) Develop a Java program to implement a seating reservation system using a 2D array in Java. **Hint:** A cinema hall has a fixed number of rows and columns of seats. A 5x5 array represents the seating arrangement (1 for booked, 0 for available). Users can select seats, and the program should update availability.
3.	a) Develop a Java program to determine whether two strings are anagram or not. b) Develop a Java program to simulate an ATM Application. The application should include the following functionalities: like 1) Withdraw 2) Deposit 3) Check balance 4) Exit. The program should allow the user to choose an option from a menu and perform

	the corresponding operation. Proper validations (like checking for sufficient balance during withdrawal) should be implemented
4.	a) Develop a Java program to find all the permutations of a string. Hint: Permutations of "abc" : abc acb bac bca cab cba b) Develop a Java program to find the largest and smallest word in a string based on the length of the word. c) Develop a Java program to find the duplicate words in a string.
5.	a) Develop a Java function to split the string using a string tokenizer using following scenario. A CSV file contains the following line: "John,Doe,35,New York, Software Engineer" You need to extract and print: First Name Last Name Age City Job Title. b) Develop a Java program based on following scenario. A user types "I love Java" but wants to insert "programming" between "love" and "Java", making it: "I love programming Java"**.**
6.	a) Develop a Java program that design a class Employee with multiple ways to initialize it. One constructor takes an employee ID and name, while another takes an employee ID, name, and salary. Based on above data implement constructor overloading in Java. b) Develop a Java program by writing an overridden getNumberOfTeamMembers method that prints the same statement as the super class getNumberOfTeamMembers method, except that it replaces with (the number of players on a Soccer team). *Output Format* When executed, your completed code should print the following: Generic Sports Each team has n players in Generic Sports Soccer Class Each team has 11 players in Soccer Class
7.	a) **Develop a Java program** that a bank has different types of accounts. A Savings Account is a specialized type of **Bank Account** that has additional features like interest calculation. We implement this scenario using single inheritance where SavingsAccount inherits from Bank Account. **Hint:** Bank Account (Parent Class): Holds account details and common operations (deposit, withdraw, display Account Details). Savings Account (Child Class, Single Inheritance): Inherits Bank Account properties and methods. Adds a new method addInterest() to calculate interest. Main Class (Bank Application): Creates a Savings Account object, performs operations, and displays details b) Develop a Java program that design a payment gateway system that supports multiple payment methods such as Credit Card and UPI. Define an interface Payment with a method processPayment(double amount). Implement two classes: **CreditCardPayment** that implements processPayment() and

	displays "Processing credit card payment of $" + amount. **UPIPayment** that implements processPayment() and displays "Processing UPI payment of $" + amount. In the main() method, accept a payment method and amount from the user and process the payment accordingly
8.	a) Develop a java program to demonstrate on a hierarchy of classes representing different types of animals: Animal, Dog, and Cat. Animal has a method called makeSound(). Dog and Cat override this method to provide their specific sounds. b) Develop a java program to demonstrate the scenario which involves implementing a Notification System where different services (Email, SMS, Push) send messages using a common interface, Notifier, with the method void send(String message), and a method that accepts any Notifier to send a notification. c) Develop a java program to demonstrate the scenario demonstrates the Strategy Pattern using interfaces by defining a SortStrategy interface with a void sort(int[] arr) method, and implementing different sorting algorithms like BubbleSort, QuickSort, and MergeSort, allowing the user to choose and apply a sorting strategy at runtime.
9.	a) Develop a java program based on the following scenario You are working on an e-commerce website where an order processing system runs in the background while users continue shopping. How will you ensure the background process does not affect user experience? **Hint:** Use ScheduledExecutorService for this task. b) Develop a java program to demonstrate the scenario involves building a modularized Library Management System in Java by organizing the application into packages—library.books, library.users, and library.transactions—each containing relevant classes like Book, User, and IssueTransaction, with a Main class in the library.main package to manage the overall system.
10.	a) Develop a java program based on the scenario 'Payment Gateway Exception Handling' that you are integrating a payment gateway for an e-commerce website. Sometimes, payments fail due to network issues or incorrect card details. How will you handle these exceptions gracefully? Write code for failed transactions. Write code for the users are notified properly. b) Develop a java program demonstrate on 'you are tasked with creating a program that processes two numbers input by the user prompt the user has to enter two numbers: numerator and denominator and validate the inputs like if the user enters non-numeric values, the program should handle it gracefully and Perform the division and display the result. Handle the following exceptions: InputMismatchException if non-integer values are entered. ArithmeticException if the denominator is zero. Any other Exception that might occur unexpectedly.
11.	a) Develop a java program based on the following scenario Reading from a File You are developing a program that reads a list of students' names from a file called students.txt and displays them on the console. How would you handle file reading exceptions? What happens if the file does not exist? b) Develop a java program based on the following scenario Scenario: Student Management System you can create a package called student containing a Student class, and another

	package main containing the Main class to use the Student class.
12.	a) Develop a java program based on the following **Scenario**: Implementing a Producer-Consumer System **Problem Statement:** You are tasked with implementing a producer-consumer system where multiple producer threads generate data and place it into a shared buffer, and multiple consumer threads process the data from the buffer. The system should ensure that the buffer has a fixed size and can hold a limited number of items,producers should wait if the buffer is full, consumers should wait if the buffer is empty and the system should handle synchronization to prevent race conditions. **b)** Develop a java program based on the following **scenario:** Managing a Shared Resource **Problem Statement:** You are tasked with implementing a system where multiple threads represent users accessing a shared printer. The printer can only handle one user at a time, and each user requires a random amount of time to print a document. Your goal is to ensure that only one user can access the printer at any given time, users should wait if the printer is currently in use and once a user finishes printing, another waiting user should be allowed to use the printer.

Text Book(s):

1. Herbert Schildt, *Java The Complete Reference*, 13th ed., New Delhi: McGraw-Hill Education, 2019.
2. Harvey Deitel, Paul J. Deitel, *Java How to Program,* 11th ed., New Delhi: Pearson Publications, 2018.
3. KathySierra, BertBates, *Head First Java*, 2nd ed., Boston: O'Reilly Publications, 2005.

Reference Book(s):

1. Uttam K. Roy, *Advanced JAVA Programming*, 1st ed., England: Oxford Publications,2013
2. Balaguruswamy, *Programming with Java: A Primer*, 7th ed., New Delhi: McGraw-Hill Education India Pvt. Ltd., 2019.
3. TanweerAlam, *Internet and Java Programming*, 1st ed., New Delhi: Khanna Publishing House, 2010.

DESIGN AND ANALYSISOF ALGORITHM LABORATORY

Class: B. Tech. IV – Semester		**Branch:** IT	
Course Code:	**U24IT408**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,
(based on psychomotor skills acquired from laboratory component)

CO1: develop solutions for weighted union and collapsing find operations, implement Strassen's matrix multiplication, and solve the Defective Chessboard problem using divide and conquer techniques

CO2 : develop optimal solutions to real-world optimization problems such as job sequencing, knapsack, and shortest paths using the greedy method.

CO3: develop optimal solutions for problems such as Optimal Binary Search Trees (OBST), 0/1 Knapsack, and Traveling Salesperson using dynamic programming techniques.

CO4: develop programs to solve the Sum of Subsets and N-Queen problems using the backtracking method.

Experiment-1

1. i. Program to implement weighted union for given sets
   ii. Program to implement collapsing find method to find an element in the given sets

Experiment-2

2. Program to implement strassen's matrix multiplication

Experiment-3

3. Program to implement Defective chessboard problem using Divide and Conquer

Experiment-4

4. Program to implement Graph map coloring using Greedy method

Experiment-5

5. Program to find the maximum profit job sequence from a given array of jobs with deadlines and profits

Experiment-6

6. Program to implement text compression using Huffman Coding

Experiment-7

7. Program to find Single Source Shortest Path using Dijkstra's algorithm

Experiment-8

8. Program to find All-Pairs Shortest Path using Floyd-Warshall algorithm

Experiment-9

9. Program to find Optimal Binary Search Tree using Dynamic Programming
10. Program to implement 0/1 Knapsack problem using Dynamic Programming

Experiment-10

11. Program to implement Travelling Salesperson Problem using Dynamic Programming

Experiment-11

12. Program to find a subset of a given set S = {s1,s2,...,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9, there are two solutions {1,2,6} and {1,8}. A suitable message is to be displayed if the given problem instance doesn't have a solution

Experiment-12

13. Program to implement N-Queen problem using Backtracking

Textbook(s):

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Universities Press, 2nd edition, 2008

Reference Book(s):

1. S. Sridhar, *Design and Analysis of Algorithms*, Oxford University Press, 1st edition, 2014
2. Gajendra Sharma, *Design & Analysis of Algorithms*, Khanna Books Publishing, 4th edition, 2019

Web and Video link(s):

1. https://nptel.ac.in/courses/106101060; *NPTEL Video Lecture on Design and Analysis of Algorithms by Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan, IIT Bombay*
2. https://nptel.ac.in/courses/106106131; *NPTEL Video Lecture on NOC:Design and Analysis of Algorithms by Prof. Madhavan Mukund, Chennai Mathematical Institute*

Laboratory Manual (for Laboratory Component):

Design and Analysis of AlgorithmsLaboratory Manual and Record Book, Department of IT, KITSW.

Course Articulation Matrix (CAM):		**U24IT408: DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT408.1**	1	1	1	-	1	-	1	1	1	-	1	1	1
CO2	**U24IT408.2**	1	2	2	-	2	-	1	1	1	-	1	1	1
CO3	**U24IT408.3**	1	2	3	-	2	-	1	1	1	-	1	2	2
CO4	**U24IT408.4**	1	2	3	-	2	-	1	1	1	-	1	2	2
U24IT408		**1**	**1.75**	**2.25**	**-**	**1.75**	**-**	**1**	**1**	**1**	**-**	**1**	**1.5**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop solutions for weighted union and collapsing find operations, implement Strassen's matrix multiplication, and solve the Defective Chessboard problem using divide and conquer techniques	SDG 9	Industry, Innovation and Infrastructure	Efficient data structures and divide-and-conquer algorithms improve computational efficiency, supporting the development of innovative software solutions and scalable digital infrastructure.
CO2	Develop optimal solutions to real-world optimization problems such as job sequencing, knapsack, and shortest paths using the greedy method.	SDG 9	Industry, Innovation and Infrastructure	Greedy algorithms enable efficient resource allocation, scheduling, and routing, contributing to industrial productivity and intelligent infrastructure systems.
CO3	Develop optimal solutions for problems such as Optimal Binary Search Trees (OBST), 0/1 Knapsack, and Traveling Salesperson using dynamic	SDG 9	Industry, Innovation and Infrastructure	Dynamic programming supports optimal decision-making and resource utilization in complex computational and industrial applications, fostering

	programming techniques.			innovation and efficiency.
CO4	Develop programs to solve the Sum of Subsets and N-Queen problems using the backtracking method.	SDG 4	Quality Education	Backtracking techniques enhance logical reasoning, analytical thinking, and problem-solving skills, which are essential for quality education in computing disciplines.

PYTHON PROGRAMMING LABORATORY

Class: B.Tech. IV-Semester		**Branch**	**:**	IT
Course Code :	**U24IT409**	**Credits**	**:**	**1**
Hours/Week (L-T-P-E):	**0-0-2-2**	**CIE**	**:**	**60 %**
Total Number of Teaching Hours :	**24 Hrs**	**ESE**	**:**	**40 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,
(based on psychomotor skills acquired from laboratory component)

CO1: develop python programs using operators, control statements & functions

CO2: apply namespaces, packages, string handling methods, regular expressions, lists & dictionaries of Python to develop efficient and effective solutions

CO3: build new classes, create objects and perform operations on files and implement database operations in Python

CO4: examine visualization graphs with Matplotlib and experiment with Numpy & Pandas libraries for data analysis programs in Python

Experiment-1

1. Installation of Python and verifying PATH environment variable
2. Running instructions in Interactive interpreter and a python script
   a) Executing instructions in Python Interactive Interpreter
   b) Running python scripts in Command Prompt
   c) Running python scripts in IDLE
3. Program to demonstrate importance of indentations. Purposefully raise Indentation Error and correct it
4. Program to take input text as command line argument and display it on screen

Experiment-2

5. Program that takes 2 numbers as command line arguments and prints its sum
6. Program to check whether the given number is even or odd
7. Program to calculate GCD of 2 numbers
8. Program to find Exponentiation (Power) of a number
9. Program to find given year is leap year or not
10. Program to develop a simple calculator

Experiment-3

11. Program to find the Factorial of a given number
12. Program to evaluate the Fibonacci series for a given number 'n'
13. Program to find the Armstrong for a given number
14. Program to find sum of N numbers
15. Program to take a number as input, and print countdown from that number to zero (use while loop)
16. Program to find circulating 'n' values

Experiment-4

17. Program to implement a module using import statement (Use python source file as a Module and implement import statement another python source files)
18. Program to implement from, import statement
19. Program to implement dir() function
20. Program to demonstrate packages in python

Experiment-5

21. Program to display substring in a string
22. Program to update an existing string
23. Program to implement string concatenation
24. Program to demonstrate string formatting operator

Experiment-6

25. Program to demonstrate use of slicing in strings
26. Program to compare two strings
27. Program which prints the reverse of a given input string. (use a function with name reverse string and call this function for performing the operation)
28. Program to demonstrate built-in string methods
29. Program to demonstrate list and related functions

Experiment-7

30. Program to demonstrate tuple, set and related functions
31. Program to demonstrate dictionaries
32. Program to demonstrate Regex functions
33. Program to demonstrate regular expressions using Meta characters

Experiment-8

34. Program for the following to demonstrate classes and objects
35. Program to demonstrate class method and static method
36. Program to demonstrate inheritance
37. Program to open and read data from a file
38. Program to write data into a file
39. Program to compute number of characters, words, lines in a file

Experiment-9

40. Program to install and verify SQLite Connector for Python
41. Program to connect check SQLite Database connectivity
42. Program to retrieve and display data from a table
43. Program to insert data into a table
44. Program to delete rows in a table

Experiment-10

45. Program to install and setup NumPy environment
46. Program to demonstrate NumPy array
47. Program to demonstrate Slice operation
48. Program to demonstrate Reshaping of an array

Experiment-11

49. Program to demonstrate Installing and using Pandas environment
50. Program to create a series from an ndarray
51. Program to demonstrate indexing and selecting data

Experiment-12

52. Program to install and setup matplotlib
53. Program to draw a simple line plot
54. Program to draw a histogram plot
55. Program to Customize plots and experiment with different maps plots

Textbook(s):

1. Reema Thareja, *Python Programming using problem solving approach*, 1st ed., New Delhi: Oxford University Press, 2017 (Chapter 1 to 7)
2. Jake VanderPlas, *Python Data Science Handbook- Essential Tools for Working with Data*, 1st ed., California, USA : O'Reilly Media Inc., 2016 (Chapter: 2 to 4)

Reference Book(s):

1. Dr. Charles R. Severance, *Python for Everybody-Exploring Data Using Python 3*, 1st ed., USA: Charles Severance, 2016.
2. D. Beazley and B. K. Jones, *Python Cookbook: Recipes for Mastering Python 3*, 3rd ed., USA: O'Reilly Media, 2013
3. Caleb Hattingh, *20 Python Libraries You Aren't Using (But Should)*, 2nd ed., USA: O'Reilly Media, 2016
4. Magnus Lie Hetland, *Beginning: from Novice to Professional*, 1st ed., USA: Apress, 2005

Laboratory Manual (for laboratory component):

1. *Python Programming Laboratory Manual and Record Book,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT409: PYTHON PROGRAMMING LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT409.1	2	2	2	2	2	1	1	2	1	-	2	2	2
CO2	U24IT409.2	2	2	2	2	2	1	1	2	1	-	1	2	2
CO3	U24IT409.3	2	2	2	2	3	1	1	2	1	-	2	2	2
CO4	U24IT409.4	2	2	2	2	3	1	1	2	1	-	2	2	2
U24IT409		**2**	**2**	**2**	**2**	**2.5**	**1**	**1**	**2**	**1**	**-**	**2.25**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop python programs using operators, control statements & functions	SDG 4, SDG 8	Quality Education and Decent Work and Economic Growth	Developing basic programming skills enhances logical thinking and problem-solving abilities and prepares students for entry-level programming roles in the IT industry.
CO2	Apply namespaces, packages, string handling methods, regular expressions, lists & dictionaries of Python to develop efficient and effective solutions	SDG 4	Quality Education	Applying advanced Python concepts improves coding efficiency, analytical thinking, and technical competency, contributing to quality education and skill development.
CO3	Build new classes, create objects and perform operations on files and implement database operations in Python	SDG 8, SDG 16	Decent Work and Economic Growth and Peace, Justice and Strong Institutions	Object-oriented programming and database handling skills support development of reliable and secure software systems, enhancing employability and contributing to structured and accountable digital systems.
CO4	Examine visualization graphs with Matplotlib and experiment with Numpy & Pandas libraries for data analysis programs in Python	SDG 4, SDG 11	Quality Education and Sustainable Cities and Communities	Data analysis and visualization skills enable interpretation of real-world data and support decision-making in areas like urban planning, resource management, and sustainability.

OPERATING SYSTEMS LABORATORY

Class: B. Tech. IV – Semester		**Branch:** IT	
Course Code:	**U24IT410**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Outcomes (COs)

After completion of this course, the students should be able to,

CO1 :	apply UNIX commands to manage files, processes, and system operations effectively
CO2 :	apply shell programming to develop scripts for automating system tasks and solving real-time problems
CO3 :	develop various CPU scheduling algorithms and apply Banker's algorithm to handle deadlocks
CO4 :	develop page replacement algorithms and analyse their performance in virtual memory management scenarios

Experiment-1

1. Practicing basic UNIX commands:
   a) General Utility Commands
   b) File and directory-related commands

Experiment-2

2. Data Processing Commands and Communication Commands

Experiment-3

3. Process Related Commands and Pattern Searching Commands

Experiment-4

4. Develop shell programs for the following:
   a) Shell Script Related Commands: sh, read, command line arguments ($1), $ @ & $*, set, exit, status ($?), logical operators: ||, &&, exit, if, sleep & wait, case, while & until, for, export, expr commands
   b) Display the details of all users in an order they logged on to system (based on time) who are working on the system
   c) Display the details of all users who are working on the system

Experiment-5

5. Develop programs for the following:
   a) Reading a character and displaying it on the screen
   b) Display the name and class of the student in a separate line
   c) To check if the given two characters are equal or not
   d) Display the given character in its binary form
   e) To check if a given number is even or odd
   f) Develop a shell script to accept login name as command line argument and find out at how many terminals the user has logged in

Experiment-6

6. Develop programs for the following:
   a) Develop a shell script which gets executed at login time and displays a blinking message "Good morning/Good Afternoon / Good Evening" depending upon the time at which the user logs in
   b) Develop a shell script to check the given character is vowel or not
   c) Develop a shell script to perform all basic arithmetic operations using switch statement
   d) Develop a menu driven program which has the following options:
      i. contents of a given file
      ii. list of users who have currently logged in
      iii. present working directory
      iv. exit

Experiment-7

7. **Creative Shell Scripting: From Math Logic to Pattern Magic**

Smart Scripting Assistant for Students:

Imagine you're building a *Smart Terminal Assistant* for students in a college lab that helps them with quick logical and mathematical problems on the fly. This terminal bot should be able to:

1. Predict growth (Fibonacci series like population or startup traction)
2. Verify a security ID (prime number check)
3. Generate pyramid patterns for fun or printing labels

Scenario-Based Problems:

a) Startup Growth Predictor (Fibonacci Series)

Your team is building a terminal-based startup growth simulator. Write a shell script that prints the Fibonacci series, representing the user base growth over N months

User Input: Number of months (terms)

Output Example: 0 1 1 2 3 5 8 13

b) Security ID Validator (Prime Number Check)

In your lab's login system, every student has a unique numeric ID. To validate if a student ID is eligible for secure mode access, write a script to check whether the ID is a prime number.

User Input: ID number

Output Example:

Enter ID: 29
Secure ID. 29 is a prime number.
(OR)
Enter ID: 18
Not a secure ID. 18 is not prime.

c) Pyramid Pattern Printer (Visual Printer Format)

You're developing a command-line label printer. Design a shell script that prints a number pyramid pattern for labels or badges

User Input: Number of rows

Output Example for 5 rows:

1
1 2
1 2 3
1 2 3 4
1 2 3 4 5

Experiment-8

8. Shell Scripting for String Manipulation, Array Processing, and Mathematical Functions.

Automating Student Data Processing in University Systems:

A university's IT department often performs maintenance tasks and data analysis on servers using shell scripts. During semester-end processes, the system administrators need to:

1. Reverse student IDs or usernames for encryption tasks.
2. Analyze student test scores to determine the highest and lowest performers.
3. Calculate the factorial of numbers for mathematical utilities in assignment evaluations.

These repetitive operations are automated using shell scripting.

Scenario-Based Tasks:

a) Reversing a String (e.g., Student ID)

The IT team needs a shell script that takes a student's ID as input and displays it in

reverse order, which is used in generating temporary access tokens.
Example Input: IT2025001
Output: 1005202TI

b) Finding Min and Max from an Array (e.g., Student Scores)
Student scores are stored in arrays. Write a shell script that finds the **minimum and maximum score** from a given array of integers.
Example Input: Scores=(85 91 77 64 92 88)
Output: Minimum: 64, Maximum: 92

c) Factorial Using Function (e.g., Assignment Utility Tool)
In mathematical assignments, factorial calculations are used frequently. Develop a shell script function that computes the **factorial of a given number**.
Example Input: 5
Output: Factorial of 5 is 120

Problem Statement:
Develop the following shell scripts based on the case study:

1. A script to **reverse a given string** (e.g., student ID).
2. A script to find **minimum and maximum** in an array of integers (e.g., student scores).
3. A script containing a **function to compute the factorial** of a given number.

Each script should include:

- Clear user input prompts
- Output formatting
- Input validation (where applicable)

Expected Output Format:

```
Enter Student ID: B24IT009
Reversed ID: 900TI42B
Enter array of scores: 85 91 77 64 92 88
Minimum Score: 64
Maximum Score: 92
Enter a number: 5
Factorial of 5 is 120
```

Experiment-9

9. Implementation of FCFS and Round Robin CPU Scheduling Algorithms Using a Real-World Scenario.

CPU Scheduling in a Student Project Submission System: During the final week of the semester, students from different departments upload their project files to the university's evaluation server. The server processes each submission by checking formatting, running plagiarism checks, and compiling the submitted code. Since the server can only handle one submission at a time, an efficient CPU scheduling policy is needed.

The arrival and processing times of each student's submission are as follows:

Student (Process ID)	Arrival Time (in ms)	Processing Time / Burst Time (in ms)
Student A (P1)	0	5
Student B (P2)	1	3
Student C (P3)	2	8
Student D (P4)	3	6

For the Round Robin algorithm, use a **time quantum of 4 ms**.

Expected Output:

- Gantt chart showing process execution order
- Table showing waiting time and turnaround time per process
- Average waiting time and average turnaround time

Experiment-10

10. Implementation of SJF and Priority CPU Scheduling Algorithms Using a Real-Life Scenario.

implement and simulate **Shortest Job First (SJF)** and **Priority Scheduling** CPU algorithms based on a real-world scenario involving background tasks in a smart home system, and evaluate performance using waiting time and turnaround time.

CPU Scheduling in a Smart Home Control System: In a smart home environment, a central controller (like a smart hub or IoT gateway) receives and processes multiple background tasks triggered by different smart devices such as lights, sensors, appliances, and security systems. Each task has a different execution time depending on its complexity, and some tasks are more urgent (have higher priority) than others.

Given Task Details:

Task (Process ID)	Arrival Time (ms)	Burst Time (ms)	Priority (Lower number = Higher priority)
Light Sensor (P1)	0	6	3
AC Control (P2)	2	8	1
Security Alarm (P3)	4	7	2
Washing Machine (P4)	5	3	4

Implement Shortest Job First (SJF) Non-Preemptive Scheduling for the above scenario and compute:

- Gantt chart
- Waiting time for each process
- Turnaround time for each process
- Average waiting time
- Average turnaround time

Implement Priority Scheduling (Non-Preemptive), where lower number indicates higher priority, and compute the same parameters.

Expected Output:

- Gantt chart showing execution sequence

- Table showing individual and average waiting & turnaround times
- Comparative analysis (optional) between SJF and Priority Scheduling based on results

Experiment-11

11. Implementation of Banker's Algorithm for Deadlock Avoidance Using a Real-World Resource Allocation Scenario.

Resource Allocation in a University Cloud Lab: In a university's cloud-based lab setup, several student groups are working on cloud simulations. Each group (process) needs different types of cloud resources—like VMs (Virtual Machines), storage units, and network bandwidth—to complete their experiments.

To ensure that no group causes the system to enter a deadlock (by requesting more resources than available), the cloud controller uses the Banker's Algorithm to decide whether to grant or deny resource requests based on current system state.

System Details:

There are 5 processes (P0 to P4) and 3 resource types (A, B, C).

1. Allocation Matrix:

Process	A	B	C
P0	0	1	0
P1	2	0	0
P2	3	0	2
P3	2	1	1
P4	0	0	2

2. Maximum Matrix:

Process	A	B	C
P0	7	5	3
P1	3	2	2
P2	9	0	2
P3	2	2	2
P4	4	3	3

3. Available Resources:

A	B	C
3	3	2

- Implement the Banker's Algorithm for the given system configuration.
- Determine if the current state of the system is safe or unsafe.
- If safe, display the safe sequence of process execution.
- Allow students to simulate a new resource request by any process and decide whether it should be granted or denied, based on the algorithm.

Expected Output:

- Safe/Unsafe state message
- Safe sequence (if safe)
- Decision on resource request validity

Step-by-step explanation of how the system decides each allocation

Experiment-12

12. Implementation of FIFO and LRU Page Replacement Algorithms Using a Real-World Memory Management Scenario.

Memory Management in a University Computer System: In a university's shared computer lab, several students use lab systems to run multiple applications such as code editors, browsers, IDEs, and document processors. Each of these applications requests memory pages to be loaded into RAM for execution.
However, the system has limited memory frames, so whenever a new page is requested and the memory is full, the system must decide which page to replace. The operating system uses Page Replacement Algorithms like FIFO and LRU to make this decision.

Given Input:

- **Reference String (Page Requests):** 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2
- **Number of Frames:** 3
- Implement the **FIFO Page Replacement Algorithm** using the above reference string.
- Implement the **LRU Page Replacement Algorithm** using the same data.
- For each algorithm:
  - Display the memory state after each page request.
  - Count and display the **number of page faults**.
  - Display the **final state of memory**.

Expected Output:

- Step-by-step memory status after each request
- Total number of page faults

Comparison of FIFO and LRU in terms of efficiency

Textbook(s):

1. Abraham Silberschatz, Peter B Galvin and Gerg Gagne, *Operating System Concepts*, Wiley, 9th edition, 2016 *(Chapters 1 to 14)*

Reference Book(S):

1. Ekta Walia, *Operating Systems*, Khanna Publishing House, Delhi, 2nd edition, 2015
2. Dhananjay and M. Dhamdhere, *Operating Systems A Concept-Based Approach*, McGraw Hill Education, 2008
3. William Stalling, *Operating Systems*, Maxwell, McMillan International Editions, 1992

Laboratory Manual (for laboratory component):

1. *Operating Systems Laboratory Manual,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT410 : OPERATING SYSTEMS LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT410.1	2	1	1	1	1	1	1	-	-	-	1	2	1
CO2	U24IT410.2	2	1	2	1	1	1	1	-	-	-	1	2	1
CO3	U24IT410.3	2	1	2	1	1	1	1	-	-	-	1	2	1
CO4	U24IT410.4	2	1	2	1	1	1	1	-	-	-	1	2	1
U24IT410		2	1	1.75	1	1	1	1	-	-	-	1	2	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to*	Relevant SDG	SDG Description	Mapping Justification

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply UNIX commands to manage files, processes, and system operations effectively	SDG9	Industry, Innovation and Infrastructure	UNIX command proficiency enables efficient management of computing resources and supports the development of reliable digital infrastructure and innovative computing solutions.
CO2	Apply shell programming to develop scripts for automating system tasks and solving real-time problems	SDG8	Decent Work and Economic Growth	Automation through shell scripting improves productivity, reduces manual effort, and develops industry-relevant skills that enhance employability and workplace efficiency.
CO3	Develop various CPU scheduling algorithms and apply Banker's algorithm to handle deadlocks	SDG9	Industry, Innovation and Infrastructure	Efficient scheduling and deadlock handling improve system performance and resource utilization, contributing to robust and innovative computing infrastructure.
CO4	Develop page replacement algorithms and analyse their performance in virtual memory management scenarios	SDG12	Responsible Consumption and Production	Memory management techniques optimize resource usage, reduce computational waste, and promote efficient utilization of computing resources.

Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute

OR

Successful completion of two suitable skill based courses (external) to qualify for Certification

B. After Second Year: (UG Diploma in IT)

(i) The candidate should pass any two of the following additional courses (Diploma Level) during the 2-Months internship at institute

Exit Option to Qualify UG Diploma in IT: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24IT412X	Introduction to Web Programming	2	-	2	-	4	3
2	PCC	U24IT413X	Internet of Things	2	-	2	-	4	3
3	PCC	U24IT414X	Cloud Computing	2	-	2	-	4	3
4	PCC	U24IT415X	Full Stack Development	2	-	2	-	4	3
5	PCC	U24IT415X	Any other course approved by BoS Chair and Dean, AA	2	-	2	-	4	3

(OR)

(ii) Any two suitable skill based courses to qualify for Diploma.

Exit Option to Qualify UG Diploma in IT: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE412X	Programming for Web Design https://onlinecourses.swayam2.ac.in/nou24_cs12/preview	-	-	6	-	6	3
2	SEC	U24SE413X	Internet of Things using Aurdino/Raspberry Pi https://onlinecourses.swayam2.ac.in/ntr24_ed44/preview	-	-	6	-	6	3
3	SEC	U24SE414X	Cloud Computing using AWS/Google Cloud https://www.coursera.org/specializations/cloud-computing	-	-	6	-	6	3
4	SEC	U24SE415X	Full Stack using JAVA / .NET https://www.coursera.org/specializations/java-fullstack	-	-	6	-	6	3
5	SEC	U24SE416X	Any other skill based course approved by BoS Chair and Dean, AA	-	-	6	-	6	3

INTRODUCTION TO WEB PROGRAMMING

Class: B.Tech. IV–Semester (Exit)			**Branch**	**:**	IT
Course Code	**:**	**U24IT412X**	**Credits**	**:**	**3**
Hours/Week (L-T-P-E)	**:**	**2-0-2-4**	**CIE**	**:**	**40 %**
Total Number of Teaching Hours	**:**	**32 Hrs**	**ESE**	**:**	**60 %**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: apply HTML tags with Cascading Style Sheet to develop static web pages
CO2: design interactive web pages using JavaScript & XML
CO3: develop web applications using Servlet technologies
CO4: develop dynamic web applications using JSP programming

(based on psychomotor skills acquired from laboratory component)

CO5: design well formatted web pages using HTML & CSS
CO6: model validating web pages using JavaScript and XML
CO7: design web based applications using servlets technology
CO8: develop web application using JSP along with database connectivity

THEORY COMPONENT

UNIT-I	**4 Hrs**

Introduction to HTML: HTML Basics, Elements, Attributes, Tags, Basic Tags: HTML Comments, HTML Background, Paragraph, Text Styles, Heading, Lists and Symbols; Advanced Tags: Table, Forms and its elements, frames, Images, Meta tag, Planning of webpage, Model and Structure for a website, Designing web pages, Multimedia Content

CSS: Introduction, Advantages, Adding CSS, Selectors: Grouping, Type, Universal, Descendant, Child, Class selectors, ID selectors

UNIT-II	**4 Hrs**

XML: Role of XML, Prolog, Body, Elements, Attributes, Validation, Displaying XML, Namespace, XML DTD: Introduction to DTD, Purpose of DTD, Using DTD in an XML document, Element type declaration, Attribute declaration, Attribute types, String types, Tokenized types

JavaScript: Introduction, Variables, Literals, Operators, Control Structures, Conditional Statements, Arrays, Functions, Objects

UNIT-III	**4 Hrs**

Server-side Programming using Servlets: Servlet architecture, Servlet life cycle, Generic servlet and Http servlet, Building and Installing Servlet, Passing parameters to servlets, Retrieving parameters, Problems with servlet

UNIT-IV	**4 Hrs**

Java Server Pages: How JSP works, JSP and servlet, JSP syntax, JSP components, Beans, Session tracking, Database connectivity, JDBC drivers, Loading a driver, Making a connection, Executing SQL statements using MYSQL database

LABORATORY COMPONENT

List of Experiments

1. Design a web page, which allows user to enter their biographical details
2. Create a web page containing row of images/logos and when user click on that image its enlarged view should appear in (a) same window (b) new window
3. Design a web page for student registrations (new admissions) into engineering college (use validations for checking the information entered by student)
4. Design a webpage using Cascading Style Sheet features which includes CSS Colors, CSS Backgrounds, CSS Borders
5. Design a login page and perform validations using JavaScript
6. Design a Servlet for validating log-in information entered by user in a login form and the Servlet has to report back to user regarding the status of login
7. Design a Servlet which accepts information from student, for an engineering college admission and store the information entered into the database. (Use the validations while student entering the information)
8. Design a web page to store and display the details of employee at server database using JSP
9. Design a web page to perform session tracking using JSP
10. Design a web page using JSP to access MYSQL database

Textbook(s):

1 Uttam K. Roy, *Web Technologies*, United Kingdom: Oxford University Press, 2022

Reference Book(s):

1. Kogent, *Web Technologies: HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML*, New Delhi: Dreamtech Press, 2013
2. Larry Ullman, *PHP for the Web: Visual QuickStart Guide*, United Kingdom: Pearson Education, 4th edition, 2008
3. Gary Bollinger and Bharathi Natarajan, *JSP: A Beginner's Guide*", New York: McGraw-Hill Education, 2001

Web and Video link(s):

1. https://onlinecourses.swayam2.ac.in/nou24_cs09/preview *NPTEL Video Lecture on Web Technology By Dr. Ashutosh Kumar Bhatt, Professor, Uttarakhand Open University, Haldwani*
2. https://archive.nptel.ac.in/courses/106/106/106106156/ *NPTEL Video Lecture on Introduction to Modern Application Development by Prof. Madhavan Mukund, Professor, IIT Madras*

Laboratory Manual (for laboratory component):

1. *Introduction to Web Programming Laboratory Manual and Record Book,* Department of IT, KITSW

INTERNET OF THINGS

Class: B.Tech. IV –Semester (Exit)			**Branch:** IT		
Course Code	**:**	**U24IT413X**	**Credits**	**:**	**3**
Hours/Week (L-T-P-E)	**:**	**2-0-2-4**	**CIE**	**:**	**40 %**
Total Number of Teaching Hours	**:**	**32 Hrs**	**ESE**	**:**	**60 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: classify and compare various sensors and actuators based on type, characteristics, and real-world usage.

CO2: develop and debug Arduino-based programs using various programming constructs and interfaces.

CO3: develop digital and analog interfacing techniques using Arduino for interactive device control and data exchange.

CO4: interface and program sensors with Arduino and apply them in a real-world case study like smart water management.

(based on psychomotor skills acquired from laboratory component)

CO5: develop and test basic Arduino programs using setup(), loop(), serial communication, variables, constants, and user-defined functions.

CO6: develop control structures, data types, arrays, strings, and operators in Arduino to perform logical operations and iterative tasks.

CO7: apply Arduino built-in functions to interface with digital and analog I/O devices including LEDs, sensors, and display units.

CO8: design and build Arduino-based systems for real-time applications using motor control and sensor integration.

THEORY COMPONENT

UNIT-I	**4 Hrs**

Sensors: Definition, Characteristics, Deviations, Types-Scalar, Multimedia, Hybrid and virtual; Considerations

Actuators: Definition, Types-Hydraulic, Pneumatic, Electric, Thermal or Magnetic, Mechanical, Soft and shape memory polymers; Characteristics

UNIT-II	**4 Hrs**

Programming with Arduino: Introduction to arduino, Features, Components, Arduino IDE, Program elements-Structure, Variables and constants, Data types, Operators, Control statements, Loops, Functions, Arrays, String objects; Time, 1/O function, Display, Random numbers

UNIT-III	**4 Hrs**

Programming with Arduino: GPIO, Controlling LEDs-Blinking led without delay, Connecting an external led, RGB LED, The 7-segment display;

Analog and Digital Communication with Arduino: Introduction-Serial communication, Parallel communication, Interfacing LCD character display

UNIT-IV	**4 Hrs**

Integration of Sensors with Arduino: Interfacing with potentiometer, Temperature sensor, Detecting motion using PIR sensor, Measuring distance using infrared and ultrasonic sensor, Object position using accelerometer and localization using Global Positioning System (GPS)

Case Study: Smart campus water management system

LABORATORY COMPONENT

List of Experiments

Experiment-1

1. Introduction of Arduino IDE
2. Program to demonstrate setup () and loop () functions
3. Program to demonstrate serial and serial.begin() statements
4. Program to demonstrate serial.print() statement

Experiment-II

5. Program to demonstrate serial.available() statement
6. Program to demonstrate serial.read() and serial.write() statements
7. Program to demonstrate serial.analogRead() function
8. Program to demonstrate user defined functions

Experiment-III

9. Program to demonstrate data types.
10. Program to demonstrate variables
11. Program to demonstrate constants

Experiment-IV

12. Program to demonstrate operators
13. Program to demonstrate if statements
14. Program to demonstrate switch case
15. Program to demonstrate loops

Experiment-V

16. Program to demonstrate arrays
17. Program to demonstrate strings
18. Program to demonstrate string object

Experiment-VI

19. Program to demonstrate time based functions
20. Program to demonstrate random numbers generation

Experiment-VII

21. Program to demonstrate digital I/O functions
22. Program to demonstrate analog I/O functions

Experiment-VIII

23. Program to demonstrate light an LED
24. Program to demonstrate the 7-segment display.

Experiment-XI

25. Program for interfacing with infrared and ultrasonic sensor
26. Program for interfacing with accelerometer

Experiment-X

27. Program for interfacing with servo motor
28. Program for interfacing with stepper motor

Text Book:

1. Sudeep Mishra, Anandarupmukherjee and Arijit Roy, *Introduction to IoT*, New Delhi: University Cambridge Press, 2021 (Chapter 4)
2. Cornel Amariei, *Arduino Development Cook Book*, Birmingham: Packt Publishing Ltd., 2015. (Chapter 2-6)

Reference Book(s):

1. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh and Mahendra Swain, *Internet of things With Raspberry Pi and Arduino*, Boca Raton: CRC Press, Taylor & Francis Group, 2020.
2. Brian Evans, Beginning Arduino Programming, New York: A press, 2011.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc25_cs44/preview *NPTEL Video Lecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Internet of Things Laboratory Manual and Record Book,* Department of IT, KITSW

CLOUD COMPUTING

Class: B.Tech. IV –Semester (Exit)		**Branch :**	IT
Course Code :	**U24IT414X**	**Credits :**	**3**
Hours/Week (L-T-P-E) :	**2-0-2-4**	**CIE :**	**40 %**
Total Number of Teaching Hours :	**32 Hrs**	**ESE :**	**60 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: analyze various cloud models and computing environments
CO2: develop cloud applications using various virtualization techniques
CO3: apply cloud platform technologies for developing real time applications
CO4: analyze the degree of security for a given cloud application

(based on psychomotor skills acquired from laboratory component)

CO5: experiment with the virtualization by installing and configuring VirtualBox/VMware with different operating systems
CO6: develop and deploy applications using Google App Engine (GAE) and cloud platforms
CO7: simulate cloud computing environments using CloudSim and analyze scheduling algorithms
CO8: apply distributed computing frameworks like Hadoop for data processing tasks

THEORY COMPONENT

UNIT-I	**4Hrs**

Introduction: Cloud computing at a glance, Historical developments, Building cloud computing environment

Principles of Parallel and Distributive Computing: Eras of computing, Parallel vs. distributive computing, Elements of parallel computing, Elements of distributive computing, Technologies for distributive computing

UNIT-II	**4 Hrs**

Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples

Cloud Computing Architecture: Introduction, Cloud reference model, Types of cloud, Economics of the cloud, Open challenges

UNIT-III	**4 Hrs**

Data Intensive Computing: What is data intensive computing? Technologies for data intensive computing.

Cloud Platform in Industry: Amazon web services, Google app engine

Cloud Applications: Scientific applications: ECG analysis in the cloud

UNIT-IV	**4 Hrs**

Cloud Security: Security the top concern for cloud users, Cloud security risks, Privacy and privacy impact assessment, Trust, Cloud data encryption, Security of database services, Operating system security, Virtual machine security, Security of virtualization

LABORATORY COMPONENT
List of Experiments 1. Install VirtualBox/VMware Workstation with different Linux or Windows OS versions on top of Windows 7 or 8 2. Install a C compiler in a virtual machine and execute simple C programs 3. Install Google App Engine (GAE) and create a "Hello World" web app using Python/Java 4. Use GAE Launcher to deploy and run web applications 5. Simulate a cloud environment using CloudSim and run a custom scheduling algorithm 6. Transfer files between virtual machines using simple file-sharing methods 7. Launch a virtual machine using Trystack (OpenStack online demo) 8. Install Hadoop single-node cluster and run a word count application 9. Simulate a multi-node Hadoop cluster and run basic tasks 10. Deploy a web application on a cloud platform like AWS/GCP
Textbook(s): 1. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi, *Mastering Cloud Computing*, New Delhi: McGraw Hill, 2013 (Chapters 1 to 4 and 8 to 11) 2. Dan C. Marnescu, *Cloud Computing Theory and Practice*, Cambridge: Elsevier, 2nd edition, 2018 (Chapter 9)
Reference Book(s): 1. Dr. Kumar Saurabh, *Cloud Computing: Architecting Next-Gen Transformations Paradigms*, New Delhi: Wiley India Private Limited, 4th edition, 2018 2. Barrie Sosinsky, *Cloud Computing Bible*, Indiana: Wiley Publications, 2011 3. Anthony T.Velte, Toby J Velte and Robert Elsenpeter, *Cloud Computing: A practical Approach*, New York: McGraw Hill, 2010
Web and Video link(s): 1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview; *NPTEL Video Lecture on CIT-003: Cloud Computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur*
Laboratory Manual (for laboratory component): 1. *Cloud ComputingLaboratory Manual and Record Book,* Department of IT, KITSW

FULL STACK DEVELOPMENT

Class: B.Tech. IV –Semester (Exit)			**Branch**	**:**	IT
Course Code	**:**	**U24IT415X**	**Credits**	**:**	**3**
Hours/Week (L-T-P-E)	**:**	**2-0-2-4**	**CIE**	**:**	**40 %**
Total Number of Teaching Hours	**:**	**32 Hrs**	**ESE**	**:**	**60 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: develop java script programs using object oriented concepts

CO2: develop react ,react router concepts in the implementation of client server applications

CO3: develop applications using Spring boot and REST API's

CO4: demonstrate agile development principles in the implementation and deployment of applications

(based on psychomotor skills acquired from laboratory component)

CO5: built informative web pages, design effective layouts, and implement interactive web forms

CO6: develop programs on React forms and basic validations

CO7: develop program to demonstrate spring boot framework

CO8: develop programs using JDBC using REST APIs

THEORY COMPONENT

UNIT-I	**4 Hrs**

Frontend Development: Javascript basics, OOPS aspects of java script memory usage and functions in JS, AJAX for data exchange with server jQuery framework jQuery events, UI components, JSON data format

UNIT-II	**4 Hrs**

REACT JS: Introduction to react ,React router and single page applications, React forms, Flow architecture and introduction to Redux, Client-server communication

UNIT-III	**4 Hrs**

Java Web Development: Java programming basics, Model view controller (MVC) pattern, MVC architecture using spring, RESTful API using spring framework.

UNIT-IV	**4 Hrs**

Databases & Deployment: Relational schemas and normalization structured query language (SQL) Data persistence using Spring, JDBC, Agile development principles and deploying application in Cloud

LABORATORY COMPONENT

List of Experiments

1. Develop a JavaScript program to remove a character at the specified position of a given string and return the new string
2. Develop and demonstrate a HTML file that includes JavaScript script for taking full name in

a text field and display first, middle, last name in 3 different labels. Middle and last name may be optional, thus message like "NA" should be displayed in corresponding labels. If the input contains 2 words, then they should be considered as first and last names

3. Design HTML form for keeping student record, apply JavaScript validation in it for restriction of mandatory fields, numeric field, email-address field, specific value in a field etc.
4. Develop program to Navigation using React Router
5. Develop Single Page Application with Dynamic Routing with parameters
6. Programs to demonstrate React Forms, Controlled components and basic Basic validation
7. Program to demonstrate Client Server Communication (Fetch API Data importing react)
8. Develop Spring Boot MVC Web App
9. Program to demonstrate REST API with Spring Boot – GET Users & REST API – POST User (Spring Boot)
10. Develop a Spring boot code to demonstrate JDBC using REST APIs

Textbook(s):

1. Nicholas C. Zakas, *Professional JavaScript for Web Developers*, Wiely India, 3rd edition, 2012
2. AZAT MARDA ,*Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB*, Apress, 2nd edition, 2015

Reference Book(s):

1. Kogent, *Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP,ADO.NET, JDBC and XML*, Dreamtech Press, 1st edition, 2013.
2. Uttam K. Roy, *Web Technologies*, Oxford University Press, 1st edition, 2016.

Web and Video link(s):

https://onlinecourses.swayam2.ac.in/nou24_cs12/preview;*NPTEL Video Lecture on CIT-003: Web Based Technologies and Multimedia Applications by Prof.P. V. Suresh, Indira Gandhi National Open University*

Laboratory Manual (for laboratory component):

1. *Java Full Stack Development Laboratory Manual and Record Book,* Department of IT, KITSW

5th Semester Syllabi

B. Tech (IT) –CURRICULUM & SYLLABUS (KITSW-URR24)

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credit Assigned

V SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE-I	U24OE501X-SDG	OE-SDGB *(from Pool – VI)*	2	1	-	3	3
2	PCC	U24IT502	Machine Learning	2	1	-	3	3
3	PCC	U24IT503	Big Data Analytics	2	1	-	3	3
4	PCC	U24IT504	Cryptography and Network Security	2	1	-	3	3
5	PCC	U24IT505	Full Stack Development	3	1	-	4	4
6	IKSC	U24IK506B	Essense of Indian Traditional Knowledge	2	-	-	2	2
7	PCC	U24IT507	Machine Learning Laboratory	-	-	2	2	1
8	PCC	U24IT508	Full Stack Development Laboratory	-	-	2	2	1
9	SEC	U24SE509	Programming Skill Development Lab – 4	-	-	2	2	1
10	ELC	U24IT510	Seminar	-	-	2	2	1
			Total:	13	5	8	26	22
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	27
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA):1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				-	-	-	-	-

#OPEN ELECTIVES: Student has to select one course as open elective from any of the OE-SDG Basket of courses offered by other departments.

[@]List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula

Pool – VI **Sustainable Development Goals Basket (OE - SDGB)**			
S. No.	**Course Code**	**Course Title**	Offered by
1.	U24OE501G	IoT based Precision Agriculture Technology for Crop Farming	CSE (Networks)
2.	U24OE501I	Sustainable AI	CSE (AI & ML)
3.	U24OE501O	AI Ethics	CSE (AI & ML)
4.	U24OE501R	Software Quality Assurance & Testing	CSE

IOT BASED PRECISION AGRICULTURE TECHNOLOGY FOR CROP FARMING *(Open Elective - Offering by Department of CSN)*			
Class: B. Tech. V – Semester		**Branch:** Common to All Branches	
Course Code:	**U24OE501G**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: understand the historical development, concepts, sensing technologies, and geospatial tools used in precision agriculture for crop production.

CO2: analyze and interpret remotely sensed and machine-acquired agricultural data to support precision crop management decisions.

CO3: apply automation, intelligent machinery, and field robots in agriculture.

CO4: analyze precision farming strategies for resource optimization, quality assurance, traceability, and smart agriculture applications in sustainable crop production.

UNIT-I	**9 Hrs**

A History of Precision Agriculture: Introduction, Review of precision agriculture history.

Precision Agriculture: Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software.

Sensing Technology for Precision Crop Farming: Introduction, Control algorithms, Yield monitoring, Crop canopy reflectance sensing, Soil property sensing, ISOBUS support for sensor systems.

UNIT-II	**9 Hrs**

Data Processing and Utilization in Precision Agriculture: Introduction, Acquisition of crop information based on remote sensing techniques, Acquisition of farmland data by machine.

Interpretation of Crop Information from Remote Sensing: Crop chlorophyll and nitrogen content inversion through remote sensing, Crop LAI estimation through remote sensing, Crop water estimation and inversion through remote sensing.

UNIT-III	**9 Hrs**

Control of Precision Agriculture Production: Introduction, Sensing for precision agriculture, Control for precision agriculture, Precision agriculture implementation.

Intelligent Agricultural Machinery and Field Robots: Intelligent machine design framework, Intelligent machine classification, Perception sensing technologies - Perception sensors, Selection of perception sensors, Challenges and new development, Machine behaviour, Navigation and machine control technologies, System and software architecture, Autonomous vehicles and field robots.

UNIT-IV	**9 Hrs**

Precision Agriculture in Large-Scale Mechanized Farming: Precision fertilizer application, Precision crop pest management, Precision water management, Precision technologies for specialty crops.

Good Agricultural Practices, Quality, Traceability, and Precision Agriculture: Food safety and good agricultural practices scheme, Meeting the traceability requirement, Crop condition sensing, Chain of traceability, Variability modelling and traceability, Model-based statistical process control.

Case study: Smart green house system.

Textbook(s):

1. Qin Zhang, *Precision Agriculture Technology for Crop Farming*, New York : CRC Press - Taylor & Francis Group, 2016,.
2. Aniket Kalhepure, *Geo Informatics and Nano Technology for precision farming*, Amey Publication, 2022

Reference Book(s):

1. Peart, R.M., and Shoup, W. D., *Agricultural Systems Management*, Marcel Dekker, New York, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., *Applications of Seasonal Climate*, Springer, Germany, 2000.

Web and Video link(s):

1. https://www.coursera.org/learn/iot-enabled-farming#modules; "IoT Enabled Farming" by EDUCBA.

Course Articulation Matrix (CAM):		U24OE501G : IOT BASED PRECISION AGRICULTURE TECHNOLOGY FOR CROP FARMING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501G.1	3	2	-	-	3	1	2	1	-	1	2	2	1
CO2	U24OE501G.2	2	3	2	3	3	1	2	1	-		2	2	1
CO3	U24OE501G.3	2	2	3	2	3	1	2	1	-	1	2	3	2
CO4	U24OE501G.4	2	3	2	2	2	3	2	1	-	1	2	2	1
U24OE501G		2.25	2.5	2.3	2.3	2.75	1.5	2	1	-	1	2	2.25	1.25
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO1	Understand the historical development, concepts, sensing technologies, and geospatial tools used in precision agriculture for crop production.	SDG 2	Zero Hunger	Precision agriculture technologies such as GPS, GIS, remote sensing, and field sensors enable site-specific crop management, improving productivity, reducing crop losses, and supporting sustainable food production to meet growing food demands.
		SDG 9	Industry, Innovation and Infrastructure	The use of advanced sensing systems, geospatial technologies, and digital agricultural infrastructure promotes technological innovation and modernization of farming practices, contributing to resilient agricultural infrastructure and smart farming solutions.
CO2	Analyze and interpret remotely sensed and machine-acquired agricultural data to support precision crop management decisions.	SDG 2	Zero Hunger	Data-driven decision-making helps optimize crop growth, identify stress conditions early, improve yield prediction, and enhance agricultural productivity, thereby strengthening food security.
		SDG 6	Clean Water and Sanitation	Precision analysis of soil moisture, irrigation requirements, and crop water stress enables efficient water management, reducing water wastage and promoting sustainable use of freshwater resources.
		SDG 12	Responsible Consumption	Accurate interpretation of agricultural data supports optimized application of fertilizers, pesticides, and

CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
			and Production	other inputs, minimizing resource wastage and environmental impacts while enhancing production efficiency.
CO3	Apply automation, intelligent machinery, and field robots in agriculture.	SDG 2	Zero Hunger	Automated agricultural machinery and robotic systems improve operational efficiency, ensure timely farm operations, reduce labour shortages, and enhance crop productivity, supporting sustainable food production.
		SDG 9	Industry, Innovation and Infrastructure	The adoption of autonomous equipment, smart machines, and agricultural robotics fosters technological innovation, digital transformation, and modernization of agricultural infrastructure.
CO4	Evaluate precision farming strategies for resource optimization, quality assurance, traceability, and smart agriculture applications in sustainable crop production.	SDG 2	Zero Hunger	Precision farming strategies improve crop yields, ensure food quality, enhance traceability, and support sustainable agricultural practices that contribute to long-term food security.
		SDG 12	Responsible Consumption and Production	Resource optimization techniques reduce excessive use of fertilizers, pesticides, energy, and water, promoting efficient resource utilization and environmentally responsible agricultural production systems.
		SDG 13	Climate Action	Smart agriculture practices help reduce greenhouse gas emissions, improve carbon-efficient farming, strengthen climate resilience, and support adaptation to changing environmental conditions through sustainable resource management.

SUSTAINABLE AI

(Open Elective - Offering by Department of CSM)

Class: B. Tech.		**Branch:** Common to All Branches	
Course Code:	**U24OE501I**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : analyze the role of sustainability & AI, resource efficiency and consumption, and climate awareness in addressing environmental challenges

CO2 : analyze energy consumption and environmental impacts of AI models

CO3 : apply optimization techniques for resource-efficient AI deployment

CO4 : analyze sustainable AI applications and emerging trends across various domains to identify their impacts, opportunities, and challenges

UNIT-I	**9 Hrs**

Sustainability and Artificial Intelligence: Scope of Sustainability and sustainable development goals, Artificial Intelligence-The New Electricity?, Sustainability x AI, A Green Path to Sustainable AI

Generative AI Foundations: Introduction to GenAI & Representation Learning, Auto Encoders , Large Language Models, Multimodal Generative Models and Data Modalities

Quantifying the Efficiency of Deep Learning: AI Waste, Resource Consumption of Deep Learning, Resource Efficiency and Climate Awareness, Carbon Footprint of AI, Estimating the Carbon Footprint of AI Models

UNIT-II	**9 Hrs**

Data Parsimony: The Cost of Data, Dataset Curation, Active Learning for Dataset Creation, Learning with Pruned Datasets, Learning with Compressed Data, Data and Dataset Compression

Automating Model Selection: Hyperparameter Optimization, Neural Architecture Search, Model Selection in the Era of Foundational Models, Model Selection Automated

UNIT-III	**9 Hrs**

Training Efficiency: Training Costs of AI Models, Transfer Learning, Training Compressed Neural Networks, Quantization, Efficient Training techniques

Lean Inference: Lifetime Cost of an AI Model, Achieving Lean Inference, Deploying Models , Lean and Efficient Inference

Hardware Considerations: Environmental Cost of AI Hardware, Hardware Scaling Laws of AI, The Alchemy of Creating AI, Improving the Resource Efficiency of AI Hardware, Hardware Optimization for sustainable AI

UNIT-IV	**9 Hrs**

A Recipe for Sustainable AI: Introduction and Sustainability Across the AI Lifecycle, Technical Debt of Machine Learning, Environmental Debt of AI, Operationalizing Sustainable AI, Green MLOps

Toward Sustainable AI: Rebound effects and AI, Economic sustainability of AI, Social Sustainabilty of AI, Sustainable AI Principles Impact of Sustainable AI

Textbook(s):

1. Raghavendra Selvan, "Sustainable AI Tools for Moving Toward Green AI", First Edition, O'Reilly Media, October 2025

Reference Book(s):

1. Aboul Ella Hassanien, Roheet Bhatnagar, and Ashraf, *Artificial Intelligence for*

Sustainable Development: Theory, Practice and Future Applications, Springer Nature, Computational Intelligence, Volume 912, September 2021, New Delhi

2. Mohammad Dastbaz, Colin Pattinson, Babak Akhgar , *Green Information Technology A Sustainable Approach*, Morgan Kaufmann1st Edition, March 3, 2015

Web and Video link(s):

https://onlinecourses-archive.nptel.ac.in/noc18_ce08; *NPTEL Video Lecture on* ***Sustainable Engineering Concepts And Life Cycle Analysis*** *by Prof. Brajesh Kr. Dubey, , IIT Kharagpur*

Course Articulation Matrix (CAM):		**U24OE501I : SUSTAINABLE AI**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	U24OE501I.1	1	2	1	1	1	-	1	1	1	1	1	1	1
CO2	U24OE501I.2	1	2	2	2	1	-	1	1	1	1	1	1	1
CO3	U24OE501I.3	1	2	2	2	1	-	1	1	2	1	1	1	1
CO4	U24OE501I.4	1	2	1	1	1	-	1	1	2	1	1	1	1
U24OE501I		**1**	**2**	**1.5**	**1.5**	**1**	**-**	**1**	**1**	**1.5**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze the role of sustainability & AI, resource efficiency and consumption, and climate awareness in addressing environmental challenges	SDG 4, SDG 13	Quality Education, Climate Action	Provide the knowledge about the principles of bio inspired computing and natural intelligence to improve the quality of understanding and study by observing nature and derive the solutions.
CO2	analyze energy consumption and environmental impacts of AI models	SDG 7, SDG 9	Affordable and Clean Energy, Industry, Innovation and Infrastructure	The algorithms developed can be used for helping the industry to improve the infrastructure by optimizing various situations with a large number of parameters.
CO3	apply optimization techniques for resource-efficient AI deployment	SDG 16	Peace, Justice and Strong Institutions	The solutions developed are useful in finding the improved infrastructure in the smart city environment like self- driving cars with swarm intelligence solutions.
CO4	analyze sustainable AI applications and emerging trends across various domains to identify their impacts, opportunities, and challenges	SDG 11, SDG 12, SDG 13	Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action	Smart applications like Smart Greenhouse improve sustainable agriculture

AI ETHICS

(Open Elective - Offering by Department of CSM)

Class: B. Tech.		**Branch:** Common to All Branches	
Course Code:	**U24OE501O**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : understand and apply the fundamental concepts of artificial intelligence to explain key ethical issues, approaches, and the significance of AI ethics in modern society

CO2 : analyze ethical issues in AI through the perspectives of policy, regulation, philosophy of technology, and real-world case studies

CO3 : apply ethical frameworks and methods in applied ethics to identify, interpret, and evaluate ethical challenges arising from AI systems

CO4 : analyze human values, intelligence, and human nature in the context of AI systems, and assess the boundaries between humans and intelligent machines

UNIT-I	**9 Hrs**

Introduction: What is Artificial Intelligence, Why AI Ethics is so exciting?, Bottom-Up and Top-Down approaches to AI Ethics, The boundaries and limitations of ethics, Developing ethical autonomy

The Rise of AI Ethics: Ethical questions in AI currently receiving attention, Same or different? What's special about AI Ethics? Common themes and varieties of questions in AI Ethics, Ethical questions in AI currently receiving attention

UNIT-II	**9 Hrs**

AI Policy and Regulatory Standards: AI Ethics, Law, Policy, Regulation, Ethics Guidance Case Study **-** An indigenous AI report

AI, Philosophy of Technology, and Ethics: Comparing AI to humans, Case Study - Attributing agency to humans and to AI, A brief introduction to the philosophy of technology, Technology and attitudes towards nature, The implicit values of technology, communication through new technologies

UNIT-III	**9 Hrs**

Methods in Applied Ethics: A simple account of methods in Applied Ethics, The challenges from AI for methodology in Applied Ethics, Common assumptions about the nature of ethics and their influence on methodology in Applied Ethics

Methodology in Applied Ethics: The stories we tell, Introduction to ethical narratives in AI, Stories about AI systems

UNIT-IV	**9 Hrs**

Humans and Intelligent Machines – Underlying Values: The nature and value of intelligence, Values underlying the use of data

Human Nature: Self, Reason, Boundaries, Philosophical perspectives - The Divided Self and notions of the Higher Self, Reason or Emotion?, The boundaries of Human nature,

Boundaries and limits, Is human nature Perfectible?, Myths and origin stories about human nature

Textbook(s):

1. P. Boddington, *AI Ethics*, 1st edition, Cham, Switzerland: Springer International Publishing, 2017. (Chapter 1 to 5)

Reference Book(s):

1. P. Boddington, *Artificial Intelligence: Foundations, Theory, and Algorithms*, Cham, Switzerland: Springer Nature, 2023.
2. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th edition, Hoboken, NJ, USA: Pearson, 2021.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs132; *NPTEL Video Lecture on **Responsible & Safe AI Systems** by Prof. Ponnurangam Kumaraguru, Prof. Balaraman Ravindran, Prof. Arun Rajkumar | IIIT Hyderabad, IIT Madras*

Course Articulation Matrix (CAM):		**U24OE501O : AI ETHICS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	U24OE501O.1	2	2	2	2	1	1	1	1	1	-	2	2	1
CO2	U24OE501O.2	2	2	3	2	1	1	1	1	1	-	2	3	1
CO3	U24OE501O.3	2	2	2	2	1	1	1	1	1	-	2	3	1
CO4	U24OE501O.4	2	2	3	3	1	1	1	1	1	-	2	3	1
U24OE501O		**2**	**2**	**2.5**	**2.25**	**1**	**1**	**1**	**1**	**1**	**-**	**2**	**2.75**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	understand and apply the fundamental concepts of artificial intelligence to explain key ethical issues, approaches, and the significance of AI ethics in modern society	SDG4	Quality Education	AI ethics improves critical thinking and awareness about responsible technology use, strengthening quality education and informed learning in emerging technologies.
CO2	analyze ethical issues in AI through the perspectives of policy, regulation, philosophy of technology, and real-world case studies	SDG16	Peace, Justice and Strong Institutions	Studying AI governance, law, and policy supports ethical decision-making, transparency, and responsible institutional frameworks for trustworthy AI systems.
CO3	apply ethical frameworks and methods in applied ethics to identify, interpret, and evaluate ethical challenges arising from AI systems	SDG9	Industry, Innovation and Infrastructure	Ethical analysis methods help design safer and more responsible AI systems, promoting innovation with accountability in technological development.
CO4	analyze human values, intelligence, and human nature in the context of AI systems, and assess the boundaries between humans and intelligent machines	SDG3	Good Health and Well-being	Understanding human-centered AI and value alignment supports safer AI applications in healthcare, psychology, and human well-being systems.

SOFTWARE QUALITY ASSURANCE AND TESTING
(Open Elective - Offering by Department of CSE)

Class: B.Tech. V–Semester		**Branch:** Common to All Branches	
Course Code:	**U24OE501R**	**Credits :**	**3**
Hours/Week (L-T-P-E)	**2-1-0-3**	**CIE :**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE :**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : *understand the scope of software quality, quality assurance processes, and quality engineering concepts*

CO2 : *apply software testing principles including realities of testing, specification examination, code examination, and blind testing techniques*

CO3 : *apply dynamic white-box testing, configuration testing, compatibility testing, and usability testing techniques for software evaluation.*

CO4 : *evaluate software testing documentation, test case design and tracking, bug reporting, and testing metrics.*

UNIT-I	**9 Hrs**

Software Quality: Perspective and expectations, Historical perspective of quality, Quality frameworks, Quality assurance as dealing with defects, Defect prevention detection and containment strategies

Quality Assurance Process and Quality Engineering: QA activities in software processes, Verification and validation perspectives, Reconciling the two views quality engineering, Activities and process quality planning, Goal setting and strategy formation quality assessment and improvement quality engineering in software processes

UNIT-II	**9 Hrs**

Software Testing Background: Infamous software case studies, Bug, why do bugs occur, The cost of bugs, Software testing functionalities, Good software *t*ester characteristics.

The Realities of Software Testing: Testing axioms, Software testing terms and definitions, Precision and accuracy, Testing quality assurance

Examining the Specification: Black-box and white-box testing, Static and dynamic testing, Performing a high leve1 review of the specification, Low level specification test techniques<

Testing the Software with Blinders On: Dynamic black-box testing, Test-to-pass and test-to-fail, Equivalence partitioning data testing, State testing, Other black-box test techniques

UNIT-III	**9 Hrs**

Testing the Software with Dynamic White-Box Testing: Dynamic white-box testing, Dynamic white-box testing vs. debugging, Testing the pieces, Data coverage, Code coverage

Configuration Testing: An overview of configuration testing, Approaching the task, Obtaining the hardware, Identifying hardware standards, Configuration testing other hardware

Compatibility Testing: Compatibility testing overview, Platform and application versions, Standards and guidelines data sharing compatibility

Usability Testing: User interface testing, User interface testing, Guidelines, Intuitive consistent, Flexible, Comfortable, Correct, Useful, Accessibility testing, Accessibility features in software

UNIT-IV	**9 Hrs**

Automated Testing and Test Tools: The benefits of automation and tools, Test tools, software test automation, Random testing

Bug Bashes find Beta Testing: Having other people test your software, Test sharing, Beta testing, Outsourcing your testing

Writing and Tracking Test Cases: The goals of test case planning, Test case planning overview, Test case organization and tracking

Measuring Your Success: Metrics for testing, Common project-level metrics

Text Book(s):

1. Jeff Tran. *Software Quality Engineering: Testing, quality Assurance. And Quantifiable Improvement*, John Wiley and IEEE Computer Society Press, 1st. ed., 2015, New Delhi.
2. Dr. Rajiv Chopra, *Software Testing and Quality Assurance*, S.K. Kataria & Sons, 5th Edition, 2023, New Delhi. [Chapter No. 1, 3, 6, 10]

Reference Book(s):

1. Kshirasagar Naik and Priyadarshi Tripathy, *Software Testing and Quality Assurance: Theory and Practice*, John Wiley & Sons, 2nd Edition, 2025, Hoboken.
2. Ron Patto, Software Testing, 2nd ed., SAMS Publications, 2016.
3. M.G.Limaye, *So{tware Testing Principles, Techniques and Tools,* Tata McGraw-Hill Educaiion, 1st. ed., 2019, New Dehi.

Course Articulation Matrix (CAM):		**U24OE501R : SOFTWARE QUALITY ASSURANCE AND TESTING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE501R.1**	1	2	2	2	1	1	1	1	1	2	1	3	2
CO2	**U24OE501R.2**	1	2	2	2	2	1	1	1	-	2	1	3	2
CO3	**U24OE501R.3**	1	2	2	2	2	1	1	1	-	2	1	3	2
CO4	**U24OE501R.4**	1	2	2	2	3	1	1	1	-	2	1	3	2
U24OE501R		**1**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand the scope of software quality, quality assurance processes, and quality engineering concepts	SDG9	Industry, Innovation and Infrastructure	Understanding software quality assurance processes supports development of reliable and innovative software infrastructure.
CO2	Apply software testing principles including realities of testing, specification examination, code examination, and blind testing techniques.	SDG8	Decent Work and Economic Growth	Software testing principles improve software reliability and productivity in industrial and professional environments.
CO3	Apply dynamic white-box testing, configuration testing, compatibility testing, and usability testing techniques for software evaluation.	SDG9	Industry, Innovation and Infrastructure	Usability and compatibility testing encourage accessible and user-friendly software systems for effective digital learning environments.
CO4	Evaluate software testing documentation, test case design and tracking, bug reporting, and testing success metrics.	SDG9	Industry, Innovation and Infrastructure	Documentation testing, automation, and quality metrics contribute to efficient software engineering and industrial innovation.

MACHINE LEARNING

Class: B. Tech. V – Semester		**Branch:** IT	
Course Code:	**U24IT502**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: analyze the different types of machine learning techniques and apply data preprocessing methods on different datasets

CO2: apply feature engineering methods for relevant feature extraction and use various probabilistic models to improving model performance

CO3: analyze different algorithms for prediction and classification on various datasets

CO4: apply clustering techniques for pattern discovery in unlabelled data and implement reinforcement learning concepts

UNIT-I	**9 Hrs**

Introduction to Machine Learning: Types of Human Learning, Machine Learning process, Well-posed Learning Problem, Types of Machine Learning and Comparison, Applications of Machine Learning

Model Preparation, Evaluation: Machine Learning Activities, Types of Data in Machine Learning, Dataset Understanding, Checking Data Quality, Data Pre-Processing, selecting a Model, Predictive and Descriptive Models, Interpreting the Model- Underfitting, Overfitting, Bias-Variance trade-off, Parameter for Evaluating Performance

UNIT-II	**9 Hrs**

Feature Engineering: Feature Transformation - Feature Construction, Feature Extraction by PCA, SVD, LDA. Feature Subset Selection – Feature Relevancy and Redundancy measures, Feature Selection Process and approaches.

Probability Concepts: Joint Probability, Conditional Probability, Bayes rule, Common Discrete and Continuous Distributions, Dealing with Multiple Random Variables, Central Limit Theorem, Bayes classifier, Multi-class Classification, Naïve Bayes classifier, Bayesian belief network

UNIT-III	**9 Hrs**

Regression: Introduction to regression, Regression algorithms: Simple Linear Regression, Multiple Linear Regression, Polynomial Regression model, Logistic Regression, Maximum likelihood estimation

Classification: Classification model and Learning steps, Classification algorithms, Distance measures, k-Nearest Neighbour (kNN), Decision tree, Support Vector Machines, Kernel trick, Random Forest

UNIT-IV	**9 Hrs**

Unsupervised Learning: Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering and its types, Partitioning method: k-Means and K Medoids, Hierarchical Clustering, Density-based methods – DBSCAN.

Reinforcement Learning: Markov Decision Process, Bellman equations, Value iteration and Policy iteration, Linear Quadratic Regulation (LQR), LQG Q-Learning.

Textbook(s):

1. Saikat Dutt, S. Chandramouli, Das – *Machine Learning*, Pearson, 1st edition.
2. Tom M Mitchell, —*Machine Learning*, McGraw Hill Education, 1st edition, 2013.

Reference Book(s):

1. Dr. Rajiv Chopra, *Machine Learning*, Second Edition, Khanna Book Publications
2. Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, Canada, John Wiley & Sons, 2014.
3. Tom M. Mitchell, Jaime G. Carbonell, Ryszard S. Michalski, *Machine Learning: A Guide to Current Research*, West Springfield Avenue, Kluwer Academic Publishers,2011
4. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, London, MIT Press, 2012.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs101/preview; *NPTEL Video Lecture on Introduction to Machine Learning by Prof. Balaraman Ravindran, Professor of CSE, IIT Madras.*

Course Articulation Matrix (CAM):		U24IT502 : MACHINE LEARNING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT502.1	3	3	2	2	3	1	-	-	-	1	-	3	2
CO2	U24IT502.2	3	3	3	2	3	-	-	-	-	1	-	3	3
CO3	U24IT502.3	3	3	3	3	3	1	-	-	-	1	-	3	3
CO4	U24IT502.4	3	3	2	3	3	1	1	-	-	1	-	3	3
U24IT502		3	3	2.5	2.5	3	1	1	-	-	1	-	3	2.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze the different types of machine learning techniques and apply data preprocessing methods on different datasets	SDG 4	Quality Education	Promotes knowledge and technical skills in machine learning and data handling.
CO2	apply feature engineering methods for relevant feature extraction and use various probabilistic models to improving model performance	SDG 9	Industry, Innovation and Infrastructure	Enhances intelligent systems and advanced computational models for industrial applications.
CO3	analyze different algorithms for prediction and classification on various datasets	SDG 3	Good Health and Well-being	ML prediction models can support healthcare analytics and disease prediction applications.
CO4	apply clustering techniques for pattern	SDG 9	Industry, Innovation	Reinforcement learning and clustering support intelligent

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	discovery in unlabelled data and implement reinforcement learning concepts		and Infrastructure	automation and innovation.

BIG DATA ANALYTICS

Class: B. Tech. V – Semester		**Branch:** IT	
Course Code:	**U24IT503**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze digital data, address the challenges and understand the realm of Big Data

CO2 : develop solutions for big data problems using HDFS and map reduce programming

CO3 : apply NoSQL database techniques to store and retrieve data using MongoDB and Apache Cassandra.

CO4 : develop big data processing applications using Hive and Pig software tools

UNIT-I	**9 Hrs**

Types of Digital Data: Classification of digital data

Introduction to Big Data: Characteristics of data, Evolution of big data, Definition of big data, Challenges with big data, Other characteristics of data which are not definitional traits of big data, Traditional business intelligence versus big data, What is changing in the realms of big data

Big Data Analytics: Classification of analytics, Top challenges facing big data, Why is big data analytics important, What kind of technologies are we looking toward to help meet the challenges posed by big data, Data science, Data scientist your new best friend, Terminologies used in big data environments, Few top analytics tools

UNIT-II	**9 Hrs**

Introduction to Hadoop: Introducing hadoop, RDBMS versus hadoop, Distributed computing challenges, Hadoop overview, Use case of hadoop, HDFS, Processing data with hadoop, Managing resources and applications with hadoop YARN, Interacting with hadoop ecosystem

MapReduce and the New Software Stack: Distributed file systems, MapReduce, Algorithms using MapReduce, Extensions to MapReduce, The communication cost model, Complexity theory for MapReduce

UNIT-III	**9 Hrs**

Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data types in MongoDB, MongoDB query language

Introduction to Cassandra: Apache cassandra, Features of cassandra, CQL data types, CQLSH, Keyspaces, CRUD, Collections, Using a counter, Time to live, Alter commands, Import and export, Querying system tables

UNIT-IV	**9 Hrs**

Introduction to Hive: What is hive, Hive architecture, Hive data types, Hive file format, Hive query language, RCFile implementation, User defined functions

Introduction to Pig: What is pig, The anatomy of pig, Pig on hadoop, Pig philosophy, Use case for pig: ETL processing, Pig latin overview, Data types in pig, Running pig, Execution modes of pig, HDFS commands, Relational operators, Eval function, Complex data types, Piggy bank, User defined functions, Parameter substitution, Diagnostic operator, Word

count example using pig, When to use pig, When not to use pig, Pig versus Hive
Textbook(s): 1. Seema Acharya, Subhashini Chellappan, *Big Data and Analytics*, New Delhi: Wiley India Pvt. Ltd., 2nd edition 2019. 2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, *Mining of Massive Datasets,* United Kingdom: Cambridge University Press, 3rd edition, 2020.(*Chapter 2*).
Reference Book(s): 1. V.K. Jain, *Big Data and Hadoop*, New Delhi: Khanna Book Publishing Co. (P) Ltd., 2017. 2. DT Editorial Services, *Big Data (Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization), Black Book*, New Delhi: Dream Tech Press, 2015. 3. Tom White, *Hadoop: The Definitive Guide*, 4th ed., California: O'Reilly Media, Inc, 2015. 4. Raj Kamal and Preeti Saxena, *Big Data Analytics*, Chennai: McGraw Hill Education(India) Pvt. Ltd., 2019.
Web and Video link(s): 1. https://onlinecourses.nptel.ac.in/noc21_cs86/preview, *NPTEL Video Lecture on Introduction to Big Data Computing* by Prof. Rajiv Misra, IIT Patna. 2. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_cs13, *Swayam online Video Lecture on Data Science and Big Data* by Prof.Sandeep Singh Rawat, Indira Gandhi Open University, New Delhi.

Course Articulation Matrix (CAM):		**U24IT503 : BIG DATA ANALYTICS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT503.1**	1	1	-	-	-	-	-	1	1	-	1	1	-
CO2	**U24IT503.2**	1	2	1	1	1	-	-	1	1	-	1	1	1
CO3	**U24IT503.3**	2	2	2	2	1	-	-	1	1	-	1	2	2
CO4	**U24IT503.4**	2	2	2	2	1	-	-	1	1	-	1	2	2
U24IT503		**1.5**	**1.75**	**1.66**	**1.66**	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**1.5**	**1.66**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze digital data, address the challenges and understand the realm of Big Data.	SDG 4	Quality Education	Understanding big data concepts improves analytical skills and supports knowledge development in modern data-driven education.
CO2	develop solutions for big data problems using HDFS and	SDG 9	Industry, Innovation and Infrastructure	Big data frameworks like HDFS and MapReduce support large-scale data

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	MapReduce programming.			processing and innovative industrial data solutions.
CO3	apply NoSQL database techniques to store and retrieve data using MongoDB and Apache Cassandra.	SDG 9	Industry, Innovation and Infrastructure	NoSQL databases enable scalable data storage and management systems required for modern digital infrastructure.
CO4	Develop big data processing applications using Hive and Pig software tools.	SDG 9	Industry, Innovation and Infrastructure	Developing big data applications using tools like Apache Hive and Apache Pig, which support scalable data processing and innovation. These technologies enable efficient data analytics infrastructure, directly contributing to industrial growth and technological advancement

CRYPTOGRAPHY AND NETWORK SECURITY

Class: B. Tech. V– Semester		**Branch:** IT	
Course Code:	**U24IT504**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : classify different security attacks, services, mechanisms and symmetric key cryptographic algorithms

CO2 : apply mathematical concepts in cryptographic algorithms for providing security & key exchange

CO3 : categorize the hash & message authentication techniques and examine key management for distribution of keys

CO4 : analyze the security issues in application, transport & network layers for protecting data from unauthorized persons, intruders & malicious software

UNIT-I	**9 Hrs**

Information and Network Security Concepts: The OSI security architecture, Security attacks, Security services, Security mechanisms

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques

Block Ciphers and the Data Encryption Standard: Traditional block cipher structure, Simplified DES, The data encryption standard, The strength of DES, Block cipher operation

Advanced Encryption Standard: AES structure, AES transformation functions, AES key expansion

Self-Learning Topics: Block cipher design principles

UNIT-II	**9 Hrs**

Introduction to Number Theory: Modular arithmetic, Fermat's and Euler's theorems, Discrete logarithms

Public-Key Cryptography and RSA: Principles of public-key cryptosystems, The RSA algorithm

Other Public-Key Cryptosystems: Diffie-Hellman key exchange, Elliptic curve cryptography

Self-Learning Topics: Prime numbers, Elliptic curve arithmetic

UNIT-III	**9 Hrs**

Cryptographic Hash functions: Applications of cryptographic hash functions, Two simple hash functions, Secure hash algorithm (SHA)

Message Authentication Codes: Message authentication functions, Requirements for message authentication codes, Security of MACs, MACs based on Hash functions (HMAC), Digital signatures

Cryptographic Key Management and Distribution: Symmetric key distribution using symmetric and asymmetric encryption, Distribution of public keys, X.509 certificates

Self-Learning Topics: Message authentication requirements

UNIT-IV	9 Hrs

Electronic Mail Security: Internet Mail Architecture, Email formats, Email threats and comprehensive email security, S/MIME

Transport-Level Security: Web security considerations, Transport layer security

IP Security: IP security overview, IP security policy, Encapsulating security payload, Combining security associations

Network Endpoint Security: Firewalls

Self-Learning Topics: malicious software

Textbook(s):

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, Pearson Education, United Kingdom. 8th edition, 2023 *(Chapters 1 to 4, 6 to 7, 9 to 13, 15, 17 to 21)*

Reference Book(S):

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, *Cryptography and Network Security*, Mc Graw Hill Education, 2nd edition, 2010, New Delhi.
2. Atul Kahate Cryptohraphy and Network Security, McGraw Hill Education, New Delhi, 2003.
3. Dening. D, D, *Cryptography and Data Security*, Addison Wesley, United Kingdom, 1982.
4. V.K.Iain, *Cryptography and Network Security,* Khanna Publishing House, New Delhi, 2013.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc26_cs57/preview; *NPTEL Video Lecture on Cryptography and Network Security by Prof. Sourav Mukhopadhya, Department of Mathematics, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24IT504: CRYPTOGRAPHY AND NETWORK SECURITY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT504.1	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	U24IT504.2	2	2	2	1	-	-	-	-	-	-	-	2	2
CO3	U24IT504.3	3	3	2	1	-	1	-	-	-	-	-	2	1
CO4	U24IT504.4	2	2	1	1	-	1	-	-	-	-	-	2	2
U24IT504		2	2.33	1.67	1	-	1	-	-	-	-	-	2	1.67
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	classify different security attacks, services, mechanisms and symmetric key cryptographic algorithms	SDG9	Industry, Innovation and Infrastructure	Understanding security attacks and cryptographic mechanisms helps in building secure communication systems and resilient digital infrastructure, supporting innovation and safeguarding

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				industrial and information systems.
CO2	apply mathematical concepts in cryptographic algorithms for providing security & key exchange	SDG9	Industry, Innovation and Infrastructure	Mathematical foundations in cryptography enable secure key exchange and data protection, which are essential for modern digital technologies, secure communications, and innovation in cybersecurity systems.
CO3	categorize the hash & message authentication techniques and examine key management for distribution of keys	SDG16	Peace, Justice and Strong Institutions	Hashing, authentication, and secure key management ensure data integrity, confidentiality, and trust in digital transactions, contributing to secure information systems and strong institutional frameworks.
CO4	analyze the security issues in application, transport and network layers for protecting data from unauthorized persons, intruders & malicious software	SDG16	Peace, Justice and Strong Institutions	Identifying and mitigating application, transport and network layer vulnerabilities enhances cybersecurity, protects users from cyber threats, and ensures safe digital communication environments.

FULL STACK DEVELOPMENT

Class: B. Tech. V–Semester		**Branch:**IT	
Course Code:	**U24IT505**	**Credits:**	**4**
Hours/Week (L-T-P-E):	**3-1-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**48 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : identify full stack components for developing web applications

CO2 : apply packages of Node.js to work with data, files, HTTP Requests and Responses

CO3 : use MongoDB database for storing and processing huge data and connects with Node.js applications

CO4 : create and design interactive user interfaces with React components and use Express and Angular for web applications development

UNIT-I	**12 Hrs**

Introduction to Full Stack Development: Understanding the basic web development framework- user, browser, webserver, backend services, Full stack components - Node.js, MongoDB, Express, React, Angular, NodeJS- understanding Node.js, Installing Node.js, Working with node packages, creating a Node.js application, Understanding the Node.js event model, Addingwork to the event queue, Implementing callbacks

Self-learning topics: *Basic tags of HTML, JavaScript Fundamentals*

UNIT-II	**12 Hrs**

Node.js: Working with JSON, Using the buffer module to buffer data, Using the stream module to stream data, Accessing the file system from Node.js- opening, closing, writing, reading files and other file system tasks, Implementing HTTP services in Node.js- processing URLs, Processing query strings and form parameters, Understanding request, response, and server objects, Implementing HTTP clients and servers in Node.js, Implementing HTTPS servers and clients, Using additional Node.js modules-using the osmodule, Using the util module, Using the dnsmodule, Using the crypto module

Self-learning topics:*Introduction to Node.js*

UNIT-III	**12 Hrs**

MongoDB: Understanding MongoDB, MongoDB data types, Planningyour data model, Building the MongoDB environment, Administeringuser accounts, Configuringaccess control, Administeringdatabases, Managingcollections, Adding the MongoDB driver to Node.js, Connecting to MongoDB from Node.js, Understanding the objects used in the MongoDB Node.js driver, Accessing and manipulating databases, Accessing and manipulating collections

Self-learning topics:*Introduction to NoSQL database*

UNIT-IV	**12 Hrs**

Express and Angular: Configuring Routes, Usingrequests objects, Usingresponse objects, Angular: understanding angular, creating a basic angular application, Angular components, Expressions, Data binding, Built-in directives, Custom directives, Implementing angular services in web applications

React: Introducing react components, Creatingcomponents in react, Rendering and life cycle methods in react, Working with forms in react

Self-learning topics:*Getting started with express, Importance of angular, Need of react*

Textbook(s):

1. Brad Dayley Brendan Dayley Caleb Dayley, *Node.js, MongoDB and Angular Web Development,* Addison-Wesley, 2nd edition, 2019, USA.
2. Mark Tielens Thomas, *React in Action,* Manning Publications, USA ,1st edition, 2018.

Reference Book(s):

1. Vasan Subramanian, *Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node*, Apress, India , 2nd edition 2019.
2. Chris Northwood, *The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*, Apress, India, 1st edition, 2008.
3. Kirupa Chinnathambi, *Learning React: A Hands-On Guide to Building Web Applications using React and Redux*, Addison-Wesley Professional, India. 2nd edition, 2018,
4. Mayur Ramgir, *Full Stack Java Development with Spring MVC, Hibernate, jQuery, and Bootstrap*, Wiley Publications, India, , 1st edition, 2020.

Web and Video link(s):

1. https://tutedude.com/category/mernstack; *TuteDude on Become a certified Web Development MERN Stack expert.*

Course Articulation Matrix (CAM):		U24IT505 :FULL STACK DEVELOPMENT												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT505.1	1	2	2	1	-	-	1	-	1	-	-	2	2
CO2	U24IT505.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24IT505.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24IT505.4	2	2	3	3	-	-	1	-	1	-	2	2	2
U24IT505		1.75	2	2.25	1.75	-	-	1	-	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify full stack components for developing web applications	SDG4	Quality Education	Full-stack knowledge helps build e-learning platforms, virtual labs, and scalable tools that improve access to education and digital literacy
CO2	apply packages of Node.js to work with data, files, HTTP Requests and Responses	SDG9	Industry, Innovation and Infrastructure	Node.js enables fast backend systems and real-time applications, supporting strong digital infrastructure and innovation across industries
CO3	use MongoDB database for storing and processing huge data and connects with Node.js applications	SDG11	Sustainable Cities and Communities	Efficient data management is crucial for smart city applications, and MongoDB enables scalable handling of large, real-time data
CO4	create and design	SDG8	Decent Work	Modern web interfaces support

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	interactive user interfaces with React components and use Express and Angular for web applications development		and Economic Growth	digital businesses and remote work, creating jobs and driving economic growth

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Class: B.Tech. V – Semester		**Branch:** IT	
Course Code:	**U24IK506B**	**Credits:**	**2**
Hours/Week (L-T-P-E):	**2-0-0-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga

CO2 : explain Vedas as principal source of knowledge for scientific inventions

CO3 : describe different yogasanas, breathing techniques, chakras, meditation and their benefits

CO4 : discuss the benefits of yoga as an effective tool for management of human crisis

UNIT-I	**6 Hrs**

Basic Structure of Indian Knowledge System:

Introduction, Vedas – origin, classification, structure, Rig Veda, Sama Veda, Yajur Veda, Atharva Veda, UpaVedas – DhanurVeda, SthapatVeda, GandharvaVeda, AyurVeda, Vedanga – Shiksha, Chanda, Vyakarna, Nirukta, Kalpa, Jyothisha, Upanga – Dharmashastra, Mimamsa, Tarkashastra, Purana

UNIT-II	**6 Hrs**

Modern Science and Indian Knowledge System:

Introduction, Vedas as basis for modern science, architectural developments, medicine and its relevance, mathematical sciences in Vedas, space and military related developments, chemical sciences

UNIT-III	**6 Hrs**

Yoga and Holistic Health Care:

Healthy mind in healthy body, yoga: definition, types, yoga to keep fit: diet, yoga asanas, fundamentals, breathing techniques in Patanjali yoga tradition, pranayama, chakras, meditation, benefits of yoga – physical health, emotional health, prevention of disease, reducing or alleviating symptoms of problems

UNIT-IV	**6 Hrs**

Case Studies – Yoga Practice:

Yoga as an effective tool for management of human crisis – depression, self-concept & mental health, yoga for stress management, yoga: a way to cure for insomnia.

Requisite: Yoga practice sessions are to be conducted for all students taking this course by the time they complete Unit 1 and Unit 2.

Textbook(s):

1. Sathish Chandra Chaterjee, Dhirendramohan Datta, *An Introduction to Indian Philosophy*, New Delhi: Rupa Publications Pvt. Ltd. (Chapter 2, 3).
2. Priyadaranjan Ray, S.N. Sen, *The Cultural Heritage of India*, Vol. 6, Science and Technology, Kolkata: The Ramakrishna Mission Institute of Culture.
3. *Yoga Sutra of Patanjali*, Kolkata: Ramakrishna Mission.
4. RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, New Delhi: VidyanidhiPrakasham, 2016 (Chapter 4, 5, 6, 7, 8).

Reference Book(s):

1. Swami Jitatmananda, *Holistic Science and Vedanta,* Mumbai: Bharatiya Vidya Bhavan (Chapter 2, 3).

Web and Video link(s):

1. NPTEL courses on Indian Philosophy, Yoga and Vedic Sciences available at https://onlinecourses.nptel.ac.in

Course Articulation Matrix (CAM):		U24IK506B : ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IK506B.1	-	-	-	-	-	1	-	2	1	1	-	-	-
CO2	U24IK506B.2	-	-	-	-	-	1	1	2	1	1	-	-	-
CO3	U24IK506B.3	-	-	-	-	-	1	-	2	2	1	2	-	-
CO4	U24IK506B.4	-	-	-	-	-	1	1	2	2	1	2	-	-
U24IK506B		-	-	-	-	-	1	1	2	1.5	1	2	-	-
		3 – HIGH, 2 – MEDIUM, 1 – LOW												

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga	SDG4	Quality Education	Understanding the foundational structure of Indian knowledge systems supports holistic education, critical thinking, and cultural literacy, contributing to quality and inclusive education.
CO2	explain Vedas as principal source of knowledge for scientific inventions	SDG9	Industry, Innovation and Infrastructure	Recognizing Vedic contributions to science and technology highlights indigenous innovation in areas such as mathematics, architecture and medicine, inspiring modern sustainable technological development.
CO3	describe different yogasanas, breathing techniques, chakras, meditation and their benefits	SDG3	Good Health and Well-being	Knowledge of yoga, pranayama, and meditation directly promotes physical health, mental well-being, and disease prevention, supporting the SDG goal of ensuring healthy lives for all.
CO4	discuss the benefits of yoga as an effective tool for management of human crisis	SDG3	Good Health and Well-being	Understanding yoga as a therapeutic tool for depression, stress, and insomnia contributes to mental health management and holistic wellness, aligning with SDG3 targets on mental health.

MACHINE LEARNING LABORATORY

Class: B. Tech. V – Semester		**Branch:** IT	
Course Code:	**U24IT507**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply preprocessing techniques on different datasets

CO2 : apply feature engineering methods for relevant feature extraction

CO3 : analyze different classification and regression algorithms

CO4 : apply clustering techniques for pattern discovery and implement reinforcement learning concepts

LIST OF EXPERIMENTS

Experiment-1

1. a) Creation and loading different types of datasets in Python using the required libraries.
   i. Creation using pandas
   ii. Loading CSV dataset files using Pandas
   iii. Loading datasets using sklearn

   b) Write a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets

Experiment-2

2. Demonstrate various data pre-processing techniques for a given dataset. Write a python program to compute
   i. Reshaping the data,
   ii. Filtering the data,
   iii. Merging the data
   iv. Handling the missing values in datasets

Experiment-3

3. Develop a program to apply Min-Max scaling and Z-score normalization
4. Demonstrate evaluation of a model using performance metrics for Classification and Regression models

Experiment-4

5. Implement Dimensionality Reduction using Principle Component Analysis method on a iris dataset
6. Implement Dimensionality Reduction using Linear Discriminant Analysis method on appropriate dataset.

Experiment-5 (UNIT-II)

7. The probability that it is Friday and that a student is absent is 3%. Since there are 5 school days in a week, the probability that it is Friday is 20%. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.(Ans: 15%)
8. Compute Joint Probability and Conditional Probability using a real dataset and verify

theoretical relationships.

Experiment-6

9. Implement naive Baye's theorem to classify the English text.
10. Develop a program to implement the Naive Bayesian Classifier considering Olivetti Face Data set for training. Compute the accuracy of the classifier, considering a few test data sets

Experiment-7

11. Write a Python program to implement Simple Linear Regression for iris using Sklearn and plot the confusion matrix.
12. Develop a program to train Logistic Regression model, plot decision boundary and evaluate performance

Experiment-8

13. Write a program to demonstrate the working of the Decision Tree based ID3 algorithm by considering a dataset.
14. Consider a dataset, use Random Forest to predict the output class. Vary the number of trees as follows and compare the results: i. 20 ii. 50 iii. 100 iv. 200 v. 500
15. Build KNN Classification model for a given dataset. Vary the number of k values as follows and compare the results: i. 1 ii. 3 iii. 5 iv. 7 v. 11

Experiment-9

16. Implement Support Vector Machine for a dataset and compare the accuracy by applying the following kernel functions:
    i. Linear
    ii. Polynomial
    iii. RBF

Experiment-10

17. Write a python program to implement K-Means clustering Algorithm. Vary the number of k values as follows and compare the results: i. 1 ii. 3 iii. 5
18. Develop a program to generate dendrogram using Hierarchical Clustering

Experiment-11

19. Develop a program to demonstrate DBSCAN and identify noise points

Experiment-12

20. Develop a program to implement Simple Grid Environment and apply Q-learning

Textbook(s):

1. Saikat Dutt, S. Chandramouli, Das – *Machine Learning*, Pearson, 1st edition.
2. Tom M Mitchell, —*Machine Learning*, McGraw Hill Education, 1st edition 2013.

Reference Book(S):

1. Dr. Rajiv Chopra, *Machine Learning*, Khanna Book Publications, 2nd edition.
2. Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, John Wiley & Sons, Canada, 2014.
3. Tom M. Mitchell, Jaime G. Carbonell,Ryszard S. Michalski, *Machine Learning: A Guide to Current Research*, West Springfield Avenue, Kluwer Academic Publishers, 2011.
4. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, London, 2012.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs101/preview; *NPTEL Video Lecture on Introduction to Machine Learning by Prof. Balaraman Ravindran, Professor of CSE, IIT Madras.*

Course Articulation Matrix (CAM):		U24IT507: MACHINE LEARNING LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT507.1	3	3	2	2	3	1	-	-	1	1	-	3	2
CO2	U24IT507.2	3	3	3	2	3	-	-	-	1	1	-	3	3
CO3	U24IT507.3	3	3	3	3	3	1	-	-	1	1	-	3	3
CO4	U24IT507.4	3	3	2	3	3	1	1	-	1	1	-	3	3
U24IT507		3	3	2.5	2.5	3	1	1	-	1	1	-	3	2.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply preprocessing techniques on different datasets	SDG 4	Quality Education	Develops technical knowledge and analytical skills in data handling and preprocessing techniques.
CO2	apply feature engineering methods for relevant feature extraction	SDG9	Industry, Innovation and Infrastructure	Enhances intelligent systems through optimized feature extraction and machine learning efficiency.
CO3	analyze different classification and regression algorithms	SDG3	Good Health and Well-being	Classification and prediction models can support healthcare analytics and disease prediction systems.
CO4	apply clustering techniques for pattern discovery and implement reinforcement learning concepts	SDG 9	Industry, Innovation and Infrastructure	Reinforcement learning and clustering contribute to intelligent automation and smart systems.

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FULL STACK DEVELOPMENT LABORATORY

Class: B. Tech. V–Semester		**Branch:**IT	
Course Code:	**U24IT508**	**Credits:**	**1**
Hours/Week (L-T-P-E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : design and develop the web pages using HTML and Java Script

CO2 : develop the server-side applications using the packages of Node.js to work with data, files, HTTP request and response objects

CO3 : develop data base applications using MongoDB for storing and processing huge data and connects with Node.js applications

CO4 : design and develop interactive user interfaces with React components and using Express and Angular for web applications

LIST OF EXPERIMENTS

Experiment-1

1. Write a JavaScript to find the factorial of a given number
2. Write a JavaScript to check the given number is prime or not
3. Write a JavaScript to design a simple calculator to perform basic arithmetic operations

Experiment-2

4. Write a JavaScript that calculates the squares and cubes of the numbers from 1 to 10 and display the resulting values in an HTML table format
5. Write a JavaScript code that displays text "TEXT-GROWING" with increasing font size in the interval of 100ms in red colour, when the font size reaches 50pt it displays "TEXT-SHRINKING" in blue colour and font size decreases to 5pt

Experiment-3

6. Develop an application using HTML and JavaScript (Use functions) for the following problems:
   a. Parameter: Any string
      Output: The position of the left-most vowel in the string
   b. Parameter: Any number
      Output: Display the number in reverse order
7. Develop and validate the user registration form using JavaScript

Experiment-4

8. Create an application to setup Node.js environment and display "Hello World"
9. Write a Node.js program to reverse the given string
10. Write a Node.js program to perform read, write and other operations on a file
11. Write a Node.js program to demonstrate user defined modules

Experiment-5

12. Write a Node.js program to demonstrate accessing static files using HTTP webserver and client
13. Write a Node.js program to demonstrate accessing dynamic content through GET

method using HTTP webserver and client

14. Write a Node.js program to read form data from query string and generate response using Node.js
15. Write a Node.js program to demonstrate events and call back functions

Experiment-6

16. Create a Node.js application for user login system
17. Create a food delivery website where users can order food from a particular restaurant listed in the website for handling http requests and responses using Node.js

Experiment-7

18. Program to implement basic commands on databases and collections using MongoDB

Experiment-8

19. Perform Count, Limit, Sort, and Skip operations on the given collections using MongoDB

Experiment-9

20. Program to implement CRUD operations on the given dataset using MongoDB

Experiment-10

21. Program to print the message 'Hello world!' using Express.js
22. Program to demonstrate configuring and implementing routes using Express.js
23. Program to demonstrate applying route parameters in Express.js

Experiment-11

24. Commands for Angular installation, create and running Angular Apps
25. Angular component configuration
26. Program to demonstrate using inline CSS and HTML in Angular applications

Experiment-12

27. Develop a web application to manage student information using Express.js and Angular.js
28. Develop an application to create a simple calculator Application using React.js
29. Develop an application to create a voting application using React.js

Textbook(s):

1. Brad Dayley Brendan Dayley Caleb Dayley, *Node.js, MongoDB and Angular Web Development,* Addison-Wesley, USA , 2nd edition 2019.
2. Mark Tielens Thomas, *React in Action,* Manning Publications, 1st edition, 2018

Reference Book(s):

1. Vasan Subramanian, *Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node*, Apress, 2nd edition, 2019
2. Chris Northwood, *The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*, Apress, 1st edition,2018
3. Kirupa Chinnathambi, *Learning React: A Hands-On Guide to Building Web Applications Using React and Redux*, Addison-Wesley Professional, 2nd edition, 2018
4. Mayur Ramgir, *Full Stack Java Development with Spring MVC, Hibernate, jQuery, and Bootstrap*, Wiley Publications, India, 1st edition, 2020

Laboratory Manual (for laboratory component):

1. *Full Stack Development Laboratory Manual,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT508: FULL STACK DEVELOPMENT LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT508.1	2	2	2	2	2	-	-	1	1	-	2	2	1
CO2	U24IT508.2	2	2	2	2	2	-	-	1	1	-	2	2	1
CO3	U24IT508.3	2	2	2	2	2	-	-	1	1	-	2	2	1
CO4	U24IT508.4	2	2	2	2	2	-	-	1	1	-	2	2	1
U24IT508		2	2	2	2	2	-	-	1	1	-	2	2	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** The student should be able to…	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	design and develop the web pages using HTML and Java Script	SDG9	Industry, Innovation and Infrastructure	Full-stack knowledge helps build e-learning platforms, virtual labs, and scalable tools that improve access to education and digital literacy
CO2	develop the server-side applications using the packages of Node.js to work with data, files, HTTP request and response objects	SDG9	Industry, Innovation and Infrastructure	Node.js enables fast backend systems and real-time applications, supporting strong digital infrastructure and innovation across industries
CO3	develop data base applications using MongoDB for storing and processing huge data and connects with Node.js applications	SDG11	Sustainable Cities and Communities	Efficient data management is crucial for smart city applications, and MongoDB enables scalable handling of large, real-time data
CO4	design and develop interactive user interfaces with React components and using Express and Angular for web applications	SDG8	Decent Work and Economic Growth	Modern web interfaces support digital businesses and remote work, creating jobs and driving economic growth

SEMINAR

Class: B. Tech. V – Semester		**Branch: IT**	
Course Code:	**U24IT510**	**Credits:**	**1**
Hours/Week (L-T-P-E):	**0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	**-**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines/ conference proceedings

CO2 : demonstrate the skills for performing a literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report

CO3 : create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic

CO4 : write a "seminar paper" in scientific journal style & format from the prepared seminar report

Student has to give an independent seminar on the state-of-the-art technical topics relevant to their program of study, which would supplement and complement the program assigned to each student.

Guidelines:

1. The HoD shall constitute a Department Seminar Evaluation Committee (DSEC)
2. DSEC shall allot a faculty supervisor to each student for guiding on (i) selection of topic, (ii) literature survey and work to be carried out (iii) preparing a report in proper format, and (iv) effective seminar presentation
3. There shall be only Continuous Internal Evaluation (CIE) for seminar
4. The CIE for seminar is as follows:

S.No	Assessment Component	Weightage	CO Mapping	PO Mapping
1	Supervisor Assessment	20	CO2, CO3	PO9, PO10
2	Choice of Base Paper	10	CO1, CO2	PO1, PO2, PO8
3	Seminar Report	30	CO3	PO4, PO5
4	Alignment with SDG's	10	CO3, CO4	PO6, PO7, PO8
5	DSEC Assessment: Oral,Presentation with PPT and Viva-Voce	30	CO3	PO9, PO10

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation

(a) **Seminar Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest.

(b) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DSEC.*

(c) **Anti-Plagiarism Check:** The seminar report should clear the plagiarism check as per the Anti-Plagiarism (including AI Plagiarism) policy of the institute Plagiarism. (Allowed Similarity % : Maximum 40%, From single Source : Max. 10% & No. of consecutive words: max. 10)

(d) **Presentation:** Each student should prepare a PPT with informative slides and make an effective oral presentation before the *DSEC* as per the schedule notified by the department.

(e) The student has to register for the Seminar as a supplementary examination in the following cases:
   i) The student is absent for oral presentation and viva-voce
   ii) The student fails to submit the report in prescribed format
   iii) The student fails to fulfill the requirements of seminar evaluation as per specified guidelines.
   iv) The CoE shall send a list of students registered for supplementary to the HoD concerned
   v) The DSEC, duly constituted by the HoD, shall conduct seminar evaluation and send the award list to the CoE within the stipulated time

Seminar Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
1	Supervisor Assessment	Regularity & Interaction (5M)	20
		Understanding of Topic (5M)	
		Progress &Timely Completion(5M)	
		Communication Skills (5M)	
2	Choice of Base Paper	Reputed Journals (5M)	10
		Base Paper Publication Year (5M)	
3	Seminar Report	Structure, Formatting (5M)	30
		Technical Depth (5M)	
		Case studies / applications (5M)	
		Clarity, Coherence & Writing (5M)	
		Critical Analysis & Insights (5M)	
		References and originality (5M)	
4	Allignment to SDGs	SDG Mapping & Impact Analysis (5M)	10
		Justification of SDG mapping, Clarity, Presentation & Originality (5M)	
5	DESC Assessment	PPT Quality (5M)	30
		Presentation Skills (10)	
		Subject Knowledge (10)	
		Time Management (5)	

Course Articulation Matrix (CAM):		U24IT510: SEMINAR												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT510.1	2	2	-	2	2	1	1	-	1	-	3	1	1
CO2	U24IT510.2	2	3	1	3	2	1	1	1	2	-	3	1	1
CO3	U24IT510.3	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	U24IT510.4	1	2	1	2	2	1	2	1	3	-	2	1	1
U24IT510		1.5	2	1	2	2	1.25	1.25	1.33	2.33	1	2.5	1	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement (The student should be able to…)	Relevant SDG	SDG Description	Mapping Justification
CO1	select current topics in their engineering discipline & allied areas from peer reviewed	SDG 4	Quality Education	Identifying and studying emerging ECE technologies such as 6G communications, VLSI, IoT, Artificial Intelligence, Embedded Systems, and

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	journals / technical magazines/ conference proceedings			Signal Processing promotes self-directed learning, technical competency, and continuous knowledge acquisition.
CO2	demonstrate the skills for performing literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report	**SDG 9**	Industry, Innovation and Infrastructure	Literature review and technical analysis of advanced communication systems, semiconductor technologies, smart electronics, and intelligent networks foster innovation, research culture, and technological infrastructure development.
CO3	create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic	**SDG 11**	Sustainable Cities and Communities	Seminar presentations on smart cities, intelligent transportation systems, IoT-enabled urban services, disaster management systems, and smart communication networks highlight the role of ECE technologies in building sustainable and connected communities.
CO4	write a "seminar paper" in scientific journal style & format from the prepared seminar report	**SDG 12**	Responsible Consumption and Production	Preparation of technical papers promotes ethical dissemination of research findings, proper citation practices, responsible use of information resources, and documentation of sustainable engineering solutions.

6th Semester Syllabi

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credit Assigned

VI SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE-II	U24OE601X-S&EB	Startups & Entrepreneurship Basket *(from Pool-VII)*	2	1	-	3	3
2	PEC	U24IT602X	Program Elective –I / MOOCs-I *(from Pool-VIII)*	2	1	-	3	3
3	PCC	U24IT603	Cloud Computing	3	1	-	4	4
4	ESC	U24IT604	Introduction to Internet of Things	2	1	-	3	3
5	SEC	U24SE605	Programming Skill Development Lab –05	-	-	2	2	1
6	IKSC	U24IK606A	Universal Human Values – II	2	-	-	2	2
7	HSMC	U24MH607	Technical English	-	-	2	2	1
8	PCC	U24IT608	Cloud Computing Laboratory	-	-	2	2	1
9	ESC	U24IT609	Internet of Things Laboratory	-	-	2	2	1
10	ELC	U24IT610	Mini Project	-	-	2	2	1
			Total:	11	4	10	25	20
			Additional Learning@:Maximum credits allowed for Honours/Minor	-	-	-	-	5
			Total credits for Honours/Minor students:	-	-	-	-	25
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)								

@List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula

B. Tech Honours with Research:

Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-II(5 Credits) at respective department during the summer vacation after VI Semester.

Pool -VII Startups & Entrepreneurship Basket (OE - S&EB)		
S. No.	**Course Code**	**Course Title**
1.	U24OE601A	Design Thinking
2.	U24OE601B	Innovative Product Design and Development
3.	U24OE601C	Entrepreneurship
4.	U24OE601D	Design Studio
5.	U24OE601Z	Any other course approved by BoS Chair and Dean AA

	Pool –VIII Program Elective – I	
S. No.	**Course Code**	**Course Title**
1	U24IT602A	Cyber Security
2	U24IT602B	Generative Artificial Intelligence
3	U24IT602C	Advanced Computer Networks
4	U24IT602D	Parallel Programming
5	U24IT602E	Applications of IoT

Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute
OR
Successful completion of two suitable skill based courses (external) to qualify for Certification

C. After Third Year: (B. Tech. Voc. in IT)

(i) The candidate should pass any two of the following additional courses (Degree Level) during the 2-Months internship at institute

Exit Option to Qualify B. Voc in IT: Any Two (02) Courses during the 2 - Months internship									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	**PCC**	**U24IT611X**	**Natural Language Processing**						
		U24IT612X	**Software Testing**	**2**	**-**	**2**	**-**	**4**	**3**
2	**PCC**	**U24IT613X**	**Fundamentals of DevOps**	**2**	**-**	**2**	**-**	**4**	**3**
3	**PCC**	**U24IT614X**	**Cyber Security**	**2**	**-**	**2**	**-**	**4**	**3**
4	**PCC**	**U24IT615X**	**Any other course approved by BoS Chair andDean AA**	**2**	**-**	**2**	**-**	**4**	**3**

(OR)

(ii) Any two suitable skill based courses to qualify for B. Voc. in IT Degree.

Exit Option to Qualify B. Voc. in IT: Any Two (02) Skill based Courses -:									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	**SEC**	**U24SE611X**	**Deep Learning using Python** https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-with-python	**-**	**-**	**6**	**-**	**6**	**3**
2	**SEC**	**U24SE612X**	**Cyber Security Tools** https://onlinecourses.swayam2.ac.in/	**-**	**-**	**6**	**-**	**6**	**3**

			nou19_cs08/preview						
3	**SEC**	**U24SE613X**	**Automated Testing Tools** https://www.udemy.com/course/automated-software-testing-with-python/?couponCode=ST3MT72524	**-**	**-**	**6**	**-**	**6**	**3**
4	**SEC**	**U24SE614X**	**DevOps** https://www.udemy.com/course/devops-with-docker-kubernetes-and-azure-devops/?couponCode=ST3MT72524	**-**	**-**	**6**	**-**	**6**	**3**
5	**SEC**	**U24SE615X**	**Any other skill based course approved by BoS Chair and Dean AA**	**-**	**-**	**6**	**-**	**6**	**3**

DESIGN THINKING

Class: B. Tech. – VI -Semester		**Branch:** IT	
Course Code:	**U24OE601A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks

CO2 : analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions

CO3 : develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies

CO4 : evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching

UNIT-I	**9 Hrs**

Identify and Analyze Real-world Problems: The Macro Industry View, Problem Identification & Segment Assembly, Customer Identification & Needs Validation, Assess 'Jobs-To-Be-Done' (JTBD) for a Customer Segment, Develop Customer Persona, Validate Customer-Problem fit, Pivot/Refine Customer-Problem fit for feasibility, Examine Ideation Techniques

UNIT-II	**9 Hrs**

Solution Idea Generation & MVP: Opportunity & Competition Mapping, Prototype Development & Minimum Viable Product (MVP), Identify Global Competitors, Review Industry Trends and Estimate Market Size (TAM), Introduction to Financial Planning, Overview of Prototypes & MVP, Build an initial Prototype, Prototypes for Early Validation, Map your Relative Position in the Market, Estimate Opportunity Size

UNIT-III	**9 Hrs**

Market Feasibility & Business Modeling: Lean Canvas Assembly, Marketing & Go-To-Market (GTM) Strategy, Examine Revenue Models, Review and Organize Lean Canvas, Build LC for your Start-up, Build LC for your Start-up, Understand Marketing and Sales, Recommend a GTM Approach, Map a Sales Process, Building an Initial Team

UNIT-IV	**9 Hrs**

Financial Management, Team Scale & Final Pitch: Funding Pathways & Scaling Orientation, Validation & Venture Presentation/Collaboration, Deep Dive into Financial Planning, Analyse the Path to Profitability, Understand Bootstrapping & Funding Options, Finding Co-Founders and Mentors, Thinking Beyond the Prototype - Scale Opportunity & Orientation, Final Milestone - Venture Idea Feasibility Presentation

Textbook(s):

1. Chandramouli Subramanian & Thiyagarajan p, Sankaran V, Design Thinking: A Hands-on Approach, University Press (India) Pvt. Ltd., 1st Edn., 2025, Hyderabad.

Reference Book(s):

1. Andrew Pressman, Design Thinking: A Guide to Creative Problem Solving for Everyone, Routledge, Taylor & Francis Group, 7th Edn., 2019, New York.
2. George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw-Hill Education, 13th Edn, 2020, New Delhi.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires

Innovation, HarperBusiness, 7th Edn., 2009, New York.
4. Karl T. Ulrich, Steven D. Eppinger, and Maria C. Yang, Product Design and Development, McGraw-Hill Education, 2020, New Delhi.
5. Tom Kelley and David Kelley, Creative Confidence: Unleashing the Creative Potential Within Us All, Crown Business, 2013, New York.
6. Idris Mootee, Design Thinking for Strategic Innovation, John Wiley & Sons, 1st Edn.,2013, New Jersey.

Web and Video link(s): .

1. https://nptel.ac.in/courses/110106124; *NPTEL Video Lecture on Design Thinking - A Primer by Prof. Ashwin Mahalingam & Prof. Bala Ramadurai, IIT Madras*.https://www.coursera.org/learn/design-thinking-innovationhttps://www.ideou.com/

Course Articulation Matrix (CAM):		U24OE601A - Design Thinking											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24OE601A.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601A.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601A.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601A.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601A.2		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks	**SDG 4**	**Quality Education**	Promotes creative learning, problem-solving, and innovation skills among students.
		SDG 9	**Industry, Innovation and Infrastructure**	Encourages innovative thinking for solving engineering and societal challenges.
CO2	analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions	**SDG 3**	**Good Health and Well-being**	Human-centered design improves usability, safety, and user well-being.
		SDG 11	**Sustainable Cities and Communities**	Supports identification of sustainable and community-oriented solutions.
CO3	develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies	**SDG 9**	**Industry, Innovation and Infrastructure**	Promotes innovation, product development, and technological advancement.
		SDG 12	**Responsible Consumption and Production**	Encourages efficient resource utilization and sustainable product development.
CO4	evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching	**SDG 8**	**Decent Work and Economic Growth**	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	**Industry, Innovation and Infrastructure**	Encourages development of practical and scalable engineering solutions.
		SDG 17	**Partnerships for the Goals**	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

INNOVATIVE PRODUCT DESIGN & DEVELOPMENT

Class: B. Tech. – VI -Semester		**Branch:** IT	
Course Code:	**U24OE601B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

- **CO1:** create the systematic lifecycle of engineering design from customer requirements to technical specifications
- **CO2:** choose principles of industrial design, materials science, and ergonomics to optimize product usability
- **CO3:** implement the advanced rapid prototyping tools to compress the product development cycle
- **CO4:** design and build prototype performance using structural validation, risk analysis, and engineering metrics

UNIT-I	**9 Hrs**

Introduction to product design engineering: Translating user needs into Product Design Specifications (PDS); Quality Function Deployment (QFD) and the House of Quality framework; Functional decomposition and physical architecture mapping; Regulatory compliance, standards, and safety considerations in product architecture.

UNIT-II	**9 Hrs**

Principles of Industrial Design (ID): Human-centered design and Ergonomics (Anthropometry); Visual hierarchy, form generation, and product aesthetics; Material selection frameworks (structural, thermal, electrical properties) and manufacturing process mapping (DFM/DFA: Design for Manufacturing and Assembly); Design semantics and user-interface touchpoints.

UNIT-III	**9 Hrs**

Prototyping strategies: proof-of-concept vs. alpha/beta prototypes: Additive manufacturing (3D Printing: FDM, SLA, SLS) and subtractive techniques (CNC machining); Rapid tooling, silicone molding, and vacuum forming; Digital prototyping: Computer-Aided Design (CAD) modeling, assembly verification, and finite element simulations; Virtual and Augmented Reality (VR/AR) workflows for product spatial validation.

UNIT-IV	**9 Hrs**

Design of Experiments (DoE) for physical/digital prototypes: Robust design testing and failure analysis; Cost modeling, Bill of Materials (BOM) management, and engineering change orders (ECO); Sustainable engineering: Design for Environment (DFE) and lifecycle evaluation; Preparing the product blueprint for production scaling and supply chain onboarding.

Textbook(s):

1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, Tata McGraw-Hill, 10th Edn, 2012, New Delhi.

Reference Book(S):

1. Devdas Shetty, Product Design for Engineers, Cengage Learning, 9th Edn, 2015, Boston.
2. A.K. Chitale and R.C. Gupta, Product Design and Manufacturing, PHI Learning, 2013, 13th Edn, New Delhi.
3. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education, 2001, New Delhi.
4. Benjamin W. Niebel and Alan B. Draper, Product Design & Process Engineering, McGraw-Hill, 1974, New York.
5. Paul Trott, Innovation Management and New Product Development, Pearson Education, 2016, Harlow.

Web and Video link(s): .

1. https://nptel.ac.in/courses/112107217; *NPTEL Video Lecture on Product Design and Development by Prof. Inderdeep Singh, Professor of Mechanical and Industrial Engineering, IIT Roorkee*.https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/

Course Articulation Matrix (CAM):		U24OE601B - INNOVATIVE PRODUCT DESIGN & DEVELOPMENT												
CO		PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	U24OE601B.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601B.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601B.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601B.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601B		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Course Outcome and SDG Goal Mapping:

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	create the systematic lifecycle of engineering design from customer requirements to technical specifications	**SDG 4**	Quality Education	Promotes creative learning, problem-solving, and innovation skills among students.
		SDG 9	Industry, Innovation and Infrastructure	Encourages innovative thinking for solving engineering and societal challenges.
CO2	choose principles of industrial design, materials science, and ergonomics to optimize product usability	**SDG 3**	Good Health and Well-being	Human-centered design improves usability, safety, and user well-being.
		SDG 11	Sustainable Cities and Communities	Supports identification of sustainable and community-oriented solutions.
CO3	implement the advanced rapid prototyping tools to compress the product development cycle	**SDG 9**	Industry, Innovation and Infrastructure	Promotes innovation, product development, and technological advancement.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization and sustainable product development.
CO4	design and build prototype performance using structural validation, risk analysis, and engineering metrics	**SDG 8**	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

ENTREPRENEURSHIP

Class: B. Tech. –VI -Semester		**Branch:** IT	
Course Code:	**U24OE601C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility

CO2 : analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques

CO3 : create students with practical knowledge of business modeling, unit economics, and venture monetization

CO4 : build a clear roadmap for executing, legally safeguarding, and pitching a new venture

UNIT-I	**9 Hrs**

Introduction to Entrepreneurship: definitions, characteristics, and the evolution of an entrepreneurial ecosystem; Myths vs. Realities of starting up; Types of entrepreneurship (Social, Tech, Lifestyle, and Corporate);

Developing an entrepreneurial mindset: risk-taking, resilience, self-efficacy, and dealing with failure; Identifying personal strengths and alignment with venture archetypes.

UNIT-II	**9 Hrs**

Deep-dive Problem Identification: moving from generic ideas to systemic problems; Root-cause analysis, stakeholder mapping, and ecosystem friction points;

Customer Discovery methodology: conducting ethnographic interviews, building user personas, and mapping customer archetypes; Validating market pain points vs. "nice-to-have" solutions; Value Proposition Canvas framework.

UNIT-III	**9 Hrs**

Designing the business architecture: Introduction to the Lean Canvas and Business Model Canvas (BMC); Revenue streams, pricing strategies, and cost structures;

Fundamentals of Unit Economics: Customer Acquisition Cost (CAC), Lifetime Value (LTV), and break-even analysis; Competitor analysis and establishing a Sustainable Competitive Advantage (Moat); Basics of bootstrapping vs. external funding.

UNIT-IV	**9 Hrs**

Building the Go-To-Market (GTM) strategy: marketing channels, sales funnels, and early user acquisition; Basics of business registration, legal structures (LLP, Pvt Ltd), and intellectual property (IP) awareness; Building an early founding team, equity splitting models, and culture; Final capstone venture pitch preparation: structuring an investor pitch deck.

Textbook(s):

1. Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd, Entrepreneurship, McGraw-Hill Education, 1st Edn, 2020, New Delhi.

Reference Book(S):

1. Poornima M. Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 5th Edn, 2018, New Delhi.
2. Bruce R. Barringer and R. Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, Pearson, 4th Edn, 2019, New Delhi.
3. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation, Crown Business, 2011, New York.

4. S. S. Khanka, Entrepreneurship Development, S. Chand & Company, 2010, New Delhi.
5. Peter Thiel, Zero to One: Notes on Startups, or How to Build the Future, Crown Business, 2014, New York.

Web and Video link(s): .

1. https://nptel.ac.in/courses/110105067; *NPTEL Video Lecture on Entrepreneurship Essentials by Prof. Rajeev Roy, Entrepreneurship Development Cell, IIT Kharagpur*.https://www.google.com/search?q=https%3A%2F%2Fecorner.stanford.edu%2F

Course Articulation Matrix (CAM):		U24OE601C – ENTREPRENEURSHIP											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24OE601C.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601C.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601C.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601C.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601C		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility	**SDG 4**	**Quality Education**	Enhances entrepreneurial learning by fostering creativity, critical thinking, and practical problem-solving skills.
		SDG 9	**Industry, Innovation and Infrastructure**	Promotes innovation and entrepreneurship by encouraging the development of scalable ventures that contribute to industrial and technological growth.
CO2	analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques	**SDG 3**	**Good Health and Well-being**	Facilitates the identification and validation of healthcare-related needs, leading to more user-centric and impactful well-being solutions.
		SDG 11	**Sustainable Cities and Communities**	Supports the development of community-focused innovations by understanding urban challenges and designing solutions aligned with citizens' needs
CO3	create students with practical knowledge of business modeling, unit economics, and venture monetization	**SDG 9**	**Industry, Innovation and Infrastructure**	Strengthens innovation ecosystems by enabling the commercialization and scaling of technology-driven ventures.
		SDG 12	**Responsible Consumption and Production**	Encourages sustainable business practices by integrating resource efficiency, value creation, and responsible production principles

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				into venture planning
CO4	build a clear roadmap for executing, legally safeguarding, and pitching a new venture	**SDG 8**	**Decent Work and Economic Growth**	Promotes entrepreneurship and job creation by enabling the successful launch and growth of innovative ventures.
		SDG 9	**Industry, Innovation and Infrastructure**	Supports innovation-driven enterprises by facilitating the protection, development, and scaling of new technologies and business models
		SDG 17	**Partnerships for the Goals**	Encourages collaboration with investors, industry partners, mentors, and institutions to strengthen venture growth and impact.

DESIGN STUDIO

Class: B. Tech. – VI -Semester		**Branch:** IT	
Course Code:	**U24OE601D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques

CO2 : apply system-level architecture and feasibility models to design technical solutions.

CO3 : build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools

CO4 : validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan

UNIT-I	**9 Hrs**

Foundations of R&D-led entrepreneurship; Identifying deep-tech and high-impact industry problems; Advanced root-cause analysis; Literature review, patent landscaping, and prior art search; Defining the innovation thesis and scientific/technological core; Drafting the initial Product Design Brief.

UNIT-II	**9 Hrs**

Translating insights into technical concepts; Systematic brainstorming and TRIZ (Theory of Inventive Problem Solving) basics; Technology readiness level (TRL) mapping; Engineering/architectural design and system topology; Value proposition design and business-technical feasibility modeling; The "Napkin Pitch" for technical solutions.

UNIT-III	**9 Hrs**

Rapid prototyping paradigms (Software/Hardware/Service); Formulating the Minimum Viable Product (MVP) core feature matrix; Materials selection and Agile development sprints; UI/UX wireframing or hardware schematics; Functional architecture implementation; Risk assessment and failure mode effects analysis (FMEA).

UNIT-IV	**9 Hrs**

Surface key engineering and market assumptions; Empirical testing protocols, simulation, and data collection; Customer co-creation loops and iterative engineering; Feedback analysis from key industry stakeholders; Creating the product "On-Ramp" strategy (Go-To-Market roadmap, Pilot launch framework, and IP Protection).

Textbook(s):

1. Brian Sullivan, The Design Studio Method: Creative Problem Solving with UX Sketching, Routledge, 2015, New York.

Reference Book(S):

1. Elizabeth Boling, James Benedict Brown, Colin M. Gray, and Derek Jones, Studio Properties: A Field Guide to Design Education, Yale Press, 2021, New Haven.
2. Charles Eastman, W. Michael McCracken, and Wendy Newstetter, Design Knowing and Learning: Cognition in Design Education, Elsevier, 2001, Oxford.
3. Donald A. Schön, Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions, Jossey-Bass, 17th Edn, 1987, San Francisco.
4. Jerzy Wojtowicz, Virtual Design Studio, Hong Kong University Press, 8th Edn, 1995, Hong Kong.

5. Lois Hetland and Ellen Winner, Studio Thinking: The Real Benefits of Visual Arts Education, Teachers College Press, 12th Edn, 2007, New York.

Web and Video link(s): .

1. https://nptel.ac.in/courses/124105003; *NPTEL Video Lecture on Understanding Design by Prof. Prasad Onkar, Department of Design, IIT Hyderabad.*https://www.google.com/search?q=https%3A%2F%2Fd-lab.mit.edu%2F

Course Articulation Matrix (CAM):		U24OE601D - DESIGN STUDIO												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE601D.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601D.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601D.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601D.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601D		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**Course Outcome**	**Mapped SDGs**		**Justification**
CO1	deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques.	**SDG 4**	**Quality Education**	Promotes experiential and innovation-based learning by equipping learners with problem-solving, research, and intellectual property skills essential for the 21st century
		SDG 9	**Industry, Innovation and Infrastructure**	Fosters innovation capacity by encouraging the development of novel technologies, strengthening industry-oriented research, and supporting sustainable technological advancement.
CO2	apply system-level architecture and feasibility models to design technical solutions.	**SDG 3**	**Good Health and Well-being**	Supports the design of reliable healthcare technologies and systems that enhance accessibility, efficiency, and overall well-being
		SDG 11	**Sustainable Cities and Communities**	Facilitates the creation of smart, resilient, and resource-efficient infrastructure solutions that improve urban sustainability and quality of life.
CO3	build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools.	**SDG 9**	**Industry, Innovation and Infrastructure**	Promotes technological innovation and strengthens engineering capabilities by accelerating product development and industry-relevant solutions.
		SDG 12	**Responsible Consumption and Production**	Encourages efficient resource utilization, iterative design, and sustainable product development practices that minimize waste and optimize production processes.
CO4	validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan.	**SDG 8**	**Decent Work and Economic Growth**	Supports entrepreneurship, innovation-driven employment, and sustainable economic growth through market-oriented solution development.
		SDG 9	**Industry, Innovation and Infrastructure**	Strengthens industry-academia innovation ecosystems by facilitating the translation of validated technologies into scalable solutions.
		SDG 17	**Partnerships for the Goals**	Encourages collaboration among academia, industry, government, and end users to co-create impactful and sustainable innovations.

CYBER SECURITY

Class: B. Tech. VI–Semester		**Branch:**IT	
Course Code:	**U24IT602A**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze the concepts of cybercrimes, cyber offenses, attack planning methods, and information security perspectives

CO2 : analyze security vulnerabilities and protection mechanisms in mobile and wireless computing environments

CO3 : analyze cybercrime tools, phishing techniques, identity theft methods, and cyberattack mechanisms

CO4 : analyze cyber laws, legal challenges, digital signatures, and cybersecurityframeworks in Indian and global contexts

UNIT-I	**9 Hrs**

Introduction to Cybercrime: Introduction, Cybercrime and information security, Who are Cybercriminals, Classifications of Cybercrimes, Cybercrime - The legal perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A global perspective on cybercrimes

Cyber offenses: How criminals plan them: Introduction, How criminals plan the attacks, Social engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The fuel for cybercrime, Attack vector, Cloud computing

UNIT-II	**9 Hrs**

Cybercrime:Mobile and Wireless Devices: Introduction, Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds in mobile and wireless computing era, Security challenges posed by mobile devices, Registry settings for mobile devices, Authentication service security,Attacks on Mobile/Cell Phones, Mobile Devices, Security implications for organizations, Organizational measures for handling mobile, Organizational security policies and measures in mobile computing era, Laptops

UNIT-III	**9 Hrs**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, DoS and DDoS Attacks, SQL Injection.

Phishing and Identity Theft: Introduction, Phishing, Methods of Phishing, Phishing Techniques, Spear Phishing, Types of Phishing Scams, Phishing Toolkits and spy Phishing, Phishing Countermeasures, Identity Theft (ID Theft)

UNIT-IV	**9 Hrs**

Cybercrimes and Cybersecurity: The Legal Perspectives - Introduction, Cybercrime and legal landscape around the world, Need of Cyber laws, The Indian context, The Indian IT act, Challenges to Indian Law and cybercrime scenario in India, Digital signatures and the Indian IT act, Amendments to the Indian IT act, Cybercrime and punishment, Cyber law, Technology and students: Indian Scenario

Textbook(s):

1. Nina Godbole, Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, New Delhi: Wiley India Pvt. Ltd., 2011 (Chapters 1,2,3,4,5,6).

Reference Book(s):

1. James Graham, Richard Howard and Ryan Otson, *Cyber Security Essentials*, CRC Press, T&F Group, 2011, New York.
2. Chwan-Hwa (John) Wu, J. David Irwin, *Introduction to Cyber Security*, CRC Press, T&F Group, 2013, New York.
3. Thomas A Johnson, *Cyber Security Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare*, CRC Press, T&F Group, 2015, Missouri.

4. Nilakshi Jain and Ramesh Menon, *Cyber Security and Cyber Laws*, Wiley India Pvt. Ltd., 2020, New Delhi.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_cs127; *Cyber Security and Privacy,By Prof. Saji K Mathew,IIT Madras*

Course Articulation Matrix (CAM):		U24IT602A: CYBER SECURITY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT602A.1	1	2	2	1	-	-	1	-	1	-	-	2	2
CO2	U24IT602A.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24IT602A.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24IT602A.4	2	2	3	3	-	-	1	-	1	-	2	2	2
U24IT602A		1.75	2	2.25	1.75	-	-	1	-	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Analyze the concepts of cybercrimes, cyber offenses, attack planning methods, and information security perspectives.	SDG 4	Quality Education	Understanding cybercrime concepts and information security enhances cybersecurity awareness, ethical practices, and digital literacy among learners and professionals.
CO2	Analyze security vulnerabilities and protection mechanisms in mobile and wireless computing environments.	SDG9	Industry, Innovation and Infrastructure	Secure mobile and wireless technologies contribute to resilient digital infrastructure, reliable communication systems, and sustainable technological innovation.
CO3	Analyze cybercrime tools, phishing techniques, identity theft methods, and cyber attack mechanisms.	SDG 16	Peace, Justice, and Strong Institutions	Understanding the anatomy of a cyber attack is essential for defending national infrastructure, mitigating digital financial fraud, and safeguarding the public from organized cybercrime networks.
CO4	Analyze cyber laws, legal challenges,digital signatures, and cybersecurity frameworks in Indian and global contexts	SDG 16	Peace, Justice, and Strong Institutions	Studying cyber legislation and compliance frameworks ensures that digital technologies are governed by justice, accountability, and the rule of law, creating a standardized defense against global and domestic cyber chaos.

GENERATIVE AI

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IT602B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply Generative AI concepts and NLP techniques to solve basic text processing and text generation problems

CO2 : analyze and implement the concepts of Transformers and LLM architectures in basic language understanding and generation tasks.

CO3 : apply the knowledge of modern LLMs and tools in implementation of text classification, vectorization, and summarization tasks

CO4 : apply enterprise LLM and LLMOps concepts to evaluate AI solutions for text and image generation tasks

UNIT-I	**9 Hrs**

Introduction to Generative AI: What is generative AI, Components of AI, Domains of Generative AI

Evolution of Neural Networks to Large Language Models:

Natural Language Processing, Probabilistic Models, Neural Network-Based Language Models, Transformer, Large Language Models (LLMs)

UNIT-II	**9 Hrs**

LLMs and Transformers: The Power of Language Models, Transformer Architecture

The ChatGPT Architecture: An In-Depth exploration of OpenAI's conversational language Model: The Evolution of GPT Models, Architecture of ChatGPT, Pre-training and fine-tuning in ChatGPT, Contextual Embeddings in ChatGPT, Response generation in ChatGPT, Handling Biases and Ethical Considerations, Strengths and Limitations

UNIT-III	**9 Hrs**

Google Bard and Beyond: The transformer architecture, Elevating transformer, Strengths and weaknesses of google bard, Difference between ChatGPT and google bard, Claude 2, Other Large Language Models

Implement LLMs Using SKLearn: Install Scikit-LLM and Setup, Zero-Shot GPT Classifier, Multi-label Zero-Shot Text Classification, Text Vectorization, Text Summarization

UNIT-IV	**9 Hrs**

LLMs for Enterprise and LLMOps: Private generalized LLM API, Design strategy to enable LLMs for enterprise In-Context learning, Fine-Tuning, Technology Stack, LLMOps, Implementation

Diffusion Model and Generative AI for Images: Variational autoencoders (VAEs), Generative adversarial networks (GANs), Diffusion models, The Technology Behind DALL-E2, The technology behind stable diffusion, The technology behind mid-journey, Comparison between DALL-E2, Stable diffusion, and mid-journey, Applications

Textbook(s):

1. Akshay Kulkarni, Adarsha Shivananda, Anoosh Kulkarni, Dilip Gudivada, *Applied Generative AI for Beginners*. Apress, November, 2023

Reference Book(S):

1. Karthikeyan Sabesan, SivagamisundariNilip Dutta, *Generative AI for Everyone*, BPB publications, January, 2025
2. Dr. Priyanka Singh, Hariom Singh, *Generative AI Essentials,* BPB publications, January, 2025
3. K.Subramanian, S.Velmurugan, B.Abirami, P.Yuvaraja, L.Haldurai, *Generative AI: Theory, Practice and Ethics,* Notion Press, 2025
4. Dhamani Numa,MaggieEngler, *Introduction to Generative AI,* Manning Publications, 2024

Web and Video link(s):

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_ma05;*NPTEL Video Lecture on Generative AI for Everyday Life by Dr. Ridip Dev Choudhury Professor of Computer Science at Krishna Kanta Handiqui State Open University (KKHSOU), Guwahati, Assam*

Course Articulation Matrix (CAM):		**U24IT602B:GENERATIVE AI**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT602B.1**	2	1	2	1	2	1	1	1	1	-	-	2	2
CO2	**U24IT602B.2**	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	**U24IT602B.3**	2	3	3	2	3	1	1	1	1	-	2	2	2
CO4	**U24IT602B.4**	2	2	3	3	3	1	1	1	1	-	2	2	2
U24IT602B		2	2	2.5	2	2.5	1	1	1	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply Generative AI concepts and NLP techniques to solve basic text processing and text generation problems.	SDG4	Quality Education	Generative AI and NLP techniques for text processing and generation, which supports the development of intelligent educational tools such as automated tutoring systems, content generation, and language translation. These technologies enhance accessibility, personalization, and efficiency in learning, thereby contributing to improved quality of education and promoting lifelong learning opportunities.
CO2	Analyze and implement the concepts of Transformers and LLM architectures in basic language understanding and generation tasks.	SDG9	Industry, Innovation and Infrastructure	It emphasizes applying Transformer and LLM architectures to build language understanding and generation systems. Such technologies are fundamental to modern AI-driven applications like chatbots, automation tools, and intelligent systems used in industries. It fosters innovation and supports the development of advanced digital infrastructure aligned with sustainable industrial growth.
CO3	Apply the knowledge of modern LLMs and tools in implementation of text classification, vectorization, and summarization tasks	SDG9	Industry, Innovation and Infrastructure	Focuses on applying modern LLM tools and techniques to implement and compare advanced AI models. Such skills are essential for developing innovative AI-driven solutions across industries, including automation, data analysis, and intelligent services.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO4	Apply enterprise LLM and LLMOps concepts to evaluate AI solutions for text and image generation tasks.	SDG9	Industry, Innovation and Infrastructure	Emphasizes applying enterprise-level LLMs, LLMOps practices, and diffusion models to build, deploy, and evaluate AI solutions for text and image generation. These competencies support the development of scalable, efficient, and innovative AI systems used in industries such as healthcare, media, and automation.

ADVANCED COMPUTER NETWORKS

Class: B. Tech. VI–Semester		**Branch:**IT	
Course Code:	**U24IT602C**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply IPv4 and IPv6 addressing and internetworking concepts for network communication and design

CO2 : identify ARP/RARP, IPv4/IPv6 datagram delivery, and ICMP error/control messaging in computer networks

CO3 : analyze routing architectures and protocols for network communication

CO4 : apply network virtualization, NAT, SDN/OpenFlow, and SDR concepts in modern networks

UNIT-I	**9 Hrs**

Introduction and Overview: The motivation for internetworking, The TCP/IP internet, internet services, History and scope, IAB, RFC, Internet growth, New version of IP, IPv4 and IPv6 relationship, IPv6 migration, Dual stack systems

Internetworking Concept and Architectural Model: Introduction, Application-level interconnection, Network-level interconnection, Properties of internet, Internet architecture, Interconnection of multiple networks with IP routers, The user's view

Internet Addressing: Universal host identifiers, IPv4: Classful addressing scheme, Dotted decimal notation used with IPv4, IPv4 Subnet addressing, Fixed length subnets, Variable length subnets, Implementation of IPv4 subnets with masks, Subnet mask representation and slash notation, classless addressing scheme, address blocks and CIDR slash notation, CIDR blocks reserved for private networks, IPv6: Addressing scheme, Colon hexadecimal notation, Address space assignment, Embedding IPv4 address in IPv6 for transition, Unicast address and /64, Interface identifiers and MAC addresses, Special addresses in IPv4 and IPv6, Internet address assignment and delegation of authority

UNIT-II	**9 Hrs**

Mapping Internet Address to Physical Address (ARP): Introduction, Address resolution problem, Types of hardware addresses, Resolution through direct mapping, IPv4 address translation through dynamic binding, ARP: Cache, Refinements, Implementation, Encapsulation and identification, Message format, Automatic cache revalidation. Reverse address resolution (RARP), Proxy ARP

Internet Protocol Connectionless Datagram Delivery (IPv4, IPv6): Purpose and importance, The IP datagram, Datagram: Type of service and differentiated services, Encapsulation, Size, Network MTU, Fragmentation, Reassembly, Header fields, Time to live, Hop limit

Internet Protocol: Error and Control Messages (ICMP): Introduction, ICMP, Message delivery, Conceptual layering, Message format, ICMP message types used with IPv4 & IPv6, Testing destination reachability and status, Echo request and reply message format, Checksum computation and pseudo header, Reports of unreachable destinations, Error reports regarding fragmentation, Route change request from routers

UNIT-III	**9 Hrs**

Routing Architecture: Introduction, Origin of forwarding tables, Forwarding with partial information, Original internet architecture and cores, Peer backbones, Automatic route propagation and a FIB, Distance-Vector (Bellman-Ford) routing, Link state (SPF) Routing

Routing Among Autonomous Systems (BGP): Introduction, Scope of route update protocol, Practical limit on group size, Autonomous system concept, Exterior gateway protocols and reachability, BGP: Characteristics, Functionality and message types, Message header, OPEN message, UPDATE message

Routing Within an Autonomous System (RIP, RIPng, OSPF, IS-IS): Introduction, Static Vs Dynamic routes, Routing information Protocol (RIP), Slow convergence problem, RIP message

format, Fields in a RIP message, RIP for IPv6 (RIPng), OSPF: OSPFv2 Message formats. OSPFv3 to support IPv6, IS-IS route propagation protocol

UNIT-IV	**9 Hrs**

Network Virtualization: VPNs, NATs, and Overlays: Virtualization, VPN, VPN Tunnelling and IP-in-IP Encapsulation, VPN Addressing and Forwarding, Extending VPN to individual hosts, Network address translation (NAT): Overview, Translation table creation, Variant of NAT, Interaction between NAT and ICMP, Interaction between NAT and Applications, Versions of NAT in different OS

Software Defined Networking (SDN, OpenFlow): Introduction, Routes, paths, and connections, Traffic engineering and control of path selection, Connection-oriented networks and routing overlays, SDN: A new hybrid approach, Separation of data and control, The SDN architecture and external controllers, SDN across multiple devices, Implementing SDN with conventional switches, OpenFlow technology, OpenFlow basics, Specific fields in an OpenFlow pattern, Actions that OpenFlow can take, OpenFlow extensions and additions, OpenFlow messages, Uses of OpenFlow, OpenFlow: Excitement, Hype, and limitations, Software Defined Radio (SDR)

Textbook(s):

1. Douglas.E.Comer, *Internetworking with TCP/IP Vol I: Principles, Protocols, and Architecture*, 6th edition, Pearson Education, 2014, USA.(Chapters: 1,3,5,6,7,9,12,13,14,19,28)

Reference Book(S):

1. James F. Kurose, Keith W. Ross, *Computer Networking, A Top-Down Approach*, Pearson, 6th edition, 2013, New York.
2. Shah, Ambawade, Mehra, Agarwal, *Advanced Computer Networks*, revised edition, Dreamtech Press, 2011, New Delhi.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_ee116/preview; *NPTEL Video Lecture on Advanced Computer Networks by Prof. Neminath Hubballi, Professor of IIT Indore and Prof. Sameer G Kulkarni, Professor of IIT Gandhinagar*

Course Articulation Matrix (CAM):		**U24IT602C : ADVANCED COMPUTER NETWORKS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT602C.1**	1	2	2	1	-	-	1	-	1	-	-	1	1
CO2	**U24IT602C.2**	2	2	2	2	-	-	1	-	1	-	2	1	1
CO3	**U24IT602C.3**	2	2	2	2	-	-	1	-	1	-	2	1	2
CO4	**U24IT602C.4**	2	2	3	3	-	-	1	-	1	-	2	2	2
U24IT602C		1.75	2	2.25	1.75	-	-	1	-	1	-	2	1.25	1.5
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply IPv4 and IPv6 addressing and internetworking concepts for network communication and design	SDG 9, SDG 11	Industry Innovation and Infrastructure; Sustainable Cities and Communities	Efficient subnet design supports scalable and resilient network infrastructure for modern digital systems and smart cities.
CO2	identify ARP/RARP, IPv4/IPv6 datagram delivery, and ICMP error/control messaging in computer networks	SDG 9, SDG 4	Industry Innovation and Infrastructure; Quality Education	Understanding IP and ICMP ensures reliable communication and enhances foundational networking knowledge.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO3	analyze routing architectures and protocols for network communication	SDG 9, SDG 8	Industry Innovation and Infrastructure; Decent Work and Economic Growth	Routing enables efficient data transmission essential for digital services and economic growth.
CO4	apply network virtualization, NAT, SDN/OpenFlow, and SDR concepts in modern networks	SDG 16, SDG 9	Peace, Justice and Strong Institutions; Industry Innovation and Infrastructure	Secure communication and network management ensure trustworthy and efficient digital systems.

PARALLEL PROGRAMMING

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IT602D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

- **CO1:** apply parallel programming concepts to analyse performance limitations of sequential programs and parallel computing
- **CO2:** analyse different parallel architectures and programming models to select suitable approaches for solving computational problems
- **CO3:** apply MPI library to parallelize the code to solve the given problem.
- **CO4:** apply OpenMP pragma and directives to parallelize the code to solve the given problem

UNIT-I	**9 Hrs**

Introduction to parallel programming, Parallel hardware and parallel software – Why Parallel Computing,Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory, Coordinating the processes/threads, Shared-memory, Distributed-memory, Performance, Parallel Program Design, Writing and Running Parallel Programs

UNIT-II	**9 Hrs**

GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance – Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, GPU performance

UNIT-III	**9 Hrs**

Distributed memory programming with MPI: MPI functions, The Trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm

Shared-Memory Programming with Pthreads: Process, Threads and Pthreads, Hello World, Matrix – Vector Multiplication, Critical Sections, Busy-Waiting, Mutexes, Producer-Consumer Synchronization and Semaphores

UNIT-IV	**9 Hrs**

Shared-memory programming with OpenMP: OpenMP pragmas and directives, The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in OpenMP, tasking, tasking, thread safety

GPU programming with CUDA: GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids Nvidia compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal rule II: improving performance, CUDA trapezoidal rule III: blocks with more than one warp

Textbook(s):

1. Peter S Pacheco, Matthew Malensek – *An Introduction to Parallel Programming*, 2nd edition, 2020. (Chapter 1-5)
2. Michael J Quinn – *Parallel Programming in C with MPI and OpenMp*, 2nd edition, 2003.(Chapter 2)

Reference Book(s):

1. Calvin Lin, Lawrence Snyder – *Principles of Parallel Programming*, 1st edition, 2008.
2. William Gropp, Ewing Lusk – Using MPI: *Portable Parallel Programming*, 3nd edition, 2014.

Web and Video link(s):

1. https://nptel.ac.in/courses/106102163; *NPTEL Video Lecture on NOC: Introduction to parallel programming with OpenMP and MPI, Prof. Yogish Sabharwal, IIT Delhi*

Course Articulation Matrix (CAM):		U24IT602D: PARALLEL PROGRAMMING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT602D.1	2	2	-	1	-	2	-	-	-	-	2	2	1
CO2	U24IT602D.2	2	2	1	2	2	-	-	-	-	-	2	2	2
CO3	U24IT602D.3	3	2	2	2	2	-	-	1	-	1	2	3	2
CO4	U24IT602D.4	3	2	2	2	2	-	-	1	-	1	2	3	2
U24IT602D		2.5	2	1.66	1.75	2	2	-	1	-	1	2	2.5	1.75
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply parallel programming concepts to analyse performance limitations of sequential programs and parallel computing.	SDG9	Industry, Innovation and Infrastructure	Parallel computing improves computational efficiency, Reduces execution time and Supports innovation in industries (AI, simulations)
CO2	Analyse different parallel architectures and programming models to select suitable approaches for solving computational problems.	SDG4	Quality Education	Enhances technical knowledge and skills and Prepares students for advanced computing systems.
CO3	Apply MPI library to parallelize the code to solve the given problem.	SDG9	Industry, Innovation and Infrastructure	MPI used in scientific simulations (climate modelling, weather prediction), Helps solve large-scale real-world problems efficiently.
CO4	Apply OpenMP pragma and directives to parallelize the code to solve the given problem	SDG8	Decent Work and Economic Growth	Improves productivity in software systems and Enhances employability in high-performance computing

APPLICATIONS OF IOT

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IT602E**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

- **CO1 :** analyze the fundamentals of IoT including architecture, characteristics, enabling technologies, and design challenges, and evaluate their role in real-world IoT applications
- **CO2 :** apply programming and interfacing skills using NodeMCU (ESP8266) and Arduino IDE for basic IoT applications involving GPIO, communication interfaces, and Wi-Fi connectivity
- **CO3 :** design IoT-based systems by interfacing sensors and actuators with NodeMCU and utilizing appropriate communication protocols such as MQTT, HTTP, and CoAP
- **CO4 :** analyze and evaluate IoT solutions for real-world domains such as industrial automation, smart agriculture, smart cities, and home automation

UNIT-I	**9 Hrs**

Basics of IoT: History, definition, characteristics, architecture of IoT with block diagram, IoT applications, Types of IoT system, Physical and logical design of IoT

Enabling technologies for IoT: Big Data Analytics, Cloud computing, Wireless Sensor Networks, Embedded Systems with example, IoT system challenges for design and security

UNIT-II	**9 Hrs**

Fundamental of NodeMCU: NodeMCU ESP8266 features, specifications, hardware architecture, GPIO pins

NodeMCU communication port: UART, I2C, SPI

Terms used with NodeMCU: firmware, Wi-Fi, NodeMCU ESP8266 development board and its pin configuration

Arduino Integrated Development Environment: Arduino IDE setup, creating, compiling and uploading programs from Arduino IDE to NodeMCU, Applications using NodeMCU ESP8266 and Arduino IDE. (Use of functions, string, array, timer, I/O function, PWM, interface LED & switch)

UNIT-III	**9 Hrs**

IoT Sensors and Actuators: Linear and Digital input devices, Sensors- LDR, PIR, LM35, DHT11, IR, Gas sensor-MQ 4, Actuators- Linear and Rotary Actuators, servo motor and servo drive, solenoid valve, motorised actuators relay, stepper motor, IoT enabled actuators

IoT Communication Protocol:

IoT Protocols: HTTP-REST, MQTT, CoAP, LoRa, NbIoT (features, methods, communication, applications)

IEEE802.11: Wi-Fi (features, applications), configure Wi-Fi on NodeMCU, Wi-Fi libraries, code for connecting to Wi-Fi networks , Procedure to create webserver with NodeMCU

UNIT-IV	**9 Hrs**

Industrial IoT (IIoT): Predictive maintenance in manufacturing using IoT sensors to monitor equipment health and prevent failures

Agriculture: Green house control using IoT, Weather forecasting

Smart City: Street light control system, Traffic control System, Waste management, IoT based smart energy meter, IoT based surveillance system

Home automation: controlling lights, Fans and smart lock

Textbook(s):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Universities Press, 1st Edition, 2015.

2. Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms and Use Cases*, CRC Press, 1st Edition, 2017.

Reference Book(s):

1. Raj Kamal, *Internet of Things: Architecture and Design Principles*, McGraw Hill Education (India) Private Limited, 2nd edition, 2017, New Delhi.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, 1st edition, 2017, Indianapolis.
3. Sudip Misra, Anandarup Mukherjee, and Arijit Roy, *Introduction to IoT*, Cambridge University Press, 1st edition, 2020, Cambridge.
4. Rahul Dubey, *An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications*, Cengage India Private Limited, 1st edition, 2019, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_cs37/preview;*NPTEL Video Lecture on Introduction To Internet Of Things by Prof. Sudip Misra, Professor, IIT Kharagpur.*

Course Articulation Matrix (CAM):		**U24IT602E: APPLICATIONS OF IOT**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT602E.1**	2	2	1	1	-	-	1	-	-	-	-	2	1
CO2	**U24IT602E.2**	2	2	2	1	2	-	1	-	-	-	-	2	2
CO3	**U24IT602E.3**	2	2	2	2	2	-	1	-	-	-	-	3	2
CO4	**U24IT602E.4**	2	2	3	2	2	1	2	-	1	1	-	2	2
U24IT602E		2.0	2.0	1.75	1.5	2	1	1.25	-	1	1	-	2.25	1.75
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze the fundamentals of IoT including architecture, characteristics, enabling technologies, and design challenges, and evaluate their role in real-world IoT applications	SDG3	Good Health and Well-being	Understanding IoT fundamentals enables the development of healthcare monitoring systems such as wearable devices and remote patient monitoring, which improve early diagnosis, continuous health tracking, and overall well-being
CO2	apply programming and interfacing skills using NodeMCU (ESP8266) and Arduino IDE to develop basic IoT applications involving GPIO, communication interfaces, and Wi-Fi connectivity	SDG9	Industry, Innovation and Infrastructure	Programming and interfacing using NodeMCU and embedded platforms support the development of smart industrial systems, automation solutions, and innovative IoT infrastructure, enhancing productivity and technological advancement
CO3	design and implement IoT-based systems by interfacing sensors and actuators with NodeMCU and utilizing appropriate communication protocols such as MQTT, HTTP,	SDG11	Sustainable Cities and Communities	Designing IoT systems with sensors, actuators, and communication protocols facilitates applications like smart traffic control, environmental monitoring, and smart surveillance, contributing to sustainable and

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	and CoAP			efficient urban development
CO4	evaluate and develop IoT solutions for real-world domains such as industrial automation, smart agriculture, smart cities, and home automation	SDG9	Industry, Innovation and Infrastructure	Developing IoT-based solutions for domains such as industrial automation, agriculture, and smart energy systems promotes innovation, efficient resource utilization, and scalable infrastructure development

CLOUD COMPUTING

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IT603**	**Credits:**	**4**
Hours/Week (L-T-P- E):	**3-1-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**48 Hrs**	**ESE:**	**40%**

CO1 : apply the concepts of cloud service models (IaaS, PaaS, SaaS) and deploy applications across public, private, and hybrid cloud environments with efficient resource management.

CO2 : identify cloud architectures multi-tier, microservices, serverless and understand virtualization concepts including hypervisors, containers, and virtual machines

CO3 : implement solutions using cloud platforms like AWS, Azure, and GCP by applying compute, storage, networking, and database services in real-world scenarios

CO4 : evaluate federated cloud models and analyze cloud security aspects such as data privacy, identity management, and threat mitigation, while exploring advanced cloud technologies

UNIT-I	**12 Hrs**

Introduction: Cloud computing at a glance, Historical developments, Building cloud computing environment, Computing platforms and technologies

Principles of Parallel and Distributive Computing: Eras of computing, Parallel vs. distributive computing, Elements of parallel computing, Elements of distributive computing, Technologies for distributive computing

UNIT-II	**12 Hrs**

Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples

Cloud Computing Architecture: Introduction, Cloud reference model, Types of cloud, Economics of the cloud, Open challenges

UNIT-III	**12 Hrs**

Data Intensive Computing: What is data intensive computing? Technologies for data intensive computing

Cloud Platform in Industry: Amazon web services, Google app engine, Microsoft azure Cloud

Applications: Scientific applications: ECG analysis in the cloud, Business and consumer applications: CRM and ERP

UNIT-IV	**12 Hrs**

Advanced Topics in Cloud Computing: Federated clouds/Intercloud characterization and definition, Cloud federation stack, Aspects of interest, Technologies for cloud federation

Cloud Security: Security the top concern for cloud users, Cloud security risks, Privacy and privacy impact assessment, Trust, Cloud data encryption, Security of database services, Operating system security, Virtual machine security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management operating system, Mobile devices and cloud security

Textbook(s):

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill, 2019. (Chapters 1,2 3,4,8,10 and 11), New Delhi
2. Dan C. Marnescu, "*Cloud Computing Theory and Practice*", 2nd ed. Cambridge: Elsevier, 2018. (Chapter 9)

Reference Book(s):

1. Dr. Kumar Saurabh, "*Cloud Computing: Architecting Next-Gen Transformations Paradigms*",4th ed,Wiley India Private Limited, 2018, New Delhi
2. Barrie Sosinsky, "*Cloud Computing Bible*", Wiley Publications, 2011
3. Anthony T.Velte, Toby J Velte and Robert Elsenpeter, "*Cloud Computing: A practical Approach*", McGraw Hill,2010, New York.

4. Dan C. Marinescu, "*Cloud Computing: Theory and Practice*", 3rd ed. 2013, USA: Morgan Kaufmann

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview; *NPTEL Video Lecture on Cloud Computing byProf. Soumya Kanti Ghosh, Professor of Computer Science and Engineering, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24IT603 : CLOUD COMPUTING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT603.1	3	2	2	–	3	–	–	–	–	–	2	–	–
CO2	U24IT603.2	3	2	–	–	2	–	–	–	–	–	2	–	–
CO3	U24IT603.3	3	2	2	2	3	–	–	2	–	–	2	2	–
CO4	U24IT603.4	2	3	2	2	2	2	3	–	2	–	3	2	3
U24IT603		2.25	2.75	2.25	2.00	2.00	2.50	2.00	3.00	2.00	2.00	–	2.25	2.00
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Make use of different cloud computing environments	SDG9	Industry, Innovation and Infrastructure	Cloud computing environments (public, private, hybrid) enable scalable IT infrastructure, supporting digital transformation, industrial growth, and innovation.
CO2	Identify cloud architectures and virtualization technologies	SDG9	Industry, Innovation and Infrastructure	Cloud architectures and virtualization technologies improve resource utilization, system efficiency, and infrastructure development, forming the backbone of modern IT systems.
CO3	Apply cloud platforms and technologies in industry	SDG8	Decent Work and Economic Growth	Cloud platforms like AWS, Azure, and GCP create employment opportunities, support startups, and drive economic growth through digital services and automation.
CO4	Analyse federated cloud and security concepts	SDG9	Industry, Innovation and Infrastructure:	Emphasizes federated cloud models and advanced cloud technologies, contributing to the development of scalable and innovative digital infrastructure. It also focuses on secure cloud systems, ensuring reliability and efficiency in modern IT environments.

INTRODUCTION TO INTERNET OF THINGS

Class: B.Tech. VI–Semester		**Branch:** IT	
Course Code:	**U24IT604**	**Credits:**	3
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze thedesign of IoT and classify the domains in IoT

CO2 : analyze IoT system with M2M and illustrate the system management with NETCOZF-YANG

CO3 : apply the design methodologies for IoT applications and deploy applications on Raspberry Pi

CO4 : classify the sensors for IoT applications and categorize the physical servers and cloud offerings

UNIT-I	**9 Hrs**

Introduction to Internet of Things: Introduction, Physical design of IoT – Logical design of IoT, IoT enabling technologies, IoT levels and deployment templates

Domain Specific IoTs: Home automations, Cities, Environment, Energy, Agriculture and industry, Health & life style

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV

UNIT-II	**9 Hrs**

IoT System Management with NETCOZF- YANG: Need for IoT systems management, Simple network management protocol, Network operator requirements, NETCONF, YANG, IoT system management with NETCONF – YANG

UNIT-III	**9 Hrs**

IoT Platform Design Methodology: Introduction, IoT design methodology.

IoT Physical Devices & Endpoints: IoT device, Exemplary device: Raspberry Pi, About the board, Raspberry PI interfaces, Programming Raspberry PI with python

Motors: Controlling servo motors, Controlling the speed of a DC motor, Controlling the direction of a DC motor, Using a unipolar & bipolar stepper motor.

UNIT-IV	**9 Hrs**

Sensors: Using resistive sensors, Measuring light, Measuring temperature with a thermistor, Detecting methane, Measuring a voltage, Reducing voltages for measurement, Using resistive sensors with an ADC, Measuring temperature with an ADC, Measuring temperature, humidity, and pressure with a sense HAT, Measuring temperature using a digital sensor, Measuring distance, Displaying sensor values.

IoT Physical Servers and Cloud Offerings: Introduction to cloud storage models and communication APIs, Python web applications framework – Django, Designing a RESTful web API, Amazon web services for IoT **Case Study:** Forest fire detection, Smart irrigation.

Text Book(s):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things* - A Hands-on Approach, Kolkata: Universities Press, 2016.
2. Simon Monk, *Raspberry Pi Cookbook*, 2nd ed., USA: O'Reilly Media,2016.

Reference Book(s):

1. Jeeva Jose, Internet of Things, New Delhi: Khanna Publishing Co. Ltd., 2018.
2. N. Ida, Sensors, Actuators and Their Interfaces- A Multidisciplinary Introduction, 2nd edition, London: CPI Group (UK) Ltd., 2020.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs115/unit?unit=18&lesson=19; *NPTEL VideoLecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*
2. https://onlinecourses.nptel.ac.in/noc24_cs115/unit?unit=45&lesson=50; *NPTEL VideoLecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*

3. https://onlinecourses.nptel.ac.in/noc24_cs115/unit?unit=64&lesson=67; *VideoLecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*	*NPTEL*
4. https://onlinecourses.nptel.ac.in/noc24_cs115/unit?unit=74&lesson=77; *VideoLecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*	*NPTEL*
5. https://onlinecourses.nptel.ac.in/noc24_cs115/unit?unit=74&lesson=78; *VideoLecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*	*NPTEL*

Course Articulation Matrix (CAM):		**U24IT604 : INTRODUCTION TO INTERNET OF THINGS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT604.1**	2	-	-	-	-	-	-	-	1	1	-	-	1
CO2	**U24IT604.2**	2	1	-	-	-	-	-	-	1	1	-	-	1
CO3	**U24IT604.3**	2	2	-	-	2	-	-	-	1	1	-	2	2
CO4	**U24IT604.4**	2	2	2	2	2	1	2	-	1	1	-	2	2
U24IT604		**2**	**1.66**	**2**	**2**	**2**	**1**	**2**	**-**	**1**	**1**	**-**	**2**	**5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze the design of IoT and classify the domains in IoT	SDG 9	Industry, Innovation and Infrastructure.	IoT architectures and domain classification form the foundation for modern digital infrastructure and enable innovation across sectorslike smart cities, healthcare, and agriculture
CO2	analyze IoT with M2M and illustrate the system management with NETCOZF-YANG	SDG 9	Industry, Innovation and Infrastructure.	Understanding IoT vs M2M and using NETCONF–YANG improves network automation, interoperability, and efficient system management, supporting advanced infrastructure development
CO3	apply the design methodologies for IoT applications and deploy applications on Raspberry Pi	SDG 4	Quality Education.	Practical implementation using Raspberry Pi enhances hands-on learning, technical skills, and innovation capability, preparing learners for real-world applications
CO4	classify the sensors for IoT applications and categorize the physical servers and cloud offerings and	SDG 12	Responsible Consumption & Production	Efficient use of cloud, servers, and sensors leads to optimized resource utilization, reduced energy consumption, and sustainable system design

UNIVERSAL HUMAN VALUES - II

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IK606A**	**Credits:**	**2**
Hours/Week (L-T-P- E):	**2-0-0-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: describe harmony within the individual by understanding the distinct roles of the self and the body

CO2 : analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society.

CO3: explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfilment among all orders of nature.

CO4: apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being.

UNIT-I	**6 Hrs**

Course Introduction - Need, Basic guidelines, Content and Process for value education **Self-exploration**: 'Natural acceptance' and Experiential validation, Basic human aspirations, Right understanding, Relationship and Physical facility, fulfilment of aspirations, Understanding happiness and prosperity, Harmony at various levels

Understanding Harmony in the Human Being: Harmony in myself, Understanding human being, Understanding the harmony of self with the body, Harmony in self; Health; Program for self and health

UNIT-II	**6 Hrs**

Understanding Harmony in the Family: Harmony in human - human Relationship, Understanding values in human-human relationship, Meaning of Justice (universal values in relationships), Mutual happiness

Understanding Harmony in the Society: Harmony in the society, Visualizing a universal harmonious order in society- Undivided society, Universal order- from family to world family

UNIT-III	**6 Hrs**

Understanding Harmony in the Nature: Whole existence as coexistence, Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Recyclability and Self-regulation in nature,

Understanding Harmony in the Existence: Understanding existence as co-existence of mutually interacting units in all- pervasive space; Holistic perception of harmony at all levels of existence.

UNIT-IV	**6 Hrs**

Professional Ethics: People friendly and eco-friendly production systems, Appropriate technologies and management patterns.

Case Studies: Case studies of typical holistic technologies, Management models and production systems

Textbooks:

1. R .R. Gaur, R. Sangal and G. P. Bagaria, *Human Values and Professional Ethics*, New Delhi Excel Books, 2010.

Reference Book(S):

1. A.Nagaraj, *Jeevan Vidya: Ek Parichaya*, Raipur: Jeevan Vidya Prakashan, Amarkantak, 2018.
2. A.N. Tripathi, *Human Values*, New Age International Publisher, 3rd ed., New Delhi, 2019.
3. M. Govindrajran, S. Natrajan & V.S. Senthil Kumar, *Engineering Ethics (includes Human Values)*, PHI Learning Pvt. Ltd., 12th ed., Haryana, 2011.

4. Jayshree Suresh, B. S. Raghavan, *Human Values & Professional Ethics*, 4thed., S. Chand & Co. Ltd., New Delhi, 2012.

Additional Resources:

1. A set of DVDs containing - Video of Teachers‟ Orientation Program - PPTs of Lectures and Practice Sessions (*Audio-visual material for use in the practice sessions*)

Web and Video link(s):

1. https://fdp-si.aicte-india.org/UHVII.php

Course Articulation Matrix		U24IK606A Universal Human Values - II												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IK606A.1	2	1	-	-	-	1	-	3	-	-	-	1	1
CO2	U24IK606A.2	-	2	-	-	-	3	-	3	2	2	-	-	1
CO3	U24IK606A.3	1	2	-	-	-	2	3	2	-	-	-	1	1
CO4	U24IK606A.3	1	2	-	-	-	3	3	3	2	2	3	2	1
U24IK606A		**1**	**1.75**	-	-	-	**2.25**	**1.5**	**2.75**	**1**	**1**	**0.75**	**1**	**1**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	describe harmony within the individual by understanding the distinct roles of the self and the body	SDG 4	Quality Education	Develops self-awareness, values, ethical thinking, and holistic education for responsible citizenship.
CO2	analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society.	SDG 16	Peace, Justice and Strong Institutions	Promotes justice, mutual respect, harmonious relationships, and peaceful societies.
CO3	explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfillment among all orders of nature.	SDG 13, SDG 15	Climate Action; Life on Land	Enhances understanding of ecological balance, coexistence, environmental sustainability, and conservation.
CO4	apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being.	SDG 9, SDG 12	Industry, Innovation and Infrastructure; Responsible Consumption and Production	Encourages ethical professional practices, sustainable technologies, and environmentally responsible production systems.

TECHNICAL ENGLISH

Class: B.Tech. VI–Semesters		**Branch:** IT	
CourseCode:	**U24MH607**	**Credits:**	**1**
Hours/Week(L-T-P-E):	**0-0-2-2**	**CIE:**	**100**
TotalNumberofTeaching Hours:	**24Hrs**	**ESE:**	**-**

CourseLearningOutcomes(COs)

After completion of this course, the students should be able to,

CO1: develop effective listening, speaking, reading and writings kills by understanding native-
speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation.

CO2: Enhance communication and professional writings kills through podcast comprehension, Group discussions, resume and email writing

CO3: develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports

CO4: develop the ability to perform well in interviews and present effectively with clarity of
Speech and appropriate accent

Activity-1	**2 hrs**

Phonetic Foundations, Authentic Audio-Visual Comprehension & Vocabulary Enhancement: SpeechSounds- Phonemes (Vowels and consonant sounds),word stress, syllables - their role and importance in spoken English, **Authentic Audio-Visual Comprehension**: Movie Clips - Screening of a short native-speaker clip - context comprehension, focus attention on accent features and key expressions,**Vocabulary:**WordFormation-Prefixes-Suffixes.

Activity: Practice pronunciation through Read-Record-Reflect, analyze audio-visual content for comprehension and expression usage

Activity-2	**2 hrs**

Story Narration, Writing Skills and Vocabulary Enhancement- Narrative structure (beginning, build-up, climax, conclusion), Cohesive devices, Voice modulation & Expression. **Writing:**PrinciplesofParagraphWriting-ImportanceofCoherenceinWriting-Cause and Effect Paragraphs. **Vocabulary:** Synonyms and antonyms.

Activity: Narrate structured stories with peer interaction, Read-Record-Reflect storytelling activity for pronunciation and expression enhancement, Write a coherent cause and effect paragraph, Vocabulary practice exercises on synonyms and antonyms

Activity-3	**2 hrs**

Reading Comprehension, Vocabulary Enhancement & Elocution Skills- Reading Comprehension: Main idea identification, interpretation, critical analysis. **Vocabulary Enhancement**: One-word substitutes.**Elocution:** Speech delivery skills (organisation, voice modulation, fluency, pronunciation, and audience engagement).

Activity: Read and analyze passages for comprehension and critical interpretation, Read-Record-Reflect activity for improving reading fluency and pronunciation, Vocabulary exercises on one-word substitutes, and deliver a short speech with emphasis on clarity, confidence, and effective expression

Activity-4	**2 hrs**

Think–Pair–Share Conversation (Podcast-Based), **Vocabulary Enhancement:** Introduction to authentic spoken English through podcasts, listening for gist and specific information, and note-taking. Think–Pair–Share strategy, use of linking words and expressing agreement/disagreement politely

Vocabulary Enhancement: Idioms in context and usage

Activity: Listen to podcasts for comprehension and note-making, Think–Pair–Share discussions to exchange ideas and respond confidently, Speak-Record-Reflect activity for improving speaking fluency, pronunciation, and expression

Activity-5	**2 hrs**
Group Discussion, Vocabulary Enhancement: GD format and roles, rules of participation, **Vocabulary –** Word Pairs, commonly confused words **Activity:** Engage in group discussions focusing on clear expression and interactionand word pair exercises	
Activity-6	**2 hrs**
Reading Comprehension, Visual Interpretation & Vocabulary Enhancement: Skimming and scanning, identifying main and supporting ideas, distinguishing fact and opinion. **Visual Interpretation:** Interpreting visual cues, logical sequence. **Vocabulary**: Phrasal Verbs: separable and inseparable forms, and contextual usage. **Activity:** Engage in reading comprehension tasks for critical analysis, describe pictures ,Speak-Record–Reflect activity for improving fluency, pronunciation, and expression, and phrasal verbs practice exercises	
Activity-7	**2 hrs**
Motivational Speeches, Presentation Skills & Vocabulary Enhancement: identifying central theme and tone, note-taking, Narrative techniques. **Presentation –** Speak to Inspire- topic selection, structure (introduction–body–conclusion), **Vocabulary Enhancement –** Collocations- Introduction to collocations, types of collocations, and contextual usage **Activity**: Listen to motivational speeches for comprehension and analysis, deliver a 3–5-minute inspirational presentation, Speak–Record–Replay activity for improving fluency, pronunciation, and expression, and collocations practice exercises	
Activity-8	**2 hrs**
Writing & Vocabulary Enhancement: Professional Resume Writing techniques, Action verbs in resume writing, Letterof Application, E-mail Etiquette—vocabulary: Jumbled sentences **Activity**: Prepare a professional resume using an appropriate format and action verbs, write a letter of application and formal e-mail following etiquette and jumbled sentence exercises	
Activity-9	**2 hrs**
Reading Comprehension, Newspaper Reading & Vocabulary Enhancement: Intensive reading , Extensive reading, Newspaper reading:5W1H method, Summarization, vocabulary building **Activity:** Reading comprehension exercises, Summarizing news content, discussion of current events, Speak–Record–Replay activity for improving fluency, pronunciation and expression. Vocabulary building through contextual usage from news articles	
Activity-10	**2 hrs**
PowerPoint Presentations: Concept and purpose of presentations, layout and structure (title, introduction–body–conclusion), slide design elements, visual aids, common mistakes to avoid **Activity:** Design and present a poster or PowerPoint presentation on a given topic, Speak–Record–Replay activity for improving fluency, pronunciation and expression, peer interaction and feedback sessions	
Activity-11	**2 hrs**
Essay Writing, Vocabulary Enhancement – Concept and Types of Essays**,** Essay structure (introduction–body–conclusion), paragraph coherence, clarity and objectivity, Sentencecompletionwithcorrectword/Group alternativeword/group **Activity:** Write essays on given topics focusing on structure, coherence, and clarity.Sentencecompletion practice exercises	
Activity-12	**2 hrs**
MockInterview – Technical & HR: Introduction to mock interviews: Purpose and importance, types of interviews, interview etiquette, self-introduction, common HR questions, self-assessment **Activity:** Mock interview with appropriate dress code. Record and review own performance, Feedback session	
Textbook(s): 1. ArunSharma&MeenakshiUpadhyay,"*VerbalAbilityandReadingComprehensionfor CAT & Other Management Examinations*", 8th Edition, McGraw Hill Education (India) Private Ltd, Chennai, 2018 2. Meenashki Raman &Sangeethe Sharma, "*Technical Communication: Principles andPractice,*	

3rdEdition, New Delhi; New York: Oxford University Press,2004

ReferenceBook(s):

1. NishitK.Sinha,*Verbal Ability and Reading Comprehension for the CAT*, 3rd ed., Chennai : Pearson India Education Services Pvt. Ltd.
2. HarperCollins,*Collins COBUILD English Grammar*, 3rd ed., Harper Collins Publishers Ltd.
3. Jerald J. Alfred, Charles T. Brusaw and Walter E. Oliu, *Handbook for Technical Writing*, 12th ed., Macmillan
4. R.S.Agarwal, *Amodern Approach to Verbal and Non-Verbal Reasoning*, Revised edition, India : Chand Publishing, 2025

Web and Video link(s):

1. Learn/Practice English with MOVIES (Lesson#1) Title:The Incredibles https://www.youtube.com/watch?v=5SfQhkMsUFk&list=PLA7lNLNvxTzig5dqfGl8DGbLOvUI08yXg&index=2

2. Learn English with WRECK-IT RALPH https://www.youtube.com/watch?v=wVhG59zh4uQ&list=PLA7lNLNvxTzig5dqfGl8DGbLOvUI08yXg&index=4

3. ThePursuitofHappiness(2006):MostPowerfulMoments! https://www.youtube.com/watch?v=TkD1QvjKlqU

4. **Podcastby**RaulJohn"InsidetheMindofIndia'sAIKid".BusinessToday https://www.youtube.com/watch?v=biCrIlhZrC4

5. Podcast bySudhaMurthy-So What IfILosttheBattle,ILived theWar | TheRanveerShow https://www.youtube.com/watch?v=KwXtalUuhLc

6. MotivationalTalk byGourGopalDas,SLEEPLESSNightsforOvernight SUCCESS https://www.youtube.com/watch?v=YyCXp_E4sMU

7. MotivationalTalk byAdmiralMcRaven'sSpeechforYourDay,"5MinutestoStartYourDay Right! - MORNING MOTIVATION" https://www.youtube.com/watch?v=b-Pn0yXL9y8

LaboratoryManual:

1. Technical English Manual prepared by the faculty of English, KITSW.

CourseArticulationMatrix(CAM):		**U24MH607:** TECHNICAL ENGLISH												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24MH607.1**	-	-	-	-	-	-	-		2	-	2	1	-
CO2	**U24MH607.2**	-	-	-	-	-	-	-	2	2	-	2	1	-
CO3	**U24MH607.3**	-	-	-	-	-	-	-		2	-	2	1	-
CO4	**U24MH507.4**	-	-	-	-	-	-	-	2	2	-	2	1	-
24MH607		-	-	-	-	-	-	-	2	2	-	2	1	-
3–HIGH,2 –MEDIUM,1-LOW														

CO–SDGAlignmentMatrix				
CO	**CO Statement** *Thestudentshouldbeable to*	**Relevant SDG**	**SDG Description**	**MappingJustification**
CO1	develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency,coherenceandaccurate pronunciation.	SDG4	Quality Education	This aligns with SDG-4 as it develops effective listening, speaking, reading and writingskills that enable learners to understand native-speakers communication and communicate clearly and fluently with appropriate vocabulary and pronunciation to promote quality education
CO3	develop the ability to understand reading texts, conversations of both nativeand non-native speakers, interpret visual information,andproducecleara ndwell-structuredtechnicalreports	SDG4	Quality Education	This aligns with SDG-4 as it develops theabilitytointerpret visualinformation and produce clear and well-structured technical reports for academic and professional contexts
CO4	develop the ability to present effectively with clarity of speech and appropriate accent	SDG4	Quality Education	ThisalignswithSDG-4asitenhances effective presentation skills and perform well in interviews

CLOUD COMPUTING LABORATORY

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IT608**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : develop and demonstrate programs to implement basic cloud computing concepts, including compute services, cloud storage, database services, cloud operations, and serverless computing using cloud platforms

CO2 : develop and configure virtualized computing environments by creating virtual machines, managing compute resources, and designing Virtual Private Cloud (VPC) networks with fundamental networking concepts

CO3 : apply networking techniques in cloud environments by designing subnets, implementing multiple VPCs, configuring VPC peering, routing mechanisms, and performing condition-based virtual machine migration

CO4 : develop and deploy cloud-based applications by implementing containerization, working with cloud-based SQL services, and securing applications using cloud security practices

LIST OF EXPERIMENTS

Experiment-1

1. Develop a basic cloud setup and demonstrate usage of cloud services.
2. Develop a program to Getting Started with Compute.

Experiment-2

3. Develop and demonstrate cloud storage services by creating and managing storage resources in a cloud environment.
4. Develop and demonstrate database services in a cloud environment by creating and configuring a managed database instance.

Experiment-3

5. Introduction to AWS Management Console and Cloud Operations.
6. Getting Started with Serverless Computing in Cloud.

Experiment-4

7. Introduction to AWS Management Console and EC2 instance access.

Experiment-5

8. Creating a Virtual Machine.
9. Compute Engine: Quick Start.

Experiment-6

10. Create your own Virtual Private Cloud (VPC).
11. VPC Networking Fundamentals.

Experiment-7

12. Create public and private subnet.
13. Develop a program to demonstrate Multiple VPC networks.

Experiment-8

14. Develop VPC network peering setup.
15. Create Private Routing Table, associate subnet and add routing rules.

Experiment-9

16. Conditional Virtual Machine Migration between Nodes.

Experiment-10

17. Develop and Deploy Windows Containers on Compute Engine

Experiment-11

18. Introduction to SQL for Big Query and Cloud SQL.

Experiment-12

19. Develop a secured application in cloud.

Textbook(s):

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill, 2019. (Chapters 1,2 3,4,8,10 and 11), New Delhi
2. Dan C. Marnescu, "*Cloud Computing Theory and Practice*", 2nd ed. Cambridge: Elsevier, 2018. (Chapter 9)

Reference Book(s):

1. Dr. Kumar Saurabh, "*Cloud Computing: Architecting Next-Gen Transformations Paradigms*", 4th ed,Wiley India Private Limited, 2018, New Delhi
2. Barrie Sosinsky, "*Cloud Computing Bible*", Wiley Publications, 2011
3. Anthony T.Velte, Toby J Velte and Robert Elsenpeter, "*Cloud Computing: A practical Approach*", McGraw Hill,2010, New York
4. Dan C. Marinescu, "*Cloud Computing: Theory and Practice*", 3rd ed. 2013, USA: Morgan Kaufmann

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview;*NPTEL Video Lecture on Cloud Computing by Prof. Soumya Kanti Ghosh, Professor of Computer Science and Engineering, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Cloud Computing Laboratory Manual,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT608 : CLOUD COMPUTING LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT608.1	3	2	2	2	3	–	–	2	–	–	2	2	–
CO2	U24IT608.2	3	2	2	2	3	–	–	2	–	–	2	2	–
CO3	U24IT608.3	3	3	2	2	3	–	–	2	–	–	2	2	–
CO4	U24IT608.4	3	2	3	2	3	2	3	2	2	–	3	2	3
U24IT608		2	3.00	2.25	2.25	2.00	3.00	2.00	3.00	2.00	2.00	–	2.25	2.00
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop and use basic cloud services including compute, storage, databases, operations, and serverless applications.	SDG9	Industry, Innovation and Infrastructure	Cloud computing fundamentals enable scalable and reliable IT infrastructure. Services like compute, storage, databases, and serverless architectures support digital transformation, foster innovation, and strengthen modern industrial ecosystems.
CO2	Develop and configure virtualized computing environments by creating virtual machines, managing compute resources, and designing VPC networks.	SDG9	Industry, Innovation and Infrastructure	Virtualization and cloud networking improve infrastructure efficiency, optimize resource utilization, and support the development of robust, scalable systems essential for modern industries.
CO3	Apply networking zechniques in cloud environments including subnet design, VPC peering, routing, and condition-based VM migration.	SDG8	Decent Work and Economic Growth	Advanced cloud networking and migration techniques enhance system performance and availability, enabling businesses to scale operations, improve productivity, and support economic growth through digital services.
CO4	Develop and deploy cloud-based applications using	SDG16	Peace, Justice and Strong	Emphasizes securing cloud-based applications through data protection,

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	containerization, cloud SQL services, and implement security mechanisms in cloud environments.		Institutions	identity management, and security practices, which support safe and trustworthy digital systems.

INTERNET OF THINGS LABORATORY

Class: B. Tech. VI – Semester		**Branch:** IT	
Course Code:	**U24IT609**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: analyze various commands used in Raspbian operating system

CO2 : apply Python programming to interface and control sensors and actuators on Raspberry Pi for developing IoT applications

CO3: apply Python on Raspberry Pi to implement file-based LED control, cron-based automation, relay switching, and remote device monitoring over a network

CO4: apply IoT concepts to integrate sensors, cloud platforms, and Raspberry Pi peripherals for developing smart real-time applications

LABORATORY COMPONENT

Experiment-1

1. Installation of OS onto Raspberry Pi
2. Demonstrating Arduino board and Raspberry Pi
3. Start Raspberry Pi and try various Linux commands in command terminal window:
    a. ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip
    b. cat, more, less, ps

Experiment-2

4. Start Raspberry Pi and try various Linux commands in command terminal window:
    a. sudo, cron, chown, chgrp, ping etc.
    b. process-related commands
5. Run a python program on Pi to Read your name and print Hello message with name
6. Run a python program on Pi to Read two numbers and print their sum, difference,product and division
7. Run a python program on Pi to read a word and count characters in that word

Experiment-3

8. Run a python program on Pi to find the area of a given shape (rectangle, triangle andcircle) reading shape and appropriate values from standard input

Experiment-4

9. Run a python program on Pi to demonstrate while loop
10. Run a python program on Pi to demonstrate for loop
11. Run a python program on Pi to demonstrate handle Divide by zero exception

Experiment-5

12. Run a python program on Pi to print current time for 10 times with an interval of twoseconds.
13. Run a python program on Pi to read a file line by line and print the word count of each line.
14. Run a python program on Pi to demonstrate Light on LED through Python program.

Experiment-6

15. Run a python program on Pi to get input from two switches and Switch oncorresponding LEDs

Experiment-7

16. Run a python program on Pi to Flash an LED at a given on time and off time cycle,where the two times are taken from a file.
17. Run a python program on Pi to Flash an LED based on cron output (acts as an alarm)

Experiment-8

18. Switch on a relay at a given time using cron, where the relay's contact terminals areconnected to a load.

Experiment-9

19. Get the status of a bulb at a remote place (on the LAN) through web.

Experiment-10

20. Get input from DHT sensor and upload on to cloud
21. Get input from ultrasonic sensor and upload on to cloud

Experiment-11

22. Working with LED, button, pi sensor

Experiment-12

23. Working with Pi camera
24. Working with 7-segment display using Raspberry Pi

Textbook(s):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things* - A Hands-on Approach, Kolkata:Universities Press, 2016.
2. Simon Monk, *Raspberry Pi Cookbook,* 2nd ed., USA: O'Reilly Media,2016.

Reference Book(S):

1. Jeeva Jose, *Internet of Things*, New Delhi: Khanna Publishing Co. Ltd., 2018.
2. N. Ida, Sensors, Actuators and Their Interfaces- A Multidisciplinary Introduction,2nd edition, London: CPI Group (UK) Ltd., 2020.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs115/unit?unit=74&lesson=78; *NPTEL Video Lecture on Introduction to IoT by Prof. Sudip Mishra, IITK Kharagpur.*

Laboratory Manual (for Laboratory Component):

1. *Internet of Things Laboratory Manual and Record Book,* Department of IT, KITSW.

Course Articulation Matrix (CAM):		U24IT609 :INTERNET OF THINGS LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT609.1	2	2	2	1	2	1	1	1	1	-	-	2	2
CO2	U24IT609.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24IT609.3	2	2	2	2	2	1	1	1	1	-	2	2	2
CO4	U24IT609.4	2	2	3	3	3	1	1	1	1	-	2	2	2
U24IT609		1.75	2	2.25	1.75	2.25	1	1	1	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyse various commands used in Raspbian operating system	SDG 4	Quality Education	Understanding Raspbian OS commands builds foundational technical skills essential for quality education in computing and IoT domains.
CO2	analyse various commands used in Raspbian operating system	SDG 4	Quality Education	Analyzing operating system commands enhances problem-solving and technical competency required for modern digital education
CO3	apply Python on Raspberry Pi to implement file-based LED control, cron-based automation, relay switching, and remote device monitoring over a network	SDG 9	Industry, Innovation and Infrastructure	Implementing automation, networking, and remote monitoring using Raspberry Pi supports innovation in smart systems and industrial IoT applications.
CO4	apply IoT concepts to integrate sensors, cloud platforms, and Raspberry Pi peripherals for developing smart real-time applications	SDG 11	Sustainable Cities and Communities	Integrating sensors, cloud, and IoT devices enables development of smart real-time applications useful for smart homes and smart city solutions.

MINI PROJECT

Class: B. Tech. VI – Semester		**Branch: IT**	
Course Code:	**U24IT610**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship

CO2: demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report

CO3: make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project

CO4: write a "Mini project paper" in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project

Student has to take up independent mini project on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study, which would supplement and complement the program assigned to each student.

Guidelines:

1. The HoD shall constitute a *Department Mini Project Evaluation Committee (DMPEC)*
2. *DMPEC* shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format and (iv) effective mini project oral presentation
3. There shall be only continuous Internal Evaluation (CIE) for miniproject
4. The CIE for mini project is as follows:

S.No	Assessment Component	Weightage	CO Mapping	PO Mapping
1	Supervisor Assessment	15	CO1, CO2	PO9, PO10
2	Working Model	20	CO2, CO3	PO3, PO5
3	Mini Project Report	15	CO3	PO4, PO5
4	Mini Project Paper	10	CO1, CO4	PO1, PO8
5	Video Pitch	10	CO3, CO4	PO9, PO10
6	Oral Presentation/Viva	20	CO3, CO4	PO9, PO10
7	Alignment with SDGs	10	CO3, CO4	PO6, PO7, PO8
	Total Weightage:	100		

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation

(a) **Mini Project Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest

(b) **Working Model**: Each student is requested to develop a working model / process / system on the chosen work and demonstrate before the *DMPEC* as per the dates specified by *DMPEC*

(c) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DMPEC*

(d) **Anti-Plagiarism Check:** The seminar report should clear plagiarism check as per the Anti-Plagiarism policy of the institute. (Allowed Similarity % : Maximum 30%, From single Source : Max. 8% & No. of consecutive words: max. 10)

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *DMPEC* as per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Mini project as supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce
ii) he/she fails to submit the report in prescribed format
iii) he/she fails to fulfill the requirements of Mini project evaluation as per specified guidelines
iv) The CoE shall send a list of students registered for supplementary to the HoDconcerned
v) The DSEC, duly constituted by the HoD, shall conduct Mini project evaluation and send the award list to the CoE within the stipulated time

Mini Project Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
1	Supervisor Assessment	Regularity & Interaction (5M)	15
		Understanding of Topic (5M)	
		Progress &Timely Completion(5M)	
2	Working Model	Problem Statement & Literature Survey (5M)	20
		Methodology& System Design (5M)	
		Implementation (5M)	
		Performance & Usability (5M)	
3	Mini Project Report	Structure, Format& Originality (5M)	15
		Technical Content (5M)	
		Clarity, Coherence & Writing (5M)	
4	Mini Project Paper	Structure, Organization & Academic Writing (5M)	10
		References, Citations & Originality (5M)	
5	Video Pitch	Content Clarity & Delivery (5M)	10
		Visual Quality & Presentation (5M)	
6	Oral Presentation / Viva Voce	PPT & Delivery (5M)	20
		Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
7	Alignment with SDGs	SDG Mapping & Impact Analysis (5M)	10
		Justification of SDG mapping, Clarity, Presentation & Originality (5M)	

Course Articulation Matrix (CAM):		**U24IT610: MINI PROJECT**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT610.1**	3	3	2	3	3	2	1	2	1	2	2	2	1
CO2	**U24IT610.2**	2	2	2	3	2	1	1	1	2	1	3	1	1
CO3	**U24IT610.3**	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	**U24IT610.4**	1	2	1	2	2	1	2	1	3	1	2	1	1
U24IT610		**1.75**	**2**	**1.5**	**2.25**	**2.25**	**1.5**	**1.25**	**1.5**	**2.25**	**1.25**	**2.25**	**1.25**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship	**SDG 9**	Industry, Innovation and Infrastructure	Mini projects involve the design and development of innovative ECE solutions such as IoT systems, embedded systems, communication networks, VLSI applications, and intelligent electronic devices. These activities promote technological innovation, entrepreneurship, and sustainable industrial infrastructure.
CO2	demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report	**SDG 4**	Quality Education	Literature review, problem analysis, technical documentation, and independent learning enhance research skills, critical thinking, and lifelong learning capabilities, thereby supporting quality technical education and knowledge creation.
CO3	make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project	**SDG 11**	Sustainable Cities and Communities	Presentation and discussion of ECE-based solutions for smart cities, intelligent transportation systems, environmental monitoring, public safety, healthcare technologies, and digital connectivity contribute to sustainable and inclusive community development.
CO4	write a "Mini project paper" in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project	**SDG 12**	Responsible Consumption and Production	Scientific reporting and dissemination of project outcomes promote responsible innovation, ethical publication practices, efficient utilization of resources, and sustainable technology development.

3rd Year Exit Courses Syllabi

NATURAL LANGUAGE PROCESSING

Class: B. Tech. VI – Semester (Exit)		**Branch:** IT	
Course Code:	**U24IT611X**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-0-2-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : analyze the concepts of natural language processing to train a machine to understand text and spoken words in much the same way human beings can understand

CO2 : analyze language models, naïve bayes and sentiment classifiers to recommend an opinion model

CO3 : apply the part of speech tagging and parsing techniques to automate the system responses

CO4 : analyze and develop different applications based on natural language processing such as named entity recognition, question answering, machine translation and chat bots

THEORY COMPONENT

UNIT-I	**4 Hrs**

Natural Language Processing (NLP): Introduction to NLP, Ambiguity, Language, Thought and Understanding

Regular Expressions, Text Normalization, Edit Distance: Regular expression, Words, Morphology, Morphology parsing, Word tokenization, Lemmatization, Stemming, Edit distance

UNIT-II	**4 Hrs**

N-gram Language Models: N-Grams, Evaluating language models and smoothing, Kneser-Ney smoothing, Perplexity's relation to entropy

Naïve Bayes and Sentiment Classification: Naïve Bayes classifiers, Training the Naïve Bayes classifier, Worked example, Optimizing for sentiment analysis

UNIT-III	**4 Hrs**

Sequence Labeling for Parts of speech and Named Entities: English word classes, Part-of-Speech tagging, Named entities and Named entity tagging, HMM Part-of-speech tagging

Constituency Parsing: Ambiguity, CKY parsing, Partial parsing

UNIT-IV	**4 Hrs**

Compositional semantics: Introduction, Semantic role, Labeling and sematic parsing, Disclosure analysis

Applications: Named entity recognition and Relation Extraction-RE using sequence labeling, Machine Translation(MT)- Basic issues in MT, Statistical translation, Word alignment, Phrase-based translation, Question answering, Chatbots and dialog system

LIST OF EXPERIMENTS

1. Develop a program to split the given text into words and remove the special characters and punctuations.
2. Apply Porter stemmer algorithm for stemming the words present in given text.
3. Apply WordNet Lemmatizer for Lemmatization of words present in text.
4. Develop a program for sentence tokenization.

5. Develop a program to build a N-Gram model from the words present two given strings.
6. Develop a program to apply naïve bayes classification for the given text.
7. Develop a program to implement the process of chunking on the given text.
8. Develop a program to implement named entity tagging and Markov chains.

Textbook(s):

1. Daniel Jurafsky and James H. Martin, *Speech and Language Processing,* Pearson Education, Second edition, ISBN: 978-9332518414, 2009

Reference Book(s):

1. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, O'Reilly Media, 1st edition, ISBN: 978-0596516499, 2009
2. Roland R. Hausser, *Foundations of Computational Linguistics: Human-Computer Communication in Natural Language*, MIT Press, first edition, ISBN: 978-3540424178, 2011

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc26_cs45/preview; *NPTEL Video Lecture on Natural Language Processing, Prof. Pawan Goyal, Professor of CSE, IIT Kharagpur.*

SOFTWARE TESTING

Class: B.Tech. VI –Semester (Exit)		**Branch:** IT	
Course Code:	**U24IT612X**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-0-2-4**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: construct basic test cases using software testing concepts
CO2: apply black-box and white-box testing techniques for solving real world problems
CO3: compare various levels of testing for a given problem
CO4: prepare test plans, test design and various test reports for given problem

(based on psychomotor skills acquired from laboratory component)

CO5: design and execute test cases using black-box and white-box techniques
CO6: use software testing tools to automate testing processes
CO7: perform different levels of testing on sample applications
CO8: develop test plans and generate test reports for software systems

THEORY COMPONENT

UNIT-I	**4 Hrs**

Software Testing Terminology and Methodology: Introduction, Software Testing Definition, Goals of Software Testing, Software Testing as aProcess, Failure, Fault, Error, Test Case, Testware, Incident, Test Oracle, Life cycle of Bug, States of Bug, Bugs Classification based on criticality, Bugs Classification based on SDLC, Testing Principle, STLC, Verification and Validation Activities

UNIT-II	**4 Hrs**

Testing Techniques : Dynamic Testing: Black-Box Testing Techniques, Boundary Value Analysis, Equivalence Class Testing, State Table Based Testing, Decision Table Based Testing, White-Box Testing Techniques, Need of White-box testing, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop testing, Data Flow testing, Mutation testing.
Static Testing : Introduction to static testing, Types of Static techniques.

UNIT-III	**4 Hrs**

Validation Activities: Unit Testing, Benefit of Designing stub and driver, Integration Testing, Decomposition based Integration, Comparison between top down and bottomup integration testing, Call Graph Based Integration, Pair-wise Integration, Neighborhood Integration, Path Based Integration, Function Testing, System Testing, Categories of System Tests, Acceptance Testing, Alpha Testing, Beta Testing, Regression Testing.

UNIT-IV	**4 Hrs**

Test Management: Test Organization, Structure of Test Group, Test Planning, Test Plan Components, Test Plan Hierarchy, Master Test Plan, Test Design Specification, Test Case Specification, Test Procedure Specification, Test Log, Test Incident Report, Test Summary Report

LIST OF EXPERIMENTS

1. Introduction to manual testing, Prepare test strategy, test plan document and test case template for any sample application.
2. Write programs in "C" Language to demonstrate the working of the following constructs and write possible test cases a. do...while ii) while...do iii) if…else iv) switch v) for

3. Consider any system (e.g. ATM system) and study its system specifications and report various bugs
4. Introduction to automation testing, demonstrate Manual & Automation testing using Login page
5. Introduction to Selenium, demonstration of Features and Limitations of Selenium Web driver. Configure Selenium with Eclipse IDE and demonstrate Browser Commands, Navigation Commands and Handling Cookies
6. Locators: Object Identification, findElement and findElements, Handling Text Field, Text Area, Checkboxes, RadioButtons, Links and Buttons
7. Installation of JMeter and demonstratingperformance testing using JMeter.
8. Using JMeter prepare Test Plan using Thread Group, Recording and View Results

Text Book:

1. Naresh Chauhan, *Software Testing Principles and Practices*, Oxford University Press, 2nd Edition, 2016.

Reference Book(s):

1. Nageshwar Rao Pusuluri, *Software Testing Concepts and Tools*, New Delhi: Dreamtech Press, 1st edition, 2006.
2. K. Mustafa and R. A. Khan, *Software Testing: Concepts and Practices*, New Delhi: Narosa Publishing House, 1st edition, 2009.
3. M. G. Limaye, *Software Testing: Principles, Techniques and Tools*, New Delhi: McGraw Hill Education, 1st edition, 2017.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc26_cs59/preview; *NPTEL Video Lecture on: Software Testing by Prof.Rajib Mall, IIT Kharagpur*

Laboratory Manual (for laboratory component):

1. *Software Testing Laboratory Manual and Record Book,* Department of IT, KITSW

FUNDAMENTALS OF DEVOPS

Class: B. Tech. VI – Semester(Exit)		**Branch:** IT	
Course Code:	**U24IT613X**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-0-2-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

- **CO1:** identify components of Devops environment.
- **CO2:** analyze DevOps lifecycle practices, Continuous Testing, and modern software architecture approaches for resilient application development.
- **CO3:** apply source code management and collaborative development practices using Git, GitLab, Gerrit, and Docker tools.
- **CO4:** demonstrate build automation and continuous integration processes using Jenkins pipelines and infrastructure as code techniques.

(based on psychomotor skills acquired from laboratory component)

- **CO5:** apply Git and GitHub tools for source code management, version control, and collaborative software development.
- **CO6:** Demonstrate continuous integration and continuous development practices using Jenkins for automated software build and deployment processes.
- **CO7:** Develop and deploy containerized applications using Docker and manage container environments effectively
- **CO8:** Implement container orchestration and automation using Kubernetes fordeploying and managing scalable applications.

THEORY COMPONENT

UNIT-I	**4 Hrs**

Introduction to DevOps: Introduction, Agile development model, DevOps and ITIL. DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipeline, identifying bottlenecks.

UNIT-II	**4Hrs**

Software development models and DevOps: DevOps Lifecycle forBusiness Agility, DevOps, and Continuous Testing.

DevOps influence on Architecture: Introducing software architecture, The monolithic scenario, Architecture rules of thumb, The separation of concerns, Handling database migrations, Micro services and the data tier, DevOps, architecture, and resilience.

UNIT-III	**4 Hrs**

Introduction to project management: The need for source code control, the history of source code management, Roles and code, source code management system and migrations, shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, GitLab.

UNIT-IV	**4 Hrs**

Integrating the system: Build systems, Jenkins build server, Managing build dependencies, Jenkins plugins, and file system layout, The host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.

Textbook(s):

1. Joakim Verona,*Practical Devops*, Second Edition. Ingram short title; 2ndedition (2018). ISBN10: 1788392574
2. Deepak Gaikwad, Viral Thakkar. *DevOps Tools from Practitioner'sViewpoint*. Wiley publications. ISBN: 9788126579952

Reference Book(S):

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10.

Web and Video link(s):

1. https://www.udemy.com/course/decodingdevops

LIST OF EXPERIMENTS
1. Develop the code for a simple user registration form for an event. 2. Explore Git and GitHub commands. 3. Practice Source code management on GitHub. Experiment with the source code in exercise 1. 4. Jenkins installation and setup, explore the environment. 5. Demonstrate continuous integration and development using Jenkins. 6. Explore Docker commands for content management. 7. Develop a simple containerized application using Docker. 8. Integrate Kubernetes and Docker 9. Automate the process of running containerized application for exercise 7 using Kubernetes.
Textbook(s): 1. Joakim Verona., Practical DevOps, Packt Publishing, 2016.
Reference Book(s): 1. Deepak Gaikwad, Viral Thakkar,*DevOps Tools from Practitioner's Viewpoint,* Wiley publications. 2. Len Bass, Ingo Weber, Liming Zhu. *DevOps: A Software Architect's Perspective,*Addison Wesley.
Web and Video link(s): 1. https://www.udemy.com/course/decodingdevops
Laboratory Manual (for laboratory component): 1. *Fundamentals DevOps Laboratory Manual,* Department of IT, KITSW

CYBER SECURITY

Class: B.Tech. VI –Semester (Exit)		**Branch:** IT	
Course Code:	**U24IT614X**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-0-2-4**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40 %**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1: apply the fundamentals of cyber security, security goals and cyber threat mitigation techniques for system protection

CO2: analyze network attacks and apply network security mechanisms for secure communication

CO3: analyze malware attacks and apply system security techniques for protecting data and computer systems

CO4: analyze cyber security tools, ethical practices and security management techniques for organizational security

(based on psychomotor skills acquired from laboratory component)

CO5: analyze system vulnerabilities and apply cyber security techniques to identify threats in computer systems

CO6: apply firewall, antivirus and authentication mechanisms for system protection

CO7: apply encryption, vulnerability assessment and secure communication practices using cyber security tools

CO8: analyze cyber security risks and apply secure backup and recovery techniques for data protection

THEORY COMPONENT

UNIT-I	**4 Hrs**

Introduction to Cyber Security: Introduction to cyber security, Need for cyber security, Cyber threats and vulnerabilities, Types of hackers, Cyber attacks

Security goals: Confidentiality, Integrity and Availability, Cyber security challenges, Basic security mechanisms

UNIT-II	**4 Hrs**

Network Security and Cyber Attacks: Introduction to network security, Types of networks**Common network attacks:** Phishing, Spoofing, Denial of Service, Password attacks, Firewalls, Virtual Private Network (VPN), Intrusion Detection System, Wireless network security, Secure browsing practices

UNIT-III	**4 Hrs**

System Security and Malware Protection: Operating system security, User authentication, Password management, Access control

Malware: Virus, Worm, Trojan horse, Spyware and Ransomware, Antivirus software, Data backup and recovery, Email security and social engineering

UNIT-IV	**4 Hrs**

Cyber Security Tools and Ethical Practices: Cyber security tools, Vulnerability assessment, Basic cryptography concepts, Digital signatures, Cyber laws and ethics, Ethical hacking concepts, Security policies, Risk management, Cyber security best practices

LIST OF EXPERIMENTS
1. Develop a system vulnerability identification and cyber threat analysis mechanism for computer systems using OpenVAS or Nessus vulnerability assessment tool 2. Develop firewall configuration and traffic filtering mechanisms in Windows/Linux systems using Windows Defender Firewall / UFW Firewall 3. Develop password security and user authentication mechanisms for secure system access using Windows/Linux Operating System 4. Develop phishing email and malicious website identification techniques using secure browsing practices using Web Browser or Online URL Scanning Tools 5. Develop malware detection and antivirus scanning mechanisms for system protection using a Antivirus Software 6. Develop file encryption and decryption mechanisms using cryptographic techniques using OpenSSL or Cryptographic Tools 7. Develop vulnerability assessment and port scanning techniques using cyber security tools like Nmap or OpenVAS 8. Develop secure data backup and recovery mechanisms for system protection using Backup Utility Software or External Storage Device
Text Book: 1. C. P. Pfleeger and S. L. Pfleeger, *Security in Computing*, 5th ed., Boston, MA: Pearson Education, 2015.
Reference Book(s): 1. W. Stallings and L. Brown, Computer Security: Principles and Practice, 4th ed., Boston, MA: Pearson Education, 2018. 2. N. Godbole and S. Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st ed., New Delhi, India: Wiley India, 2011. 3. C. Easttom, Network Defense and Countermeasures, 2nd ed., Burlington, MA: Jones & Bartlett Learning, 2014.
Web and Video link(s): 1. https://nptel.ac.in/courses/106105217; *NPTEL Video Lecture on: Ethical Hacking by Prof.Indranil Sengupta, IIT Kharagpur*
Laboratory Manual (for laboratory component): 1. *Cyber Security Laboratory Manual and Record Book,* Department of IT, KITSW

7th Semester Syllabi

VII SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE-III	U24MB701X	Open Elective-MB *(from Pool – IX)*	2	1	-	3	3
2	PEC	U24IT702X	Program Elective - II/ MOOCs-II *(from Pool – X)*	2	1	-	3	3
3	PCC	U24IT703	DevOps Essentials	3	1	-	4	4
4	PCC	U24IT704	Data Science	2	1	-	3	3
5	PCC	U24IT705	DevOps Laboratory	-	-	2	2	1
6	PCC	U24IT706	Data Science Laboratory	-	-	2	2	1
7	ELC	U24IT707	Internship Evaluation*	-	-	2	2	1
8	ELC	U24IT708	Major Project Phase-1 / Industrial Internship - 1	-	-	8	8	4
Total:				9	4	14	27	20
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	24

Pool –IX Management Courses Basket (OE-MB)		
S. No.	Course Code	Course Title
1.	U24OE701A	Management Economics and Accountancy
2.	U24OE701B	Engineering Finance
3.	U24OE701C	Organisational Behaviour
4.	U24OE701D	E-Commerce and Digital Marketing
5.	U24OE701Z	Any other course approved by BoS Chair and Dean AA

	Pool –X Program Elective – II	
S. No.	Course Code	Course Title
1	U24IT702A	Ethical Hacking
2	U24IT702B	Computer Vision & Image Processing
3	U24IT702C	Mobile Computing
4	U24IT702D	High Performance Computing Architecture
5	U24IT702E	Industrial IoT

MANAGEMENT ECONOMICS AND ACCOUNTANCY

Class: B. Tech. VII - Semester		**Branch: IT**	
Course Code:	**U24OE701A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : comprehend the basic concepts of management, functions of management

CO2 : distinguish between micro & macroeconomics & forms of business organizations

CO3 : pass journal entries & post them into ledgers, prepare profit & loss accounts and assesses the financial position through the balance sheet

CO4 : evaluate financial statements with a the help of various ratios and reveal the financial health of the organization

UNIT-I	**9 Hrs**

Introduction to Management: Concept of Management, Features of Management, Importance of Management, Nature and Scope of Management, Fayol's Administrative Management, Taylor's Scientific Management

Functions of Management: Planning- Concept of Planning, Nature of Planning, Importance of Planning, Planning Process, Types of Planning; **Organizing**-Concept of Organizing, Organization Structure- line and staff, Advantages of Organizing; **Staffing** - Meaning, Functions of Human Resources Management; **Directing**- Elements of Directing- Supervision; Leadership- Nature; Motivation – Nature, Types; Communication- Process, Types, Barriers to effective communication; **Co-ordination**- Definition, Steps to achieve effective coordination; **Controlling**- Definition, Process

UNIT-II	**9 Hrs**

Economics: Meaning and definition, Scope, Micro and Macro Economics, Methods of Economics

Forms of Business Organization: Sole Proprietor ship, Partnership firm - Types of Partners, Limited Liability Partnership (LLP), Joint Stock Company - Features, Types, Merits and demerits, Cooperative society

UNIT-III	**9 Hrs**

Introduction to Financial Accounting: Accounting concepts and conventions, Double Entry System and Book Keeping, Overview of accounting cycle, Journal-meaning, Journalizing, Ledger - Meaning, Ledger posting, Balancing; Cash book (Single column), Preparation of Trial balance

Final Accounts: Trading Account, profit and loss account and Balance Sheet with simple adjustments.

UNIT-IV	**9 Hrs**

Financial Statement Analysis: Introduction to Financial Statement Analysis, Ratio Analysis, Introduction, Types of Ratios, Analysis and Interpretation of Liquidity Ratios, Profitability ratios, Activity Ratios, and Capital structure Ratios (simple problems).

Textbook(s):

1. L.M.Prasad, *Principles and Practices of Management,* Sultan Chand & Sons Educational Publishers, 11th edition.2025, New Delhi.
2. D. N. Dwivedi, *Engineering Economics*: *Text & Cases*, Vikas Publishing, 5th edition, 2014.
3. R. Narayana Swamy, *Financial Accounting – A Managerial Perspective*, Prentice Hall of India, 7th edition, 2023,new Delhi.

Reference Book(S):

1. Harold Koontz and Heinz Weihrich, Essentials of Management, 6th ed. New Delhi: Tata Mc Graw Hill Publications, 2015.
2. Maheshwari, S. N., & Maheshwari, S. K. (2024). Financial Accounting (7th ed.). Vikas Publishing House Pvt. Ltd, 2024.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg52
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ec10

Course Articulation Matrix (CAM):		U24MB701A: MANAGEMENT ECONOMICS AND ACCOUNTANCY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24MB701A.1	-	3	3	2	-	2	2	3	3	3	3	2	1
CO2	U24MB701A.2	-	2	2	-	-	2	3	3	3	3	3	2	1
CO3	U24MB701A.3	-	1	2	1	-	2	3	2	3	3	3	2	1
CO4	U24MB701A.4	-	2	2	2	-	1	2	-	3	2	3	2	1
U24MB701A		-	2.25	2.25	1.67	-	1.75	2.5	2.67	3	2.75	3	2	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	comprehend the basic concepts of management	SDG 4	Quality Education	Understanding the management concepts and managerial function will help the students to take effective and efficient decisions and able to solve work place problems.
CO2	distinguish between micro & macro- economics & forms of business organizations	SDG 8	Decent Work and Economic Growth	Economics concepts will help to promote sustained, inclusive and sustainable economic growth, and different forms of organizations will

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				provide knowledge about creating full and productive employment and decent work for all
CO3	pass journal entries & post them into ledgers, prepare profit & loss accounts and assesses the financial position through the balance sheet	SDG 17	Partnerships for the goals	accounting concepts and conventions will promote a universal, rules-based, open, non-discriminatory and equitable application of
CO4	evaluate financial statements with a the help of various ratios and reveal the financial health of the organization	SDG 8	Decent Work and Economic Growth.	Evaluating financial statements through ratio analysis reveals the financial health of an organization, enabling better decision-making, efficient resource utilization, and sustainable growth.

ENGINEERING FINANCE

Class: B.Tech. VII –Semester		**Branch:** IT	
Course Code:	**U24OE701B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.

CO2 : apply capital budgeting techniques including inflation adjusted Net Present Value/Internal Rate Return for project evaluation and selection.

CO3: analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects.

CO4: evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.

UNIT-I	**9 Hrs**

Fundamentals of Engineering Finance

Engineering Finance – Meaning, Definition, and Scope; Role of Finance in Engineering – Importance for engineers in decision making and cost control; Ethics in Engineering Finance – Transparency, Cost estimation honesty, Avoidance of financial conflicts of interest; Financial Management – Meaning, Functions, Objectives (profit maximization v/s. wealth maximization), Sources of Finance, Time value of Money

UNIT-II	**9 Hrs**

Investment Decisions

Investment Decisions- Types of Investment projects, Investment evaluation criteria; Methods of capital budgeting – Discounted cash flow techniques v/s. non discounted cash flow techniques, Inflation adjusted NPV and IRR, Comparison and selection of mutually exclusive engineering projects

UNIT-III	**9 Hrs**

Cost-Volume-Profit Analysis

Cost concepts- Fixed, Variable, Marginal, Sunk, Opportunity costs, Direct and Indirect costs; Breakeven analysis – Meaning, Assumptions, Graphical and Mathematical determination of breakeven point; Make or buy decisions using breakeven analysis; Application of breakeven analysis in engineering projects

UNIT-IV	**9 Hrs**

Replacement Decisions and Valuation of engineering assets

Replacement analysis – Meaning, Need, Defender v/s. Challenger concept; Economic service life; Valuation of equipment's and physical assets - Depreciation definition, Depreciation fund; Methods of depreciation - straight line, Declining balance, Sum of the years-digits, Sinking fund and Service output method, Application of depreciation methods on equipment's and physical asset with the passage of time.

Textbook(s):

1. M Y Khan and P K Jain, *Financial Management,* Tata McGraw Hill 5th edition, ISBN:978-0-07-065614-7 *(Unit-I in part 1 of section 1,2&3 and Unit-II in part 3 of 9&10).*
2. R. Panneerselvam, *Engineering Economics,* PHI Learning 2nd edition, ISBN:978-81-203-4837-0 *(Unit-III in Chapter 1&16 and Unit-IV in Chapter 8& 9).*

Reference Book(S):

1. F.K. Crundwell, *Finance for Engineers: Evaluation and Funding of Capital Projects*, Springer London Ltd, Atlantic Publishers and Distributors (P) Ltd., ISBN: 978-1849967082, 2010.
2. Robert L. Kosowski, Salih N. Neftci, *Principles of financial engineering*, Academic press, Atlantic Publishers and Distributors (P) Ltd. 3rd edition, ISBN: 978-0123869685, 2014.
3. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th edition, ISBN: 9788126510887, 2014.
4. Prasanna Chandhra, *Financial Management: Theory and Practice,* Tata Mc Graw Hill Education (India) private limited, ISBN-10: 93-392-1225-8, 2015.
5. Chan S. Park, *Fundamentals of Engineering Economics,* Pearson Education. 3rd edition, ISBN: 978-9352864379, 2017.
6. Chatterjee Partha Sheikh Salim, *Engineering Economy & Financial Management*, Himalaya Publishing House, ISBN:978-9350247389, 2011.

Course Articulation Matrix (CAM):		**U24OE701B : ENGINEERING FINANCE**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24OE701B.1**	2	-	-	-	-	-	2	-	-	2	2	1	-
CO2	**U24OE701B.2**		3			2						3	1	-
CO3	**U24OE701B.3**			2					2		2		1	-
CO4	**U24OE701B.4**			2	2		2				2	2	1	-
U24OE701B		2	3	2	2	2	2		2		2	2.3	1	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.	SDG 4 And SDG 16	Quality Education and Peace, Justice and Strong Institutions	Promotes financial literacy, ethical decision-making, and professional responsibility essential for quality education and transparent institutional practices.
CO2	Apply capital budgeting techniques including inflation adjusted NPV/IRR for project evaluation and selection.	SDG 8 And SDG 9	Decent Work and Economic Growth And Industry, Innovation and Infrastructure	Supports economically viable investment decisions, efficient resource allocation, industrial growth, and sustainable infrastructure development.
CO3	Analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects.	SDG 9 And SDG 12	Industry, Innovation and Infrastructure and Responsible Consumption and Production	Encourages cost efficiency, optimized production planning, and responsible utilization of resources in engineering and industrial projects

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO4	Evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.	SDG 8 And SDG 12	Decent Work and Economic Growth and Responsible Consumption and Production	Promotes sustainable asset management, economic efficiency, lifecycle optimization, and responsible use of engineering resources.

ORGANIZATIONAL BEHAVIOUR

Class: B. Tech. VII – Semester		Branch: IT	
Course Code:	**U24OE701C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : evaluate the fundamentals, importance, influencing factors, and communication processes of Organizational Behaviour.

CO2 : analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation.

CO3 : examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings.

CO4 : evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour.

UNIT-I	**9 Hrs**

Introduction: Foundations of organizational behavior, Concept, Importance, Factors influencing organizational behavior, Challenges and opportunities for organization behavior; Managerial perspective of OB; Communication-Process-channels-communication barriers , Measures to overcome barriers

UNIT-II	**9 Hrs**

Individual Behavior: Individual in the organization, Nature of man, Models of man, Personality-Stages of development of personality; Perception-Factors influencing perception; Learning-Theories of Learning-Cognitive Learning Theory, Behaviourist Learning Theory; Attitudes-Formation of attitudes; Personality and emotions, Managing emotions and stress in organizations; Motivation- Motivation theories-Maslow's Needs Hierarchy Theory and Herzberg's Two-Factor Theory

UNIT-III	**9 Hrs**

Group decision making: Groups in organization, Basic group concepts, Groups vs. Teams, Understanding work teams-Types of teams, Creating effective teams; Conflicts-Types of conflicts, Strategies for resolution of conflicts in groups

Group dynamics: Group dynamics, Leadership-Leadership types and managerial effectiveness, Trust and leadership, Power and politics, Basis of power, Organizational politics

UNIT-IV	**9 Hrs**

Organization structure: Organization structure, Size and design; Organizational culture; Organizational change-Resistance to change; Organizational stress- Factors contribute to stress, Coping strategies, Stress and performance; Organizational effectiveness-concepts; Quality of work life-concepts; International organizational behavior-concepts

Textbook(s):

1. Stephen P. Robbins, Timothy A. Judge & Neharika Vohra, *Organizational Behavior*, *Pearson India, 18th edition*, 2022, New Delhi. (Chapter I to IV)
2. K. Aswathappa, *Organizational Behaviour, Himalaya Publishing House, 14th edition,* 2021, Mumbai. (Chapter I to IV)

Reference Book(S):

1. Fred Luthans, *Organizational Behavior, McGraw Hill Education, 13th edition*, 2020, New York.
2. Uma Sekaran, *Organizational Behavior: Text and Cases, McGraw Hill Education, 2nd edition*, 2019, New Delhi.
3. S. S. Khanka, *Organizational Behavior, S. Chand Publishing, 11th edition, 2021*, New Delhi.

Web and Video link(s):

1. Harvard Business Review – Organizational Behavior Articles and Videos ; Web resources and expert videos on leadership, teamwork, communication, conflict management, and organizational effectiveness.

Course Articulation Matrix (CAM):		U24OE701C : ORGANIZATIONAL BEHAVIOUR												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE701C.1	2	-	-	-	-	-	-	2	2	-	-	1	-
CO2	U24OE701C.2	-	3	-	-	-	-	2	--	-	-	3	1	-
CO3	U24OE601C.3	-	2	-	-	-	-	-	2	2	2	-	1	-
CO4	U24OE701C.4	-	-	2	-	-	2	-	-	-	2	2	1	-
U24OE701C		2	2.5	2	-	-	2	2	2	2	2	2.5	1	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Explain the fundamentals, importance, influencing factors, and communication processes of Organizational Behaviour.	SDG 4	Quality Education	Understanding organizational behaviour and communication processes helps students develop professional knowledge, communication, and workplace learning skills.
CO2	Analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation.	SDG 3	Good Health and Well-being	Analysing emotions, stress, motivation, and attitudes promotes mental well-being, self-management, and healthy work practices.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO3	Examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings.	SDG 16	Peace, Justice and Strong Institutions	Studying leadership, conflict management, teamwork, and group dynamics supports inclusive, cooperative, and effective organizational practices
CO4	Evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour.	SDG 8	Decent Work and Economic Growth	Evaluating organizational culture, innovation, quality of work life, and change management supports productive employment and sustainable organizational growth.

E-COMMERCE & DIGITAL MARKETING

Class: B. Tech. VII – Semester		**Branch:** IT	
Course Code:	**U24OE701D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : interpret the concepts, scope, types, functions, framework, opportunities, and limitations of E-Commerce, and analyse its role in modern business and electronic transactions

CO2 : analyze e-payment systems, e-finance operations, e-banking, e-trading, and the legal framework governing e-commerce transactions

CO3 : evaluate digital marketing practices, emerging trends, and consumer behaviour in the online environment

CO4 : determine digital marketing channels and design effective online marketing plans

UNIT-I	**9 Hrs**

Introduction to E-Commerce: E-Commerce – Introduction, Definition, Scope, Evolution, Internet Commerce vs E-Commerce; Electronic Commerce Market; E-Commerce Industry Framework; Trade Cycle in E-Commerce; Electronic Data Interchange (EDI); E-Commerce Functions; Types of E-Commerce – B2B, B2C, C2C, C2B, B2G, G2B, and G2C; Forces fuelling E-Commerce – Differences between Traditional Commerce and E-Commerce; Limitations of E-Commerce; Introduction to Artificial Intelligence (AI) in E-Commerce

UNIT-II	**9 Hrs**

E-payment Systems: Digital payment Requirements; Types of E-Payment Systems - Digital Token-based E-payment systems, Credit card as E-payment system, Mobile payments, smart card cash payment system, Micropayment system, E-Security, E- Cash; E-Finance: Areas of Financing; E-Banking - Traditional Banking Vs. E-Banking; Operations in E-Banking; E-Trading – Stock Market trading; Importance and advantages of E-Trading

Legal Framework for E-Commerce: E-Commerce Legal Framework - The Information Technology Act 2000, Information Technology (Amendment) Act, 2008, Copyrights, Defamation, Privacy, Contracts, Taxation, Signing a contract Electronically, Domain name and Registration

UNIT-III	**9 Hrs**

Digital Marketing: Concept, Components of Digital Marketing, Need and Scope of Digital Marketing, Benefits of Digital Marketing, Digital Marketing Platforms and Strategies, Comparison of Marketing and Digital Marketing, Digital Marketing Trends, Marketing in the Digital Era: Segmentation – Importance of Audience Segmentation, different segments used in Digital Media – Organizational characteristics, purchasing characteristics, using Digital Media to Reach, acquisition and retention of new customers, Digital Media for Customer Loyalty

UNIT-IV	**9 Hrs**

Channels of Digital Marketing: Digital Marketing, Website Marketing, Search Engine Marketing, Search Engine optimization, Online Advertising, Email Marketing, Campaign Design, Automation, Personalization, Blog Marketing-Content Creation, Blogging Platforms, Social Media Marketing-Marketing through Facebook, Instagram, LinkedIn, X (Twitter), and YouTube, Audio, Video and Interactive Marketing, Mobile Marketing. Digital Marketing

Plan: Need for Digital Marketing Plan, Elements of Digital Marketing Plan, Writing the Marketing Plan and Implementation

Textbook(s):

1. C. S. V. Murthy, *E-Commerce: Concepts, Models & Strategies*, Himalaya Publishing House, 2nd Edition (2025).
2. Seema Gupta – *Digital Marketing*, McGraw-Hill, 3rd Edition, 2022/2023.
3. Tracy L. Tuten & Michael R. Solomon – *Social Media Marketing*, SAGE Publication, 5th Edition, 2023.

Reference Book(S):

1. Matthew Reynolds – *Beginning E-Commerce with Visual Basic, ASP, SQL Server 7.0 & MTS*, published by Wrox Publisher.
2. P. T. Joseph, S.J., *E-Commerce: An Indian Perspective,* Latest Edition: 7th Edition (2023) Publisher: PHI Learning Pvt. Ltd.
3. Michael Miller – *B2B Digital Marketing: Using the Web to Market Directly to Businesses* 1st Edition (2012; Indian reprint 2014/2015) Pearson India / Que Publishing.

Web and Video link(s):

1. https://youtu.be/qnBhOVH1QQ8?si=6UtzpR5d6t8Rk5da Digital Marketing Full Course 2026 In 24 Hrs | Digital Marketing Tutorial For Beginners
2. https://youtu.be/qsO_YCjgBFI?si=zVdKwrU8l6eEr4wg

Course Articulation Matrix (CAM):		**U24OE701D: E-COMMERCE & DIGITAL MARKETING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE701D.1**	2	2	1		2	1			1		2	1	-
CO2	**U24OE701D.2**	2	2	1	1	2	2	1		1	1	1	1	-
CO3	**U24OE701D.3**	2	2	2	1	2	1	1	1	2	1	2	1	-
CO4	**U24OE701D.4**	2	2	2	2	2	1	1	2	2	2	2	1	-
U24OE701D		**2**	**2**	**1.5**	**1.3**	**2**	**1.25**	**1**	**1.5**	**1.5**	**1.3**	**1.75**	**1**	-
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand the concepts, scope, types, functions, framework, opportunities, and limitations of E-Commerce, and analyse its role in modern business and electronic transactions.	**SDG 8**	Decent Work and Economic Growth	E-Commerce promotes entrepreneurship, digital business growth, employment opportunities, and innovation in the global economy
CO2	Analyse e-payment systems, e-finance operations, e-banking, e-trading, and the legal framework governing e-commerce transactions.	**SDG 9**	Industry, Innovation and Infrastructure	Digital payment systems and e-banking strengthen technological infrastructure, financial inclusion, and innovation in digital industries

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO3	Evaluate digital marketing practices, emerging trends, and consumer behaviour in the online environment.	**SDG 12**	Responsible Consumption and Production	Digital marketing helps organizations understand consumer behaviour and promote sustainable and responsible consumption patterns
CO4	Analyze digital marketing channels and design effective online marketing plans.	**SDG 17**	Partnerships for the Goals	Digital marketing channels improve global communication, collaboration, networking, and partnerships among businesses and stakeholders

ETHICAL HACKING

Class: B. Tech. VII – Semester		**Branch:** IT	
Course Code:	**U24IT702A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze security vulnerabilities, security models and phases of penetration testing frameworks in computer systems and networks

CO2 : analyze the various cyber attacks and security threats in business and network environments, to measure their impact on data confidentiality, integrity, and system availability.

CO3 : apply reconnaissance, enumeration and exploitation techniques using ethical hacking tools

CO4 : analyze penetration testing results and recommend suitable mitigation and defense mechanisms to improve the security of computer systems and networks

UNIT-I	**9 Hrs**

Introduction: Hacking impacts, Script kiddies

Framework: Planning the test, Sound operations, Reconnaissance, Enumeration, Vulnerability analysis, Exploitation, Final analysis, Deliverable, Integration

Information Security Models: Computer security, Network security, Service security, Application security, Security architecture

Information Security Program: The process of information security, Component parts of information security programs, Risk analysis and ethical hacking

Self-Learning Topics: *The hacker-type of hacker*

UNIT-II	**9 Hrs**

The Business Perspective: Business objectives, Previous test results, Business challenges

Planning for a Controlled Attack: Inherent limitations, Imposed limitations, Timing is everything, Attack type, Source point, Required knowledge, Multi-phased attacks, Teaming and attack structure, Engagement planner, The right security consultant, The tester, logistics, Intermediates, Law enforcement

Self-Learning Topics: *Security policy*

UNIT-III	**9 Hrs**

Reconnaissance: Social engineering, Physical security, Internet reconnaissance

Preparing for a Hack: Technical preparation, Managing the engagement

Enumeration: Enumeration techniques, soft objective, Looking around or attack, Elements of enumeration, Preparing for the next phase

Exploitation: Intuitive testing, Evasion, Threads and groups, Operating systems, Password crackers, Rootkits, Applications, Wardialing, Network

Self-Learning Topics: *Services and areas of concern*

UNIT-IV	**9 Hrs**

Deliverable: The deliverable, The document, Aligning findings, Presentation

Integration: Integrating the results, Integration summary, Mitigation, Defense planning, Incident management, Security policy, Conclusion

Case study: various attacks scenarios and their remedies

Self-Learning Topics: Overall structure

Textbook(s):

1. James S. Tiller, *The Ethical Hack: A Framework for Business Value Penetration Testing*, Auerbach Publications, 1st edition, 2019, New York.

Reference Book(s):

1. Michael Simpson, Kent Backman, James Corley, *Hands-On Ethical Hacking and Network Defense*, Cengage Learning, 2nd edition, 2005, New York.
2. Patrick Engebreston, *The Basics of Hacking and Penetration testing*, : Syngress Publishers, 2011, New York.
3. EC-Council, *Ethical Hacking and Counter measures: Attack Phases,* Course Technology Press, 2016, New York.
4. Hein Smith, Hilary Morrison, *ETHICAL HACKING: A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking,* Kindle Edition, 2018, New York.

Web and Video link(s):

1. https://nptel.ac.in/courses/106105217; *NPTEL Video Lecture on Ethical Hacking by Prof. Indranil Sengupta, Department of Computer Science and Engineering, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24IT702A: Ethical Hacking												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT702A.1	2	3	1	-	2	-	2	-	-	-	1	1	-
CO2	U24IT702A.2	2	3	2	-	2	1	2	-	-	-	1	2	1
CO3	U24IT702A.3	2	2	2	2	3	-	1	-	-	-	1	2	2
CO4	U24IT702A.4	2	3	3	2	2	2	2	-	-	-	2	2	2
U24IT702A		2	2.75	2	2	2.25	1.5	1.75	-	-	-	1..25	1.75	1.67
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Analyze security vulnerabilities, security models and phases of penetration testing frameworks	SDG9	Industry, Innovation and Infrastructure	Analysis of security vulnerabilities and penetration testing frameworks supports the development of secure and resilient digital infrastructure for industrial and communication systems.
CO2	Analyze various cyber attacks and security threats in business and network environments	SDG16	Peace, Justice and Strong Institutions	Understanding cyber attacks and security threats helps in protecting information systems and ensuring secure and trustworthy digital environments.
CO3	Apply reconnaissance, enumeration and exploitation techniques using ethical hacking tools	SDG9	Industry, Innovation and Infrastructure	Application of ethical hacking and reconnaissance tools enables proactive identification of system vulnerabilities, supporting reliable and secure computing infrastructure.
CO4	Evaluate penetration testing results and recommend suitable mitigation and defense mechanisms	SDG11	Sustainable Cities and Communities	Evaluation of penetration testing results and implementation of defense mechanisms contribute to securing smart systems, communication networks and digital services in modern communities.

COMPUTER VISION AND IMAGE PROCESSING

Class: B.Tech. VII–Semester		**Branch:** IT	
Course Code:	**U24IT702B**	**Credits:**	3
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply the image pre-processing techniques and various intensity transformation, filtering techniques to enhance the look and feel of an input image for further processing

CO2: identify the effect of frequency domain filters, image restoration and reconstruction techniques and apply the same for smoothing, sharpening and image enhancement

CO3: apply morphological image processing techniques on objects present in input images to extract image components and discover various ways to segment the objects present in the input images

CO4: identify the features to depict the shape of an object and apply classification techniques to identify the object present in an input image

UNIT-I	**9 Hrs**

Introduction: What is digital image processing, Examples of fields that use digital image processing, Fundamental steps in digital image processing

Digital Image Fundamentals: Elements of visual perception, Light and the electromagnetic spectrum, Image sensing and acquisition, Image sampling and quantization, some basic relationships between pixels, Introduction to the mathematical tools used in digital image processing

Intensity Transformations & Spatial Filtering: The basics of intensity transformations and spatial filtering, Basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods

UNIT-II	**9 Hrs**

Filtering in the Frequency Domain: A brief history of the Fourier series and transform, Preliminary concepts, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, Some properties of the 2-D discrete Fourier transform, The basics of filtering in the frequency domain

Image Restoration and Reconstruction: A model of the image degradation/ restoration process, Noise models, Restoration in the presence of noise only-spatial filtering, Periodic noise reduction using frequency domain filtering

UNIT-III	**9 Hrs**

Morphological Image Processing: Preliminaries, Erosion and dilation, Opening and closing, Hit-or-miss transformation, Some basic morphological algorithms

Image Segmentation: Fundamentals, Point, Line and edge detection, Thresholding, Segmentation by region growing and by region splitting and merging, Region segmentation using clustering and superpixels, Segmentation using morphological watersheds

UNIT-IV	**9 Hrs**

Feature Extraction: Background, Boundary preprocessing, Boundary feature descriptors, Region feature descriptors, Principal components as feature descriptors, Whole-image features, Scale-

invariant feature transform

Image Pattern Classification: Background, Patterns and pattern classes, Pattern classification by prototype matching, Optimum (Bayes) statistical classifiers, Neural networks and deep learning, Deep convolution neural networks

Text Book:

1. RafaelC. Gonzalez,RichardE. Woods,*DigitalImageProcessing,* 4th ed., NewDelhi: Pearson, 2018. *(Chapters 1 to 5,* 9 *to 12)*

Reference Book(s):

1. Anil K. Jain, *Fundamentals of Image Processing*, 1st ed., Chennai: Pearson, 2015.
2. B. Chanda, D. Dutta Majunder, *Digital Image Processing and Analysis*, 2nd ed., New Delhi: Prentice Hall of India, 2011.
3. S. Sridhar, *Digital Image Processing*, 2nd ed., Naida: Oxford University Press, 2016.
4. Munesh C. Trivedi, *Digital Image Processing*, 1st ed., New Delhi: Khanna Book Publishing, 2014.

Web and Video link(s):

1. *Preview: Computer Vision And Image Processing - Fundamentals And Applications | SWAYAM*; Computer Vision and Image Processing-Fundamentals and Applications by Prof. M. K. Bhuyan, IIT Guwahati

Course Articulation Matrix (CAM):		**U24IT702B : COMPUTER VISION AND IMAGE PROCESSING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT702B.1**	2	2	2	2	1		1	1	1		1	2	2
CO2	**U24IT702B.2**	3	3	2	2	1		1	1	1		2	2	2
CO3	**U24IT702B.3**	2	2	2	2	1		1	1	1		2	2	2
CO4	**U24IT702B.4**	3	2	3	3	1		1	1	1		2	2	2
U24IT702B		**2.5**	**2.25**	**2.25**	**2.25**	**1**		**1**	**1**	**1**		**1.75**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** The student should be able to…	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply the image pre-processing techniques and various intensity transformation, filtering techniques to enhance the look and feel of an input image for further processing	SDG4	Quality Education	Image enhancement techniques are foundational for industrial applications like medical imaging, satellite monitoring, and smart infrastructure. Students gain practical skills that strengthen innovation capacity and contribute to quality education
CO2	identify the effect of frequency domain filters, image restoration and reconstruction techniques and apply the same for smoothing, sharpening and image enhancement	SDG9	Industry, Innovation and Infrastructure	Image restoration is crucial in healthcare (e.g., MRI/CT scan noise reduction) and industrial automation. This outcome supports better diagnostics and resilient infrastructure through

				advanced imaging
CO3	apply morphological image processing techniques on objects present in input images to extract image components and discover various ways to segment the objects present in the input images	SDG11	Sustainable Cities and Communities	Segmentation enables smart city applications (traffic monitoring, surveillance) and environmental monitoring (wildlife tracking, deforestation analysis). It directly contributes to sustainable urban planning and biodiversity protection
CO4	identify the features to depict the shape of an object and apply classification techniques to identify the object present in an input image	SDG9	Industry, Innovation and Infrastructure	Object recognition supports industrial automation, security systems, and governance (e.g., biometric identification). It strengthens innovation ecosystems and institutional transparency

MOBILE COMPUTING

Class: B. Tech. VII – Semester		**Branch:** IT	
Course Code:	**U24IT702C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply fundamental concepts of mobile computing, wireless communication technologies, and mobile network architectures.

CO2 : apply MAC layer protocols, wireless LAN standards, Mobile IP, and transport layer protocols in wireless communication systems.

CO3 : analyze routing mechanisms, mobile ad hoc networks, wireless sensor networks, and database issues in mobile environments.

CO4 : apply data dissemination, synchronization techniques, and advanced mobile technologies for real-world mobile applications.

UNIT-I	**9 Hrs**

Introduction to Mobile Computing: Basic communication technologies, mobile computing paradigm, novel applications, limitations, challenges, and mobile computing architecture

Cellular Wireless Networks: Wireless communication fundamentals, cellular concepts, frequency reuse, GSM architecture and services, GPRS, LTE and 4G overview

Mobile Devices and Systems: Smartphones, tablets, Bluetooth, Wi-Fi, GPS, RFID, sensors, handheld devices and smart systems

SelfLearning Topics (SLTs):*Evolution of Cellular Networks (2G to 4G), Applications of Bluetooth and GPS in Mobile Devices*

UNIT-II	**9 Hrs**

Medium Access Control Layer: Hidden terminal problem, exposed terminal problem, collision avoidance, congestion control, and energy efficiency

MAC Protocols: MACA, MACAW protocols, FDMA, TDMA, CDMA

Wireless LAN and Mobile Network Layer:IEEE 802.11 architecture, physical layer, MAC layer, WLAN security, Mobile IP, DHCP, packet delivery, handoff management, tunneling, encapsulation, and route optimization

SelfLearning Topics (SLTs):*IEEE 802.11 WLAN Security Mechanisms, Hidden and Exposed Terminal Problems in Wireless Networks*

UNIT-III	**9 Hrs**

Mobile Transport Layer: Conventional TCP/IP protocols, Indirect TCP, Snooping TCP, Mobile TCP, and transport layer issues in mobile networks

Routing in MANET: Mobile ad hoc networks, applications and challenges, topology-based routing, proactive, reactive and hybrid routing protocols

Routing Protocol Analysis:DSDV, DSR, AODV routing protocols

Wireless Sensor Networks: Routing protocols, localization methods, sensor deployment strategies and traffic flow patterns

SelfLearning Topics (SLTs):*Comparison of MANET Routing Protocols (AODV, DSR, DSDV), Applications of Wireless Sensor Networks*

UNIT-IV	**9 Hrs**

Database and Mobile Computing: Transaction models, query processing, data recovery,

database hoarding, caching, and client-server adaptation

Data Dissemination: Communication asymmetry, data delivery mechanisms, broadcast models, selective tuning and indexing techniques

Data Synchronization and Mobile Platforms: Synchronization concepts, strategies, protocols, synchronization software, mobile application development platforms

Advanced Mobile Technologies: Delay tolerant networks, vehicular ad hoc networks, GPS, RFID, Bluetooth, Android basics and applications

SelfLearning Topics (SLTs):*Data Synchronization Techniques in Mobile Systems, Applications of RFID and Vehicular Ad Hoc Networks (VANETs)*

Textbook(s):

1. Jochen Schiller, *Mobile Communications*, Pearson Education, 2nd edition, 2003. (Chapters 1, 2, 3, 4, 5, 7, 8 and 9)
2. Raj Kamal, *Mobile Computing*, Oxford University Press, 3rd edition, 2018. (Chapters 2, 3, 4, 6, 8 and 9)

Reference Book(s):

1. C. D. M. Cordeiro, D. P. Agrawal, *Ad Hoc and Sensor Networks: Theory and Applications*, World Scientific, 2nd edition, 2006.
2. Asoke K Talukder, Roopa R. Yavagal, *Mobile Computing – Technology, Applications and Service Creation*, Tata McGraw Hill, 2nd edition, 2006.

Web and Video link(s):

1. https://nptel.ac.in/courses/106106147, *NPTEL Video Lecture on: Mobile Computing byProf. Pushpendra Singh, IIIT Delhi.*

Course Articulation Matrix (CAM):		U24IT702C– MOBILE COMPUTING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT702C.1	3	2	1	2	2	-	-	-	1	1	-	2	2
CO2	U24IT702C.2	3	2	1	2	3	-	-	-	1	1	1	2	2
CO3	U24IT702C.3	2	3	2	2	3	-	-	-	1	1	1	2	2
CO4	U24IT702C.4	2	2	2	2	3	-	-	-	1	1	1	2	3
U24IT702C		**2.5**	**2.25**	**1.5**	**2**	**2.75**	**-**	**-**	**-**	1	**1**	**1**	**2**	**2.25**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply fundamental concepts of mobile computing, wireless communication technologies, and mobile network architectures.	SDG9	Industry, Innovation and Infrastructure	Mobile communication systems support digital infrastructure, innovation, and connectivity.
CO2	Apply MAC layer protocols, wireless LAN	SDG9	Industry, Innovation	Secure wireless standards are critical for communication infrastructure.

CO–SDG Alignment Matrix				
CO	**CO Statement**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	standards, and security mechanisms in wireless communication systems.		and Infrastructure	
CO3	Analyze routing mechanisms, mobile ad hoc networks, wireless sensor networks, and database issues in mobile environments.	SDG11	Sustainable Cities and Communities	Routing and sensor networks are essential in smart cities, intelligent transportation, and urban communication systems.
CO4	Apply data dissemination, synchronization techniques, and advanced mobile technologies for real-world mobile applications.	SDG11	Sustainable Cities and Communities	GPS, RFID, VANET, and mobile synchronization technologies contribute to smart urban and transportation systems.

HIGH PERFORMANCE COMPUTING

Class: B. Tech. VII – Semester		**Branch:** IT	
Course Code:	**U24IT702D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand modern processor architectures and apply serial code optimization techniques to improve computational performance and memory efficiency.

CO2 : analyze various parallel computing paradigms and evaluate the scalability and performance requirements of parallel systems.

CO3 : develop efficient shared-memory parallel applications using OpenMP and optimize locality and synchronization in ccNUMA architectures.

CO4 : design and implement distributed-memory parallel programs using MPI while minimizing communication and synchronization overheads.

UNIT-I	**9 Hrs**

Modern Processors: Stored-Program Computer Architecture, General purpose cache-basedMicroprocessor Architecture, Memory Hierarchies, Multicore processors, Multithreaded processors,Vector processors.

Basic optimization techniques for serial code: Scalar profiling, Common sense optimizations,Simple measures, large impact, The role of compilers, Data access optimization.

UNIT-II	**9 Hrs**

Parallel computers: Taxonomy of parallel computing paradigms, Shared-memory computers, Distributed-memory computers, Hierarchical (hybrid) systems, Networks.

Basics of parallelization: Need for Parallelism, Parallel scalability.

UNIT-III	**9 Hrs**

Shared-memory parallel programming with OpenMP: Introduction to OpenMP, Case study: OpenMP-parallel Jacobi algorithm.

Efficient OpenMP Programming: Profiling OpenMPprograms, Performance pitfalls,AmelioratingtheimpactofOpenMPworksharingconstructs,Determining OpenMP overheadforshortloops,Serialization,Falsesharing.

UNIT-IV	**9 Hrs**

Locality optimizations on ccNUMAarchitectures : Locality of access on ccNUMA,Page placement by first touch,Access locality by other means,Casestudy:ccNUMAoptimizationofsparseMVM.

Distributed-memory parallel programming with MPI: Message passing, Introduction to MPI, MPIperformance tools, Communication parameters, Synchronization, serialization, contention, Reducingcommunication overhead, Case study: Parallel sparse matrix-vector multiply.

Textbook(s):

1. Georg Hager, Gerhard Wellein, *Introduction to High Performance Computing for Scientists and Engineers* ,Chapman & Hall / CRC Computational Science series, 2011
2. Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta,*Introduction to Parallel Computing*, Second Edition, Addison-Wesley, 2003

Reference Book(s):

1. Michael J. Quinn,*Parallel Computing – Theory and Practice*, Second Edition, Tata McGraw-Hill Edition.
2. V. Rajaraman, C. Siva Ram Murthy - *Parallel Computers Architecture and Programming*- PHI (2016)
3. John L.Hennessey and David A.Patterson, *Computer Architecture A Quantitative Approach*, Morgan Kaufman Publishers

Web and Video link(s):

1. https://nptel.ac.in/courses/106105033; *NPTEL Video Lecture on High Performance Computer Architectureby Prof. Ajith Pal, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24IT702D HIGH PERFORMANCE COMPUTING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT702D.1	3	2	-	-	2	-	-	-	-	-	-	3	2
CO2	U24IT702D 2	3	3	2	2	2	-	-	-	-	-	-	3	2
CO3	U24IT702D.3	3	3	3	2	3	-	-	-	1	-	-	3	3
CO4	U24IT702D.4	3	3	3	3	3	-	-	-	1	-	-	3	3
U24IT702D		3	2.75	2	1.75	2.5	-	-	-	0.5	-	-	3	2.5
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Explain modern processor architectures and apply serial code optimization techniques to improve computational efficiency and memory performance.	SDG 9	Industry, Innovation and Infrastructure	Understanding advanced processor architectures and optimization methods supports the development of efficient and innovative computing infrastructure.
CO2	Analyze different parallel computing paradigms and evaluate scalability requirements in parallel systems.	SDG9	Industry, Innovation and Infrastructure	Parallel computing technologies contribute to high-performance and scalable computational systems used in modern industries and research.
CO3	Develop and optimize shared-memory parallel programs using OpenMP and analyze performance issues such as serialization and false sharing.	SDG9	Industry, Innovation and Infrastructure	OpenMP-based parallel programming enhances computational efficiency and supports the development of scalable high-performance computing systems used in scientific research, engineering simulations, and industrial applications.
CO4	Implement and optimize	SDG 12	Responsible	MPI communication optimization

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	distributed-memory parallel programs using MPI and locality optimization techniques in ccNUMA architectures.		Consumption and Production	and locality-aware memory access techniques improve computational efficiency, reduce resource overhead, and support sustainable utilization of high-performance computing infrastructure.

INDUSTRIAL IOT

Class: B.Tech. VII- Semester	**Branch:**IT		
Course Code :	**U24IT702E**	**Credits :**	**3**
Hours/Week (L-T-P-E) :	**2-1-0-3**	**CIE :**	**60 %**
Total Number of Teaching Hours :	**36 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

CO1: apply the concepts and enabling technologies of Industrial Internet of Things (IIoT) toanalyze industrial applications and use-case scenarios

CO2: analyze the role of CPS, cloud/fog computing, SDN, big data, machine learning, and AI in IIoT systems

CO3: apply IIoT reference architectures, system topologies, data analytics, and industrial communication protocols in industrial internet environments

CO4: apply middleware protocols and IIoT platforms to develop smart industrial applications suchashealthcare, smart cities, irrigation, and surveillance systems

UNIT-I	**9 Hrs**

Introduction to Industrial Internet and Use-Cases: Industrial Internet, Key IIoTtechnologies, Innovation and the IIoT, Key opportunities and benefits, The digital and human workforce, Logistics and the industrial internet

Self-Learning Topics (SLTs)*: IoT innovations in retail*

UNIT-II	**9 Hrs**

The Technical and Business Innovators of The Industrial Internet: Cyber physical systems (CPS), IP mobility, Network virtualization, SDN (Software defined networks), Thecloud and fog,Role of machine learning and AI in IIOT

Self-Learning Topics (SLTs):*Role of Big Data in IIOT*

UNIT-III	**9 Hrs**

IIOT Reference Architecture: Industrial internet architecture framework (IIAF), Industrial internet viewpoints

Architectural Topology: The Three-tier topology, Key system characteristics, Datamanagement, Advanced data analytics

Protocols for Industrial Internet Systems: Legacy industrial protocol, Modern communication protocols, Proximity network communication protocols

Self-Learning Topics (SLTs):*Wireless communication technologies*

UNIT-IV	**9 Hrs**

Middleware Software Patterns and IIOT Platforms: Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS, Middleware architecture, SigFox, LoRaWANaugmented reality, Real-world smart factories

Application of IIOT: Case study: Health monitoring, Robot surveillance

Self-Learning Topics (SLTs)*:Iot smart city, Smart irrigation*

Textbook(s):

1. Gilchrist, Alasdair, "*Industry 4.0 The Industrial Internet of Things*",Apress, 2017.
2. Zaigham Mahmood, "*The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer),* 2019.

Reference Book(s):

1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat "*Industrial Internet of Things: Cyber manufacturing Systems*" (Springer), 2017.
2. *Industrial IoT Challenges, Design Principles, Applications, and Security* by Ismail Butun (editor)
3. Vijay Madisetti and Arshdeep Bahga, "*Internet of Things (A Hands-on-Approach)*", 1stEdition, VPT, 2014.
4. Michahelles, "*Architecting the Internet of Things*", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
5. Francis daCosta, "*Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*", 1stEdition, Apress Publications, 20132 Cuno Pfister, Getting Started with the Internet of Things, O "Reilly Media, 2011, ISBN: 978-1-4493-9357-1

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs38*NPTEL Video Lecture on Introduction to Industry 4.0 and Industrial Internet of Things byProf. Sudip Misra, IITK Kharagpur.*
2. https://nptel.ac.in/courses/106105195*NPTEL Video Lecture on Introduction to Industry4.0and Industrial Internet of Thingsby Prof. Sudip Mishra, IITK Kharagpur.*

Course Articulation Matrix (CAM):		**U24IT702E: INDUSTRIAL IOT**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT702E.1**	3	2	-	2	1	-	-	-	-	-	1	-	-
CO2	**U24IT702E.2**	3	3	-	2	1	-	-	-	-	-	1	-	-
CO3	**U24IT702E.3**	2	2	3	2	2	-	-	-	-	-	1	1	1
CO4	**U24IT702E.4**	2	2	3	2	2	1	1	-	-	-	1	1	1
U24IT702E		**2.5**	**2.55**	**3**	**2**	**1.5**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply the concepts and enabling technologies of Industrial Internet of Things (IIoT) to analyze industrial applications and use-case scenarios.	SDG 9	Industry, Innovation and Infrastructure	IIoT technologies and industrial applications support smart infrastructure, industrial automation, and innovation across sectors such as logistics, retail, and manufacturing
CO2	analyze the role of CPS, cloud/fog computing, SDN, big data, machine learning, and AI in IIoT systems	SDG 9	Industry, Innovation and Infrastructure	Advanced IIoT technologies such as CPS, AI, big data, and cloud computing improve intelligent industrial systems, automation, and modern infrastructure development

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO3	apply IIoT reference architectures, system topologies, data analytics, and industrial communication protocols in industrial internet environments	SDG 4	Quality Education	Practical application of IIoT architectures, protocols, and analytics enhances technical competency, problem-solving skills, and industry-oriented learning
CO4	apply middleware protocols and IIoT platforms to develop smart industrial applications such as healthcare, smart cities, irrigation, and surveillance systems	SDG 11	Sustainable Cities and Communities	Smart IIoT applications such as smart cities, healthcare monitoring, and smart irrigation contribute to sustainable urban development

DEVOPS ESSENTIALS

Class: B. Tech. VII–Semester		**Branch:**IT	
Course Code:	**U24IT703**	**Credits:**	**4**
Hours/Week (L-T-P-E):	**3-1-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**48 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply Git and GitHub tools to manage version control, collaborate on software projects, and maintain repositories using local and remote workflows

CO2 : implement continuous integration workflows using Jenkins for automated build, testing, and deployment

CO3 : develop CI pipelines using Jenkins and Docker for automated integration and containerized deployment

CO4 : implement continuous development strategies using Jenkins across multiple deployment environments

UNIT-I	**12 Hrs**

Getting Started: About version control, A short history of Git, What is Git?, The command line, Installing Git, First-Time Git setup

Git Basics: Getting a Git repository, Recording changes to the repository, Viewing the commit history, Undoing things, Working with remotes, Tagging, Git aliases

Git on the Server: The protocols, Getting Git on a server, Generating your SSH public key, Setting up the server, Git daemon, Smart HTTP, GitWeb, GitLab, Third party hosted options

GitHub: Account setup and configuration, Contributing to a project, Maintaining a project, Managing an organization, Scripting GitHub

UNIT-II	**12 Hrs**

Continuous integration: Introduction, Set up, Pre-development checks, Intermediate operations, post-development integrations, Branching strategy

Introduction to Jenkins: Tooling landscape, Why Jenkins?, Jenkins installation, Plugins, Authentication and authorization, Jenkins pipeline, Shared library, What if the server gets deleted?, master/slave architecture, Global tool configuration

UNIT-III	**12 Hrs**

CI with Jenkins: CI pipeline with pre-development integration checks, Converting multibranch pipeline, CI pipeline update with intermediate steps, CI pipeline with notification integration

Introduction to Docker: Need for containerization, What and why containers?, Container engines, Docker installation

CI with Jenkins and Docker: Containerization of application, CI pipeline with pre-development integration checks

UNIT-IV	**12 Hrs**

Continuous development: Different kinds of environments, CD testing elements, Development strategies

Continuous development using Jenkins: Development strategy discussion, Continuous development for QA environment (normal development), Continuous development for security environment (rolling development), Continuous development for UAT

environment (canary development)

Textbook(s):

1. Scott Chacon and Ben Straub, *Pro Git*, Apress, 2nd edition, 2025, USA.
2. Sandeep Rawat, *CI/CD Pipeline with Docker and Jenkins,* Addison-Wesley Professional, 1st edition, 2023, UK

Reference Book(s):

1. Gene Kim, Jez Humble, Patrick Debois, John Willis, Nicole Forsgren, *The Unicorn Project,* 2nd edition, 2021, USA.
2. Len Bass, Ingo Weber, Liming Zhu, *DevOps A Software Architect's Perspective*, 1st edition, 2015, USA.
3. Joakim Verona, *Practical DevOps : harness the power of DevOps to boost your skill set and make your IT organization perform better*, 1st edition, Packt Publishing Ltd., 2016, UK.

Web and Video link(s):

1. https://git-scm.com/book/en/v2; *Scott Chacon and Ben Straub, Pro Git, Apress, 2nd edition, 2025, India.*
2. https://www.udemy.com/course/mastering-aws-devops-for-cloud-engineers; *Pravin Mishra, Udemy.*

Course Articulation Matrix (CAM):		U24IT703 : DEVOPS ESSENTIALS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT703.1	1	2	2	1	-	-	1	-	1	-	-	2	2
CO2	U24IT703.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24IT703.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24IT703.4	2	2	3	3	-	-	1	-	1	-	2	2	2
U24IT703		1.75	2	2.25	1.75	-	-	1	-	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** The student should be able to…	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply Git and GitHub tools to manage version control, collaborate on software projects, and maintain repositories using local and remote workflows	SDG 4	Quality Education	Develops collaborative softwaredevelopment and version controlskills essential for modern technicaleducation and lifelong learning
CO2	implement continuous integration workflows using Jenkins for automated build, testing, and deployment	SDG 8	Decent Work and Economic Growth	Enhances industry-readyautomation and DevOps skills thatimprove productivity, softwarequality, and employmentopportunities in technology sectors
CO3	develop CI pipelines using Jenkins and Docker for automated integration and containerized deployment	SDG9	Industry, Innovation and Infrastructure	Supports scalable and efficientsoftware deployment technologiesthat strengthen industrialinnovation and reliable digitalsystems
CO4	implement continuous development strategies using Jenkins across multiple deployment environments	SDG 11	Sustainable Cities and Communities	Supports reliable and scalabledigital service deployment practice esessential for sustainable and smartdigital infrastructure systems.

DATA SCIENCE

Class: B. Tech. VII – Semester		**Branch:** IT	
Course Code:	**U24IT704**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply fundamental concepts of data science and statistical techniques to analyze data using R

CO2 : apply different data visualization methods to study the different data characteristics and encoding methods

CO3 : apply various data wrangling techniques for the preprocessing of data

CO4 : apply data acquisition, preprocessing, and analysis methods to determine optimal parameter values for minimizing cost functions using techniques such as gradient descent and stochastic gradient descent

UNIT-I	**9 Hrs**

Introduction to Data Science: Data science, Terminology related with data science, Types of data, Methods of data repository, The Data Science Process (DSP), Popular data science toolkits, Familiarity with example applications

Data Analysis using R Programming Language: Introduction to applied statistical techniques, Types of statistical data, Collecting data for sampling and distribution, Probability, Frequency distribution, Population and parameters, Central tendency or central value, Measures of central tendency, Different types of statistical means,Normal distribution curve

SelfLearning Topics (SLTs):*Sampling Techniques in Data Collection, Applications of Statistical Measures*

UNIT-II	**9 Hrs**

Data Visualization: Conventional data visualization methods, Retinal variables, Mapping variables to encodings, Introduction to Bokeh

Recent Trends in Data Science: Recent trends in various data collection and analysis techniques, Various big data visualization tools, Visualizing big data, Pre-attentive attributes, Challenges of big data visualization

SelfLearning Topics (SLTs): *Interactive Dashboard Design using Bokeh, Advanced Encoding Methods in Data Visualization*

UNIT-III	**9 Hrs**

A Deep Dive into Data Wrangling with Python: Sub setting, filtering and grouping, Detecting outliers and handling missing values, Concatenating, merging and joining, Useful methods of Pandas, Working with the audit income dataset (UCI), Advanced Pandas methods

Case Study for E-commerce Data Handling missing values and merging datasets for customer transactions and recommendations.

SelfLearning Topics (SLTs):*Advanced Pandas Methods for Data Wrangling, Handling Missing*

Values and Outlier Detection
UNIT-IV **9 Hrs**
Gradient Descent: The idea behind gradient descent, Estimating and using the gradient, Choosing the right step size, Putting it all together, Stochastic gradient descent Getting Data: stdin and stdout, Reading files, Scraping the web, Using APIs, Example: Using the twitter APIs **Working with Data**: Exploring your data, Cleaning and munging, Manipulating data, Rescaling, Dimensionality reduction ***SelfLearning Topics (SLTs):****Web Scraping and API-based Data Collection, Learning Rate Tuning in Gradient Descent*
Textbook(s): 1. V.K. Jain, *Data Science & Analytics*, Khanna Book Publishing, 1st edition, 2018, New Delhi. (Chapters 1, 3 to 6) 2. Tirthajyoti Sarkar, Shubhadeep Roychowdhury, *Data Wrangling with Python: Creating Actionable Data from Raw Sources*, Packt Publishing Ltd., 1st edition, 2019, U.K. (Chapter 4) 3. Joel Grus, *Data Science from Scratch: First Principles with Python*, O'Reilly Media, 2ndedition, 2019, U.S.A. (Chapters 8 to 10)
Reference Book(s): 1. Dinesh Kumar, *Business Analytics*, Wiley, 1st edition, 2017, New Delhi. 2. Cathy O'Neil, Rachel Schutt, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly Media, 1st edition, 2013, U.S.A. 3. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, *Mining of Massive Datasets*, Cambridge University Press, 2nd edition, 2014, U.K. 4. Pratap Dangeti, *Statistics for Machine Learning*, Packt Publishing Ltd., 1st edition, 2017, U.K.
Web and Video link(s): 1. https://onlinecourses.nptel.ac.in/noc26_cs65/preview; *NPTEL Video Lecture on: Data Science for Engineers byProf. Ragunathan Rengasamy, Prof. Shankar Narasimhan, IIT Madras*

Course Articulation Matrix (CAM):		**U24IT704– DATA SCIENCE**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT704.1**	2	2	1	2	2	-	-	-	1	1	-	-	2
CO2	**U24IT704.2**	2	1	1	1	2	-	-	-	1	1	1	-	1
CO3	**U24IT704.3**	2	1	1	1	2	-	-	-	1	1	1	1	1
CO4	**U24IT704.4**	2	2	1	2	3	-	-	-	1	1	1	1	2
U24IT704		**2**	**1.5**	**1**	**1.5**	**2.25**	**-**	**-**	**-**	1	**1**	**1**	**1**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply fundamental concepts of data science and statistical techniques to analyze data using R	SDG4	Quality Education	Develops data literacy, analytical thinking, and computational skills using tools like R, supporting quality education and lifelong learning
CO2	apply different data visualization methods to study the different data characteristics and encoding methods	SDG9	Industry, Innovation and Infrastructure	Data visualization supports interpretation of complex data, aiding innovation and decision-making in industrial and technological systems
CO3	apply various data wrangling techniques for the preprocessing of data	SDG11	Sustainable Cities and Communities	Data preprocessing enables effective analysis of urban datasets such as traffic, environment, and public services, contributing to smart and sustainable cities
CO4	apply data acquisition, preprocessing, and analysis methods to determine optimal parameter values for minimizing cost functions using techniques such as gradient descent and stochastic gradient descent	SDG9	Industry, Innovation and Infrastructure	Optimization techniques like gradient descent are core to machine learning systems used in industrial automation, predictive analytics, and intelligent infrastructure, promoting innovation

DEVOPS LABORATORY

Class: B. Tech. VII–Semester		**Branch:**IT	
Course Code:	**U24IT705**	**Credits:**	**1**
Hours/Week (L-T-P-E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on psychomotor skills acquired from laboratory component)

CO1 : apply Git and GitHub tools to create, manage, andcollaborate on local and remote repositories using version controloperations

CO2 : develop and execute Jenkins jobs and CI pipelines for automatedbuild, testing, and integration processes

CO3 : implement Docker-based containerization and integrate Jenkins withDocker for automated deployment workflows

CO4 : design and demonstrate end-to-end CI/CD pipelines using Git,Jenkins, and Docker across multiple deployment environments

Experiment-1

1. Introduction to Linux, Git Installation and Git Configuration
   A. Demonstrate basic Linux commands for file and directory management.
   B. Install and configure Git environment on the system.
   C. Create and manage a local Git repository using commit operations.

Experiment-2

2. Git Repository Management and Version Control
   A. Perform Git staging and commit operations for version tracking.
   B. Apply Git commands to restore, reset, and revert changes.
   C. Create, switch, and merge branches in a Git repository.

Experiment-3

3. Remote Repository Management using GitHub
   A. Configure a GitHub account and establish secure authentication.
   B. Push and clone repositories between local system and GitHub.
   C. Collaborate on projects using fork, pull request, and merge operations.

Experiment-4

4. Advanced Git Operations and GitHub Workflow
   A. Create and manage Git tags for repository versioning.
   B. Configure Git aliases and inspect repository history.
   C. Implement GitHub workflow practices for collaborative development.

Experiment-5

5. Jenkins Installation and Basic Configuration
   A. Install and configure Jenkins automation server.
   B. Configure Jenkins plugins, authentication, and user management.
   C. Create and execute Jenkins freestyle jobs for automation.

Experiment-6

6. Jenkins Pipeline Fundamentals
   A. Develop declarative Jenkins pipelines with multiple stages.
   B. Integrate GitHub repositories with Jenkins pipelines.

C. Monitor build execution and configure notification mechanisms.

Experiment-7

7. Continuous Integration using Jenkins
   a. Implement Continuous Integration pipelines with build and test stages.
   b. Configure and execute Jenkins multibranch pipelines.
   c. Perform pre-development and post-development integration checks.

Experiment-8

8. Docker Installation and Container Basics
   A. Install and configure Docker container engine.
   B. Create, execute, and manage Docker containers.
   C. Configure Docker volumes and networking services.

Experiment-9

9. Dockerfile Creation and Containerized Applications
   A. Develop Dockerfiles for containerized applications.
   B. Deploy and execute applications inside Docker containers.
   C. Configure multi-container applications using Docker Compose.

Experiment-10

10. CI Pipeline using Jenkins and Docker
    a. Build Docker images using Jenkins pipelines.
    b. Automate container deployment through Jenkins.
    c. Push and manage Docker images in Docker Hub repositories.

Experiment-11

11. Continuous Development Strategies using Jenkins
    A. Implement Continuous Development pipelines for QA environments.
    B. Configure rolling deployment strategies for secure releases.
    C. Apply canary deployment strategy for UAT environments.

Experiment-12

12. Mini DevOps Project using Git, Jenkins and Docker
    A. Integrate GitHub repositories with Jenkins CI workflows.
    B. Develop Dockerized deployment pipelines using Jenkins.
    C. Demonstrate an end-to-end CI/CD workflow using Git, Jenkins, and Docker.

Textbook(s):

1. Scott Chacon and Ben Straub, *Pro Git*, Apress, 2nd edition, 2025, USA
2. Sandeep Rawat,*CI/CD Pipeline with Docker and Jenkins,*Addison-Wesley Professional,1st edition, 2023, UK

Reference Book(s):

1. Gene Kim, Jez Humble, Patrick Debois, John Willis, Nicole Forsgren, *The Unicorn Project,* 2nd edition, 2021, USA
2. Len Bass, Ingo Weber, Liming Zhu, *DevOps A Software Architect's Perspective*, 1st edition, 2015, USA
3. Joakim Verona,*PracticalDevOps : harness the power of DevOps to boost your skill set and make your IT organization perform better*, 1st edition, Packt Publishing Ltd., 2016, UK

Laboratory Manual (for laboratory component):

1. *DevOps Laboratory Manual,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT706: DEVOPS LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT705.1	2	2	2	2	2	-	-	1	1	-	2	2	1
CO2	U24IT705.2	2	2	2	2	2	-	-	1	1	-	2	2	1
CO3	U24IT705.3	2	2	2	2	2	-	-	1	1	-	2	2	1
CO4	U24IT705.4	2	2	2	2	2	-	-	1	1	-	2	2	1
U24IT705		2	2	2	2	2	-	-	1	1	-	2	2	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** The student should be able to…	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply Git and GitHub tools to create, manage, and collaborate on local and remote repositories using version control operations	SDG 4	Quality Education	Develops practical softwaredevelopment andcollaborativeversion controlskills that support industryoriented technicaleducationand continuous learningpractices
CO2	develop and execute Jenkins jobs and CI pipelines for automated build, testing, and integration processes	SDG9	Industry, Innovation and Infrastructure	Promotes automation,software reliability,andefficientdevelopmentinfrastructure through continuous Integrationpracticesused in modern industries
CO3	implement Docker-based containerization and integrate Jenkins with Docker for automated deployment workflows Implement	SDG 9	Industry, Innovation and Infrastructure	Supports scalable andinnovative softwaredeployment technologiesthrough containerization andautomated deploymentsystems
CO4	design anddemonstrate end-to-end CI/CD pipelines using Git, Jenkins, and Docker across multiple deploymentenvironments	SDG 11	Decent Work and Economic Growth	Encourages reliable, scalable,and sustainable digital servicedeployment practices essentialfor smart infrastructure andmodern

DATA SCIENCE LABORATORY

Class: B. Tech. VII – Semester		**Branch:** IT	
Course Code:	**U24IT706**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : develop R programs to perform data manipulation operations using lists, vectors, files, and datasets

CO2 : Implement Python programs for data preprocessing, cleaning, transformation, and visualization using appropriate libraries

CO3 : develop and evaluate machine learning models using Python libraries for regression, classification, and validation techniques

CO4 : apply optimization and data analysis techniques using Python for model improvement and parameter tuning

LIST OF EXPERIMENTS

Experiment-1

1. Install and load required R packages for data science applications.
2. Develop an R program to create and manipulate vectors, matrices, arrays, and lists with different data types.
3. Develop an R program to perform arithmetic, relational, and logical operations on vectors and matrices.
4. Create a list containing strings, numeric values, vectors, and logical values, and access individual elements using indexing operations.

Experiment-2

5. Develop an R program to read data from CSV and text files into data frames.
6. Perform operations to inspect datasets using functions such as head(), tail(), summary(), and str().
7. Load and analyze larger datasets using R packages and export processed results into CSV format.
8. Apply basic file operations such as writing data into files and appending new records.

Experiment-3

9. Apply dplyr package functions for filtering, sorting, grouping, and summarizing datasets.
10. Use tidyr and reshape2 packages to reshape datasets between wide and long formats.
11. Demonstrate date and time manipulation using the lubridate package.

Experiment-4

12. Develop Python programs to identify and handle missing values in datasets using Pandas
13. Perform data cleaning operations such as removal of duplicate records and null values
14. Detect and visualize outliers using boxplots and interquartile range techniques
15. Apply preprocessing methods for handling inconsistent and noisy data

Experiment-5

16. Develop Python programs for normalization and standardization of datasets.
17. Perform data transformation techniques such as encoding categorical variables.
18. Apply aggregation and summarization functions on grouped datasets.
19. Implement feature scaling techniques using Scikit-learn preprocessing tool.

Experiment-6

20. Visualize datasets using Matplotlib and Seaborn libraries.
21. Create univariate visualizations such as histograms, bar charts, and boxplots.

22. Generate bivariate visualizations such as scatter plots and line charts.
23. Develop correlation heatmaps for multivariate datasets.

Experiment-7

24. Develop Python programs to split datasets into training and testing sets
25. Implement K-Fold Cross Validation for model validation
26. Evaluate model performance using accuracy, precision, recall, and F1-score
27. Compare model performance with and without cross validation

Experiment-8

28. Develop a Linear Regression model using Scikit-learn using sample dataset
29. Develop a Logistic Regression model using Scikit-learn using sample dataset and evaluate model performance using Mean Squared Error and R^2 score
30. Predict output values using trained regression models

Experiment-9

31. Develop Logistic Regression classifier using Scikit-learn
32. Generate confusion matrix and classification report
33. Analyze accuracy, precision, recall, and F1-score

Experiment-10

34. Develop a Decision Tree classifier using Python
35. Visualize the generated decision tree
36. Evaluate model accuracy using test datasets
37. Compare entropy and gini index criteria

Experiment-11

38. Develop a KNN classification model using Scikit-learn
39. Train the classifier using labeled datasets
40. Classify new instances using the trained model
41. Analyze the effect of different K values on model accuracy

Experiment-12

42. Develop Python program to implement Gradient Descent for linear regression
43. Demonstrate Stochastic Gradient Descent using Scikit-learn SGDRegressor/SGD Classifier
44. Analyze effect of learning rate on convergence
45. Plot cost function reduction across iterations

Textbook(s):

1. Hadley Wickham, Garrett Grolemund, *R for Data Science*, O'Reilly Media, 1st edition, 2017, California.
2. Wes McKinney, *Python for Data Analysis*, O'Reilly Media, 3rd edition, 2022, California.

Reference Book(S):

1. Brett Lantz, *Machine Learning with R*, Packt Publishing, 3rd edition, 2019.
2. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media, 2nd edition, 2023.
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras& TensorFlow*, O'Reilly, 3rd edition, 2022.

Web and Video link(s):

1. https://nptel.ac.in/courses/106107220; *NPTEL Video Lecture on Data Analytics with Python by Prof. A. Ramesh, Prof, IIT Roorkee.*
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs07; *NPTEL Video Lecture on Exploratory Data Analysis for Data Science with R software by Prof. Shalabh, Prof, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Data Science Laboratory Manual,* Department of IT, KITSW

Course Articulation Matrix (CAM):		U24IT706 : DATA SCIENCE LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT706.1	2	2	2	1	2	1	1	1	1	-	-	2	2
CO2	U24IT706.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24IT706.3	3	3	3	3	3	1	1	1	1	-	2	3	3
CO4	U24IT706.4	2	2	2	2	3	1	1	1	1	-	2	2	3
U24IT706		2.25	2.25	2.25	2	2.5	1	1	1	1	-	2	2.25	2.5
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO1	Develop R programs to perform basic data manipulation operations using lists, vectors, files, and datasets	SDG4	Quality Education	Programming and data manipulation skills enhance computational thinking and practical learning in data science and analytics education
CO2	Implement Python programs for data preprocessing, cleaning, transformation, and visualization using appropriate libraries	SDG9	Industry, Innovation and Infrastructure	Data preprocessing techniques improve the quality and reliability of data-driven systems used in industrial and analytical applications
CO3	Develop and evaluate machine learning models using Python libraries for regression, classification, and validation techniques	SDG8	Decent Work and Economic Growth	Machine learning techniques support intelligent automation, predictive analytics, and innovation in industrial and business environments
CO4	Apply optimization and data analysis techniques using Python for model improvement and parameter tuning	SDG11	Sustainable Cities and Communities	Optimization and data analysis techniques enable efficient decision-making and predictive modeling for applications such as smart governance, healthcare systems, traffic management, environmental monitoring, and sustainable urban planning

INTERNSHIP EVALUATION

Class: B. Tech. VII – Semester		**Branch: IT**	
Course Code:	**U24IT707**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience

CO2: apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems

CO3: exhibit professional skills including communication, teamwork, leadership, and lifelong learning

CO4: prepare internship reports and effectively communicate internship outcomes through presentations and viva-voce

Mandatory Internships:

1. The internships provide exposure to the real-world, get a feel for the work environment and how a professional workplace operates.
2. During the internship, students will experience a real-life engineering workplace and understand how their engineering and professional knowledge, skills, and qualities (KSQs) can be utilized in industry.
3. Students can learn, more importantly, how to apply the KSQs they have acquired during an internship to their future workplaces.
4. Students will also be able to demonstrate functioning engineering knowledge, both new & existing, and identify areas of further development for their future careers.
5. Internships give the student an opportunity to bridge theory and practice
6. Internships also provide students with the soft skills needed at workplace and leadership positions.
7. The internship guidelines are governed by the rules stipulated in the Institute's Internship Policy-2020 document.
8. The students shall have to undergo 6-8 weeks of mandatory internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs, IIITs& NITs.
9. HoD, along with Prof i/c internships, shall address students (*of 2nd, 4th and 6th semesters*) during last week of even semester of every academic year on the following
    a. creating awareness on mandatory 6-8 weeks internship by every student
    b. creating awareness on COs of internships
    c. KSQs the students would acquire doing internships
    d. expected internship outcomes
    e. available internship options, and organizations offering internships
    f. progressively completing 6-8 weeks internship by the end of 6th semester summer, starting from 2nd semester summer break.
    g. internship evaluation in 7th semester
    h. internship report submission and oral presentation (through PPT) by student
10. Students undergoing the internship shall be required to submit their details to the department internship coordinators of the respective branches. He will coordinate all the internship activities of the students of that department.
11. Students have to submit a signed undertaking to the department internship coordinator for demonstrating honesty, integrity, professionalism and regular attendance at work place to add value to the organization where the internship is allotted. Students also have to uphold the professional image of our institute.
12. In case, a student is found to violate the internship rules and regulations, the student will have to produce a valid reason for the violation of internship rules. Without a valid reason, the student will be debarred from taking part in subsequent placement activities of the institute.

13. The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of one week internship at every stage.
14. The internship evaluation shall be done in the VII semester of study and hence the students shall complete the prescribed period of internship before start of VII semester (from end of II semester to commencement of VII semester).
15. The student learning assessment process (SLAP): The SLAP in internships shall include feedback from internship supervisor, submission of internship report on the complete internship and PPT presentation.
16. Internship Log Book: The activity journaling in a log book is very important for a successful internship.
    a. The internship supervisor identifies the work goals at the beginning of the internship
    b. Student has to maintain internship log book, where in the activities undertaken during internship and timely submission at periodic intervals are to be documented.
    c. At the conclusion of the internship, the supervisor shall specifically comment, in the internship log book, on whether the student met each of the work goals and to give evidence which describes the quality of work. For student, this also serves as a self- assessment.
    d. Internship log book *(with due signatures of the internship supervisor)* shall beconsidered for evaluation during presentation, i.e., number of planned meetings with internship supervisor and number attended by student
17. Meeting Cadence:
    i. **Regular meetings with internship supervisor:** Regular meetings with the internship supervisor to discuss work goals and review the status of activities undertaken are very essential. Student shall participate in discussions and take notes.
    ii. **Meeting Frequency:** The meeting cadence, *i.e., meeting frequency* shall be fixed inconsultation with the internship supervisor and accordingly student has to participate in discussions and take notes. Take signatures of internship supervisor as per the planned cadence in the internship log book.
18. The internship evaluation shall be done by ***department internship evaluation committee*** **(DIEC)** based on the submitted report by student and oral presentation.
19. There shall be only Continuous Internal Evaluation (CIE) for internship evaluation.
20. CIE for the Internship evaluation in VII semester shall be as below:

Internship evaluation	Weightage
A. **Internship Supervisor's Assessment** *(i) Feedback from the internship supervisor* *- on completion of internship assignment/work (20%)* *(ii) Feedback from the internship supervisor* *- on quality of work in internship assignment/work (10%)* *(iii) Feedback from the internship supervisor* *- internship log book (10%)* *(iv) Feedback from the internship supervisor* *- on attendance, punctuality and work hours (10%)* (For the case of 6-8 week internship done in more than one spell, it will be the average of all the internship supervisors' assessments)	**50%**
B. DIEC Assessment *(i) Internship duration (8 /12 weeks) (6/8 weeks online via NPTEL and 2/4 weeks offline) (10% / 10%)* *(ii) Internship Report (20%)* *(iii) Oral Presentation (with PPT) and viva voce (10%)*	**50%**

(iv) SDG (5%) *(v) Research Orientation (5%)*	
Total Weightage:	**100%**

Note: *It is mandatory for the student to appear for oral presentation (with PPT) and viva voce to qualify for course evaluation*

(a) Internship Report: Each student is required to submit a well-documented internship report (both *soft copy and softbound hard copy*) as per format specified by DIEC. In case of completing the 6-8 weeks internship in more than one organization, the student shall be required to prepare separate softbound internship reports signed by the internship supervisor (s)along with the seal(s) of the organization(s). The student shall submit two final softbound internship reports along with a soft copy, keeping all the certificate(s) issued by the internship supervisor(s) and all the individual internship reports cleared by the respective internship supervisor. Chapter 1 of the final internship report shall clearly describe the following, indicating an overall summary.

(i) **Internship(s) attended**: A table with name & address of organization, organization's vision and mission, internship weeks attended, internship period (exact dates attended), internship supervisor, head of the section and head of the organization.

(ii) **Duties/tasks during internship(s)**: Table describing name &address of organization, and the duties/tasks undertaken during internships. This indicates what opportunities and learning experiences the interns got to get hands-on experience on a wide range of KSQs of a professional engineer.

(iii) **Tangible outcomes of internship:** These are the lessons learnt from internship experience. The students have to describe in their own words what they learnt from the internship experience. The student has to describe what specific KSQs are acquired by him, with reference to the expected internship COs, after successful completion of internship(s). Finally, a table depicting systematic mapping of what they have learnt and the expected internship COs is to be shown.

(iv) Student feedback on internship: To gather information on whether the internship was useful and gave practical experience in the chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*)with closed and open questions shall be kept in the report.

(v) Pictures at the worksite: Student has to keep, in the report, his working pictures at the worksite, discussing with the internship supervisor, the creative project he is working on, or an event he is attending for work, group photo of the team/section/department he worked with.

(b) Anti-Plagiarism Check: The internship report should clear the plagiarism check as per the Anti-Plagiarism policy-2020 of the institute.

(c) Presentation: Each student should prepare PPT with informative slides and make an effective oral presentation before the DIEC as per the schedule notified by the department. The presentation shall compulsorily have slides on the points mentioned in (a)(i)-(v)

(d) It is mandatory for every student to *appear for oral presentation(with PPT) and viva-voce*, toqualify for internship evaluation

(e) A student shall register for supplementary examination for the internship evaluation in the following cases:

(i) absent for oral presentation and viva-voce
(ii) fails to submit the internship report in prescribed format
(iii) fails to fulfill the requirements of internship evaluation as per specified guidelines

(f) Supplementary examination for internship evaluation

(i) The CoE shall send the list of students registered for supplementary examination to the HoD concerned.
(ii) The DIEC, duly constituted by the HoD, shall conduct the internship

evaluation supplementary exam and send the award list to the CoE within the stipulated time.

Course Articulation Matrix (CAM):		U24IT707: INTERNSHIP EVALUATION												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT707.1	1	-	-	-	-	-	1	3	-	-	-	-	-
CO2	U24IT707.2	3	2	1	1	3	-	1	-	-	-	-	2	2
CO3	U24IT707.3	-	-	-	-	-	-	1	1	3	3	2	-	-
CO4	U24IT707.4	-	-	-	-	-	-	1	-	1	3	-	-	-
U24IT707		2	2	1	1	3	-	1	2	2	3	2	2	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience	**SDG 4**	Quality Education	Industrial internship provides experiential learning in ECE domains such as Embedded Systems, IoT, VLSI, Communication Systems, Signal Processing, Artificial Intelligence, and Semiconductor Technologies. Students acquire practical skills, industry exposure, professional networking opportunities, and lifelong learning abilities, thereby strengthening quality technical education and employability.
CO2	Apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems	**SDG 11**	Sustainable Cities and Communities	Effective communication and collaboration are essential for multidisciplinary ECE projects such as smart city infrastructure, intelligent transportation systems, public safety networks, and digital communication platforms that contribute to sustainable and connected communities.
CO3	Exhibit professional skills including communication, teamwork, leadership, and lifelong learning	**SDG 9**	Industry, Innovation and Infrastructure	Application of ECE concepts to industrial problems through communication networks, embedded systems, IoT, VLSI, robotics, AI-enabled systems, and automation technologies promotes innovation, industrial modernization, and sustainable infrastructure development.
CO4	Prepare internship reports and effectively communicate internship outcomes through presentations and viva-voce	**SDG 12**	Responsible Consumption and Production	Professional ethics, quality assurance, responsible technology deployment, resource optimization, and sustainable engineering practices in ECE industries encourage responsible production, efficient use of resources, and continuous improvement.

MAJOR PROJECT PHASE-1

Class: B. Tech. VII – Semester		**Branch: IT**	
Course Code:	**U24IT708**	**Credits:**	**4**
Hours / Week (L-T-P- E):	**0-0-8-8**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real- world complex engineering problems (**Technical skills**)

CO2: design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (**Problem solving and critical thinking skills**)

CO3: apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (**Ethics and teamwork**)

CO4: collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (**Communication skills and life-long learning**)

1. Final Year Major Project work represents the culmination of study towards the B. Tech degree. ***Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems***. The **student learning assessment process** (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project work.
2. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
3. **Team work:** Major project work is a team work.
   - **(i)** The students of a project team shall work together to achieve a common objective.
   - **(ii)**Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of a team having knowledge diversity, gender diversity, social and cultural diversity among its members.
4. **Two phases:** Major project work shall be carried out in two phases. Nearly 50 - 75% of the proposed work to be completed in 7th semester as *Phase-I* and the remaining work to be continued and completed in 8th semester as *Phase-II.*
5. Every student is expected to put approximately **72 hours of work** into the major project *phase-I* course over the 12 weeks of 7thsemester.

6. Major project work *Phase-I*: 7th semester

(i) The HoD shall constitute the ***department project evaluation committee (DPEC)*** with following composition

Department project evaluation committee (DPEC)	
HoD	Chairman
Senior Faculty	Convener
Coordinator(s)	Section-wise coordinator(s) - *One coordinator for each section*
Three Faculty members	Section-wise faculty members - *Three faculty members for each section representin specializations. (Five specializations will be covered including the coordinator's and Convener'*

(ii) Major project allotment to students during 6th semester:

(a) **First / Second week of 6thSemester**: The process shall be initiated during the first / second week of 6thsemester by collecting project titles from the department faculty research groups, on offering innovative ideas/solutions for engineering problems.

(b) **MSE-I period of 6th Semester – Notifying project titles**: The finalized project titles shall be notified to students during the MSE-I period of 6th semester and student teams shall be allowed to exercise their options on titles that interest them.

(c) **Last working week of 6th Semester – Allotment of titles and supervisors to project teams**: The project title allotment to major project teams shall be completed before the last day of instruction of 6th semester

(d) **6th semester summer break - Literature review**: This 6th semester schedule enables students to complete literature review, preliminary simulations / investigations / experimentation during 6th semester summer break and *start the work from day-one in 7th semester*

(e) **Registration Presentation - Notifying the tentative dates:** The major project teams are expected to give registration presentation during second / third week from the commencement of 7th semester. The tentative dates for conducting the registration presentation shall be notified at the time of releasing the circular on allotted project title and project supervisors, as indicated in (c) above. This enables student teams to plan the work accordingly during summer break, to complete the literature review, preliminary simulations / investigations and get ready for informative, confident and comfortable presentations on their project work.

(iii) The convener DPEC shall notify, during MSE-I period of 6th semester, the list of implementable project titles offered by the faculty of different research groups of the department

(a) Project titles shall come with the following details to be made available to students on dept webpage and notice boards, facilitating students to select problems that interest them.

i. abstract
ii. deliverables / outcomes
iii. knowledge and skills required to complete the project
iv. resources required
v. one of the deliverables shall be writing a technical paper out of the major project work done for submission to a reputed non-predatory conference/non-paid peer reviewed journal

(iv) The major project teams, finalized by the convener DPEC, shall be allowed to exercise their options on the titles that interest them from the notified list

(v) **Project supervisor allotment**: The convener DPEC shall allot, during the last week of 6th semester, the faculty supervisors to all project teams

(a) The project supervisors shall

i. **define project objectives and expected deliverables**
ii. **help the students plan their project work and timeline**
iii. **provide enough resources for successful project completion**

(vi) The faculty supervisors are expected to provide guidance to project teams on

i. *Engineering Knowledge* - Applies engineering fundamentals, computing knowledge, and domain-specific concepts to solve the selected project problem.
ii. *Problem Analysis* - Identifies, formulates, and analyzes a real-world engineering problem through literature review and requirement analysis.
iii. *Design/Development of Solutions* - Designs and develops an innovative solution, system, or application that satisfies functional requirements while considering societal and environmental aspects.
iv. *Conduct Investigations of Complex Problems* - Conducts experiments, collects and analyzes data, validates results, and draws meaningful conclusions using research methodologies.
v. *Engineering Tool Usage* - Uses modern engineering and IT tools, software frameworks, simulation tools, IDEs, databases, AI tools, and testing platforms for implementation.
vi. *The Engineer and the World* - Evaluates the project's impact on society, sustainability, economy, health, safety, legal, cultural, and environmental aspects wherever applicable.
vii. *Ethics* - Follows professional ethics by ensuring originality, respecting intellectual property, maintaining data privacy, and adhering to ethical standards.
viii. *Individual and Collaborative Team Work* - Works effectively as an individual and as a member of a multidisciplinary project team, demonstrating leadership and collaboration.
ix. *Communication* - Prepares project reports, technical documentation, presentations, demonstrations, and communicates project outcomes effectively.
x. *Project Management and Finance* - Plans project activities, schedules tasks, manages resources, estimates costs (where applicable), and completes milestones within timelines.
xi. *Life-Long Learning* - Learns emerging technologies, research methodologies, and new tools independently to successfully complete the project.

(vii) The project supervisors are also expected to continuously emphasize and guide students on

(a) Meeting Cadence:

i. **Regular meetings with supervisor:** Short and frequent meetings increasea team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.
ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week.** Due weightage will be given to meeting cadenceand considered for evaluation during presentations, i.e., number of planned meetings and number attended by students

(b) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).
ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-I*, the supervisor shall specifically comment, in the project log book, on whether the project team met each of the project work *phase-I* goals and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(c) **Following project timeline**: completing the tasks as planned in project timeline

(d) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, which can be specially acquired by participating in major project work

(e) **Writing down whatever is done and making notes of whatever is read.** Writing down the procedures/models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, ***difficulties faced and how they were fixed*** are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well- documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on.

This information will be needed for the bibliography in your project report. On the other hand, documenting a report ***on the spur of the moment*** would end up copying things from other sources resulting in a plagiarized document.

(f) **Good and sufficient literature review**: Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

(g) Completing nearly 50 - 75% of the proposed work during phase-I

(h) Right conduct of research to promote academic integrity, honesty and time management

(i) Preparing a well-documented report in proper format, covering the progress made during Phase-I

(j) Consequences of plagiarism and use of anti-plagiarism software to detect plagiarism in documents

(k) Submission of major project phase-I report within acceptable plagiarism levels, as per the ***Anti-plagiarism policy-2020 of our institute***. (Allowed Similarity % : Maximum 24%, From single Source : Max. 4% & No. of consecutive words: max. 6)

(l) **Video pitch:** Capturing short videos, photos, screenshots on experimentsconducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the work done during *phase-I.*

(m) **Project Paper**: Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained, and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.

(n) **Project poster**: At the end of phase-II, the project teams shall have to presenttheir project in the form of posters, at the time of demonstration of complete porotype / working model / software package / system developed.

(viii) Phase– I evaluation: There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components

(a) **Registration Presentation** *(during second / third week of 7th semester):* The Registration Presentation shall include a brief report and presentation focusing the identified problem, objective(s), literature review, identifying research gap in the literature, implementation of existing methods, proposed solution, and expected outcome(s).

i. The registration presentation shall invariably include the **project plan timeline** with actual start and finish dates– monthly/weekly project milestones/ timeline prepared in MS Excel or any other project management tool.

ii. **Project timeline –** *Weekly project milestones*: It's a compact and creative way to present a project plan. Identify the project intermediate goals and related tasks for completing each of those goals. Categorize tasks for each week. In the project timeline use different colors to the tasks for each week. Horizontal timeline layouts shall be preferred or any other layout of team's choice.

iii. Project teams shall create and present the following during registration presentation
   1. *Complete project timeline*
   2. *Phase-I project timeline*
   3. *Phase-II project timeline*

iv. During every presentation, project teams shall compulsorily show the following as part of their presentation
   1. *The slides on project timeline and*
   2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*

v. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*) during presentations

(b) **Progress Presentation-I** *(during penultimate week of 7th semester):* At the end of first stage (7th semester), student teams shall be required present, before the DPEC, the progress made during phase-I and submit a well-documented report of work done for evaluation to the project coordinator

i. **Following project timeline**: The project timeline shall be meticulously followed and the tasks shall be completed as planned in the project timeline.

ii. Project teams shall compulsorily show the following as part of their progress presentation-I
   1. *The slides on project timeline and*
   2. *A table showing targeted tasks as per timeline and whether tasks are accomplished?*

iii. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*)

(c) **CIE schedule**: The convener DPEC shall release the complete schedule of CIE before start of 7th semester well in advance, so that student teams will complete the scheduled works and get ready with an informative, confident, and comfortable presentation for registration and progress presentations.

(ix) CIE for the Major project work Phase-I shall be as given below:

Major project Phase-I Assessment *(7th semester)*

S.No	Assessment Component	Weightage (%)	CO Mapping	PO Mapping
1	Supervisor Assessment (Individual Contribution & Teamwork)	15	CO1, CO2	PO9, PO10
2	Problem Definition & Literature Review	5	CO1	PO1, PO2
3	Design & Methodology	5	CO2	PO3, PO4
4	Implementation & Working Model	15	CO2, CO3	PO3, PO5
5	Video Pitch	5	CO3, CO4	PO9, PO10

6	Project Report	15	CO1, CO4	PO1, PO8
7	Research Paper Writing	10	CO2, CO3	PO2, PO3
8	Oral Presentation & Viva Voce	20	CO3, CO4	PO9, PO10
9	Alignment with SDGs	10	CO3, CO4	PO6, PO7,PO8
	Total	100		

** Students are advised to complete major part of the project in phase-I only*

(a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system, on the chosen work. The progress made in this shall be demonstrated during progress presentation-I at the end of *phase-I* and the completed working model/ process/software package/system before the DPEC as per the dates specified by DPEC at the end of *phase-II*.

(b) **Progress Report on *phase-I*:** Every project team shall be required to submit a well-documented progress report on dissertation phase-I as per format specified by DPEC.

a. **Tangible outcomes of *phase-I* in Conclusions - Chapter:** These are thelessons learnt from doing a project work. The students have to describe in their own words what they learnt from the *phase-I* project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of *phase-I* work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be presented in the conclusions chapter of *phase-I* report

(c) **Video pitch on *phase-I*:** Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I*. The project team shall present the produced video pitch during progress presentation-I. The produced video pitch should

a. be 3 to 5-minute-long video (no longer than 5 minutes)
b. be concise and to the point, on the problem and proposed solution
c. show project timeline and sample page of log book
d. highlight the progress made at various stages during *phase-I* project implementation with the help of short videos/photos / screenshots on experiments conducted, simulations carried out, part of prototype/ working model/process / software package/system being under development as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project
e. discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts.*
f. emphasize key points about *business idea, potential market for the proposed solution*

(x) It is mandatory for
(a) every student of the team to *appear for oral presentation and viva-voce*, as part of progress presentation -I to qualify for course evaluation
(b) every project team *to submit a well-documented progress report on major project work phase-I*, as part of progress presentation -I to qualify for course evaluation
(c) every project team to create and present a good video pitch on major project work*phase-I*, as part of progress presentation -I to qualify for course evaluation

(xi) A student shall register for supplementary examination for the Major project *phase-I* in the following cases:
(a) He/she is absent for oral presentation and viva-voce as part of progress presentation-I
(b) The project team fails to submit the progress report on *Phase-I* in prescribedformat
(c) The project team fails to submit the video pitch on the progress made during the *phase-I* period.
(d) he/she fails to fulfill the requirements of Major project *phase-I* evaluation as per specified guidelines

(xii) Supplementary examination for Major project *phase-I*
(a) The CoE shall send the list of students registered for supplementary examination to

the HoDs concerned

(b) The DPEC, duly constituted by the HoD, shall conduct Major Project Phase I supplementary exam and send the award list to the CoE within the stipulated time

Major Project Phase-1 Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
1	Supervisor Assessment	Regularity & Interaction (5M)	15
		Understanding of Topic (5M)	
		Progress &Timely Completion(5M)	
2	Problem Definition & Literature Review	Problem Statement & Literature Survey (5M)	5
3	Design & Methodology	Methodology & System Design (5M)	5
4	Implementation & Working Model	Implementation (5M)	15
		Innovation & Testing (5M)	
		Performance & Usability (5M)	
5	Video Pitch	Visual Quality, Content Clarity & Delivery (5M)	5
6	Major Project Report	Structure, Format & Originality (5M)	15
		Technical Content (5M)	
		Clarity, Coherence & Writing (5M)	
7	Research Paper Writing	Structure, Organization & Academic Writing (5M)	10
		References, Citation & Originality (5M)	
8	Oral Presentation & Viva Voce	PPT & Delivery (5M)	20
		Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
9	Alignment with SDGs	SDG Mapping & Impact Analysis (5M)	10
		Justification of SDG mapping, Clarity, Presentation & Originality (5M)	

Course Articulation Matrix (CAM):		**U24IT708: MAJOR PROJECT PHASE-I**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT708.1**	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	**U24IT708.2**	3	3	3	2	3	3	2	1	1	2	2	2	1
CO3	**U24IT708.3**	1	1	1	1	1	2	3	3	2	3	1	2	1
CO4	**U24IT708.4**	1	1	1	2	2	1	2	1	3	1	3	2	2
U24IT708		2	**2**	**1.75**	**2**	**2**	**1.75**	**2**	**1.5**	**1.75**	**175**	**2**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real- world complex	**SDG 9**	Industry, Innovation and Infrastructure	Research gap identification, problem formulation, and development of innovative engineering solutions promote technological advancement, industrial innovation, and sustainable infrastructure development in ECE domains such as communication

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	engineering problems (Technical skills)			systems, IoT, VLSI, AI, and embedded systems.
CO2	design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)	**SDG 12**	Responsible Consumption and Production	Engineering design considering resource optimization, environmental impact, sustainability, and efficient utilization of technology promotes responsible production and sustainable engineering practices.
CO3	Apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader of a multidisciplinary team.	**SDG 11**	Sustainable Cities and Communities	Effective teamwork, ethical engineering practices, leadership, and multidisciplinary collaboration facilitate the development of sustainable technological solutions that improve societal well-being and community infrastructure.
		SDG3	Good Health and Well-Being	ECE projects related to biomedical instrumentation, healthcare IoT, telemedicine, wearable sensors, and assistive technologies contribute to improved healthcare services and quality of life.
CO4	Collate results, compare prototype performance with specifications, communicate findings through reports, posters, technical papers, presentations, and video pitches; engage in self-directed and lifelong learning.	**SDG 4**	Quality Education	Technical communication, dissemination of knowledge, professional documentation, and lifelong learning foster continuous education, skill enhancement, and knowledge sharing among engineering professionals.

8th Semester Syllabi

Abbreviations

L	Lecture Hours	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hours	E	Total Engagement in Hours
P	Practical Hours	C	Credit Assigned

VIII SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	PEC	U24IT801X	Program Elective - III / MOOCs-III *(from Pool-XI)*	2	1	-	3	3
2	PEC	U24IT802X	Program Elective - IV / MOOCs-IV *(from Pool-XII)*	2	1	-	3	3
3	ELC	U24IT803	Major Project Phase – 2 / Industrial Internship - 2	-	-	12	12	6
			Total:	4	2	12	18	12
			Additional Learning@:Maximum credits allowed for Honours/Minor:	-	-	-	-	4
			Total credits for Honours/Minor students:	-	-	-	-	16

	Pool – XI : Program Elective – III	
S. No.	Course Code	Course Title
1	U24IT801A	Blockchain Technologies
2	U24IT801B	Natural Language Processing
3	U24IT801C	Wireless Adhoc Networks
4	U24IT801D	Fog & Edge Computing
5	U24IT801E	Privacy and Security in IoT

	Pool – XII : Program Elective – IV	
S. No.	Course Code	Course Title
1	U24IT802A	Computer Forensics
2	U24IT802B	Deep Learning
3	U24IT802C	Wireless Sensor Networks
4	U24IT802D	Augmented Reality &Virtual Reality
5	U24IT802E	IoT Architectures and Protocols

BLOCKCHAIN TECHNOLOGIES

Class: B. Tech. VI Semester		**Branch:** IT	
Course Code:	**U24IT801A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze blockchain technology and decentralization concepts, including distributed systems, consensus mechanisms, and CAP theorem.

CO2 : apply cryptography and consensus algorithms for secure blockchain systems

CO3 : describe bitcoin fundamentals, including its network, transactions, wallets, mining, and payment systems

CO4 : apply ethereum concepts, including smart contracts, EVM, transactions, and ecosystem components, for developing decentralized applications.

UNIT-I	**9 Hrs**

Blockchain: The growth of blockchain technology, Distributed systems, The history of blockchain, Types of blockchain and bitcoin, Consensus, CAP theorem and blockchain.

Decentralization: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, Pertinent terminology, Platforms for decentralization, Innovative trends

UNIT-II	**9 Hrs**

Symmetric Cryptography: Working with the openSSL command line, Introduction, Cryptographic primitives.

Public Key Cryptography: Cryptographic and Blockchain technology

Cryptographic constructs and blockchain technology: Homomorphic encryption, Signcryption, Secret sharing, Commitment schemes, Zero-knowledge proofs, Different types of digital signatures, Applications of cryptographic hash functions

Consensus Algorithms: Introducing the Consensus Problem, Analysis and design, Classification Algorithms, Choosing an algorithm

UNIT-III	**9 Hrs**

Introducing Bitcoin: Bitcoin-an overview, Cryptographic keys, Transactions, Blockchain, Mining

Bitcoin Network and Payments: The Bitcoin Network, Wallets, Bitcoin Payments, Innovation in Bitcoin, Advanced protocols, Bitcoin investment and buying and selling bitcoin

UNIT-IV	**9 Hrs**

Bitcoin Clients and APIs: Bitcoin client Installation, Experimenting further with bitcoin-cli, Bitcoin programming

Alternative Coins: Introducing altcoins, Theoritical foundations: Alternatives to proof of work (PoW), Proof of stake (PoS), Proof of activity(PoA), Non-outsourceable puzzles **Smart Contracts:** Introduction, History, Ricardian contracts, Smart contract templates, Deploying smart contracts

Ethereum: Introduction, The ethereum network, Components of the ethereum ecosystem Transactions and messages, Ether cryptocurrency / tokens (ETC and ETH), The Ethereum Virtual Machine (EVM)

Textbook(s):

1. Imran Bashir, *Mastering Blockchain*: Packt Publishing Limited, 3rd edition, 2020.

Reference Book(S):

1. Narayanan A, Bonneau J, Felten E, Miller A, and Goldfeder S, *Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction*, Princeton University Press, 2nd edition,2016.
2. Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, O'Reilly Media, 2nd edition, Inc., 2018.

Web and Video link(s):

1. ***Blockchain and itsApplications - Course****; NPTEL Video Lecture on Blockchain and its Applications, By Prof. Sandip Chakraborty, Prof. Shamik Sural, IIT Kharagpur*

Course Articulation Matrix (CAM):		U24IT801A : BLOCKCHAIN TECHNOLOGIES												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT801A.1	1	2	2	1	-	-	1	-	1	-	-	2	2
CO2	U24IT801A.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24IT801A.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24IT801A.4	2	2	3	3	-	-	1	-	1	-	2	2	2
U24IT801A		1.75	2	2.25	1.75	-	-	1	-	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze blockchain technology and decentralization concepts, including distributed systems, consensus mechanisms, and CAP theorem.	SDG9	Industry, Innovation and Infrastructure	Blockchain promotes innovative digital infrastructure and resilient distributed systems.
CO2	apply cryptography and consensus algorithms for secure blockchain systems	SDG16	Peace, Justice and Strong Institution	Secure and transparent systems enhance trust, accountability, and cyber security in digital transactions.
CO3	describe bitcoin fundamentals, including its network, transactions, wallets, mining, and payment systems	SDG8	Decent Work and Economic Growth	Blockchain-based financial systems and digital payments support economic growth and financial inclusion.
CO4	apply ethereum concepts, including smart contracts, EVM, transactions, and ecosystem components, for developing decentralized applications.	SDG9	Industry, Innovation and Infrastructure	Smart contracts and decentralized applications foster technological innovation and digital transformation.

NATURAL LANGUAGE PROCESSING

Class: B. Tech. VIII– Semester		**Branch:** IT	
Course Code:	**U24IT801B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze the concepts of natural language processing to train a machine to understand text and spoken words in much the same way human beings can understand

CO2 : analyze language models, naïve bayes and sentiment classifiers to recommend an opinion model

CO3 : apply the part of speech tagging and parsing techniques to automate the system responses

CO4 : analyze and develop different applications based on natural language processing such as named entity recognition, question answering, machine translation and chat bots

UNIT-I	**9 Hrs**

Natural Language Processing (NLP): Introduction to NLP, Ambiguity, Language, Thought and Understanding

Regular Expressions, Text Normalization, Edit Distance: Regular expression, Words, Morphology, Morphology parsing, Word tokenization, Lemmatization, Stemming, Edit distance

SelfLearningTopics (SLTs):*Context-sensitive pattern matching*

UNIT-II	**9 Hrs**

N-gram Language Models: N-Grams, Evaluating language models and smoothing, Kneser-Ney smoothing, Perplexity's relation to entropy

Naïve Bayes and Sentiment Classification: Training the Naïve Bayes classifier, worked example, Optimizing for sentiment analysis, LSTM Sentiment models, Transformer-based sentiment models

SelflearningTopics (SLTs):*Naïve Bayes classifiers*

UNIT-III	**9 Hrs**

Sequence Labeling for Parts of speech and Named Entities: Part-of-Speech tagging, Namedentities and Named entity tagging,BIO Tagging, HMM Part-of-speech tagging, Modern NLP Systems (BERT, spaCy, Stanford CoreNLP)

Constituency Parsing: Ambiguity, CKY parsing, Partial parsing

SelflearningTopics (SLTs):*English word classes*

UNIT-IV	**9 Hrs**

Compositional semantics: Introduction, sematic parsing, ,Statistical Semantic Parsing, Neural Sematic Paring, Disclosure analysis

Applications: Named entity recognition and Relation Extraction-RE using sequence labeling, Machine Translation (MT)- Basic issues in MT, Statistical translation, Word alignment, Phrase-based translation, Question answering, Chatbots and dialog system

SelflearningTopics (SLTs):*Semantic role Labeling*

Textbook(s):

2. Daniel Jurafsky and James H. Martin, *Speech and Language Processing*, Pearson Education, 2nd edition, 2009

Reference Book(S):

1. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, O'Reilly Media, 1st edition, 2009
2. Roland R. Hausser, *Foundations of Computational Linguistics: Human-Computer Communication in Natural Language*, MIT Press, 1st edition, 2011

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc26_cs45/preview
   NPTEL Video Lecture on Natural Language Processing, Prof. Pawan Goyal, Professor of CSE, IIT Kharagpur.

Course Articulation Matrix (CAM):		U24IT801B : NATURAL LANGUAGE PROCESSING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT801B.1	2	2	2	2	1	-	-	-	-	1	-	1	1
CO2	U24IT801B.2	3	3	2	3	1	-	-	-	-	1	-	1	1
CO3	U24IT801B.3	3	3	2	3	1	-	-	-	-	1	-	1	1
CO4	U24IT801B.4	3	3	2	3	1	-	-	-	-	1	-	1	1
U24IT801B		2.75	2.75	2	2.75	1	-	-	-	-	1	-	1	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze the concepts of natural language processing to train a machine to understand text and spoken words in much the same way human beings can understand	SDG 4	Quality Education	NLP techniques support intelligent learning systems, language learning platforms, and accessible education technologies.
CO2	analyze language models, naïve bayes and sentiment classifiers to recommend an opinion model	SDG 9	Industry, Innovation and Infrastructure	Sentiment analysis and predictive opinion models improve intelligent business analytics and innovation in digital platforms.
CO3	apply the part of speech tagging and parsing techniques to automate the system responses	SDG 9	Industry, Innovation and Infrastructure	Parsing and tagging techniques enable development of smart automated communication systems and AI applications.
CO4	analyze and develop different applications based on natural language processing such as named entity recognition, question answering, machine translation and chat bots	SDG 9	Industry, Innovation and Infrastructure	Advanced NLP applications encourage AI innovation, multilingual communication, and intelligent digital services.

WIRELESS ADHOC NETWORKS

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT801C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply wireless communication concepts to utilize and analyze ADHOC wireless networks

CO2 : analyze performance of various MAC protocols and routing protocols for development of ADHOC wireless networks

CO3 : apply transport layer protocols, and techniques of QoS to improve performance in ADHOC wireless networks

CO4 : apply concepts of energy management and hybrid wireless networks to support data communication and network operations

UNIT-I	**9 Hrs**

Introduction: Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms, Characteristics of the Wireless channel, Modulation Techniques, Multiple Access Techniques

Wireless Lans and Pans : Network Architecture, Bluetooth

ADHOC Wireless Networks : Introduction, Issues inADHOC Wireless Networks, ADHOC Wireless Internet

Self LearningTopics(SLTs): *Error Control (Text1: topic 1.8)*

UNIT-II	**9 Hrs**

MAC Protocols for ADHOC Wireless Networks: Introduction, Issues in Designing a MAC Protocol for ADHOC Wireless Networks, Design Goals of a MAC Protocol for ADHOC Wireless Networks, Classification of MAC Protocols, Contention based protocols, Contention based protocols with Reservation Mechanisms, Contention based protocols with Scheduling Mechanisms

Routing protocols for ADHOC wireless networks: Introduction, Issues in designing a routing protocol for ADHOC wireless networks, Classification of routing protocols, Table-Driven Routing Protocols,On-demand routing protocols, Hybrid routing protocols

Self LearningTopics(SLTs):*MACprotocols that use directional antennas (Text1: Topic 6.8), Other MAC protocols (Text1: topic 6.9),*Hybrid routing protocols*(Text1: topic 7.6) , Power-aware routing protocols(Text1: topic 7.9)*

UNIT-III	**9 Hrs**

Transport Layer and Security Protocols for ADHOC Wireless Networks: Introduction, Transport Layer protocol for ADHOC networks, Design Goals of a Transport Layer Protocol for ADHOC Wireless Networks, Classification of Transport Layer solutions, TCP over ADHOC Wireless, Security in ADHOC wireless networks, Network security requirements

Quality of Service in ADHOC Wireless Networks: Introduction, Issues and Challenges in Providing QoS in ADHOC Wireless Networks, Classifications of QoS solutions, MAC layer solutions, DBASE, Network layer solutions, QoS frameworks for ADHOC wireless networks

Self LearningTopics(SLTs):Issues in designing a transport layer protocol for ADHOC

wireless networks*(Text1: topic 9.2),*Issues and challenges in security provisioning (*Text1: topic 9.9)*

UNIT-IV	9 Hrs

Energy Management in ADHOC Wireless Networks: Introduction, Classification of Energy Management Schemes, Battery Management Schemes, System power management schemes, Transmission power management schemes, System power management schemes
Hybrid Wireless Networks: Introduction, Next-Generation Hybrid Wireless architectures, Routing in hybrid wireless networks, Power control schemes in hybrid wireless networks, Load balancing in hybrid wireless networks
SelfLearningTopics(SLTs):Need For Energy Management In ADHOC Wireless Networks, *(Text1: topic 11.2)*

Textbook(s):

1. C. Siva Ram Murthy, and B. S. Manoj, "*ADHOC Wireless Networks: Architectures and Protocols*", Pearson Education, 2008. *(Chapters 1, 2, 5, 6, 7, 9 to 11, 13)*

Reference Book(s):

1. Li, X, "*Wireless ADHOCand sensor Networks: theory and applications*", Cambridge University Press, 2008.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "*ADHOC & Sensor Networks: Theory and Applications*", World Scientific Publishing Company, 2nd edition, 2011.
3. Labiod. H, "*Wireless Adhoc and Sensor Networks*", Wiley, 2008.
4. Feng Zhao and Leonides Guibas, "*Wireless Sensor Networks*", Elsevier Publication
5. Holger Karl and Andreas Willig, "*Protocols and Architectures for Wireless Sensor Networks*", Wiley, 2005
6. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "*Wireless Sensor Networks Technology, Protocols, and Applications*", John Wiley, 2007
7. Anna Hac, "*Wireless Sensor Network Designs*", John Wiley, 2003

Web and Video link(s):

1. *https://onlinecourses.nptel.ac.in/noc26_cs51/preview, NPTEL Video Lecture onWireless ADHOC and Sensor Networks by Prof. Sudip Misra, Professor of CSE, IIT Khargpur.*

Course Articulation Matrix (CAM):		U24IT801C : WIRELESS ADHOC NETWORKS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT801C.1	3	2	-	2	1	-	-	-	-	-	1	-	-
CO2	U24IT801C.2	3	2	2	2	2	-	-	-	-	-	1	-	-
CO3	U24IT801C.3	2	3	-	2	2	-	-	-	-	-	1	-	1
CO4	U24IT801C.4	2	2	3	2	1	-	-	-	-	-	1	-	1
U24IT801C		**2.5**	**2.25**	**2.5**	**2**	**1.5**	-	-	-	-	-	**1**	-	**1**
3 – HIGH, 2 – MEDIUM, 1, LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply wireless communication concepts to utilize and analyze ADHOC wireless sensor networks	SDG 4	Quality Education	Supports development of wireless communication infrastructure and enhances technical knowledge
CO2	analyze performance of various MAC protocols and routing protocols for development of ADHOC wireless networks	SDG 8	Decent Work and Economic Growth	Enables efficient network design and builds industry-relevant networking skills
CO3	apply transport layer protocols and techniques of QoS to improve performance in ADHOC wireless networks	SDG 11	Sustainable Cities and Communities	Improves network performance and promotes energy-efficient communication systems
CO4	apply concepts of energy management and hybrid wireless networks to support data communication and network operations	SDG 16	Peace, Justice and Strong Institutions	Supports advanced wireless infrastructure and ensures secure, reliable communication systems

FOG AND EDGE COMPUTING

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT801D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to

CO1 : design applications based on Fog computing technologies

CO2 : design applications based on Edge computing technologies

CO3 : apply network slicing in 5G, software defined networks, Fog and Edge applications

CO4 : analyze optimization problems and apply metrics with middleware technologies in Fog and Edge applications

UNIT-I	**9 Hrs**

Introduction: Relevant technologies, Fog and Edge computing completing the Cloud, Advantages of FEC-SCALE, How FEC achieves these advantages: SCANC, Hierarchy of Fog and Edge computing outer-edge, Opportunities and challenges

Introduction to Fog Computing: Fog computing definition, Characteristics, Application scenarios, Issues and challenges, Cloud vs Fog computing

Fog Computing architecture: Communication and network model, Programming models

Fog Computing Communication Technologies: Introduction, IEEE 802.11, 4G, 5G standards, WPAN, Short-range technologies, LPWAN and other medium, Long-range technologies

Self LearningTopics(SLTs): *Business models, Case Study:Intelligent Traffic Lights Management (ITLM) system*

UNIT-II	**9 Hrs**

Introduction to Edge Computing: Edge Computing purpose and definition, Need of Edge computing, Key techniques that enable Edge computing, Characteristics, Application scenarios, Edge vs Fog Computing, Edge computing architectures

Edge Computing Systems: Apache Edgent, OpenStack, EdgeX Foundry, Data processing on the edge, Edge computing applications

Challenges: The Networking challenge, The management challenge, Miscellaneous challenges

Edge Computing Case study:A Wearable ECG Sensor

Self LearningTopics(SLTs): *Apache Edgent, Case study: Smart home*

UNIT-III	**9 Hrs**

Management and Orchestration of Network Slices in 5G, Fog, Edge and Clouds: Background, Cloud computing, Mobile Edge Computing (MEC), Edge and Fog computing

Network Slicing in 5G: Infrastructure layer, Network function and virtualization layer, Service and application layer, Slicing management and orchestration (MANO)

Network Slicing in Software-Defined Clouds: Network-aware virtual machines management, Network-aware virtual machine migration planning, Network slicing

management in Edge and Fog ***Self LearningTopic(SLTs)::*** *5G, Virtual network functions management*
UNIT-IV **9 Hrs**
Optimization Problems in Fog and Edge Computing: Introduction, The case for optimization in Fog computing, Formal modeling framework for Fog computing **Metric:**Performance, Resource usage, Energy consumption, Financial costs, Further quality attributes, Optimization opportunities along the Fog architecture, Optimization opportunities along the service life cycle **Middleware for Fog and Edge Computing Design Issues:**Need for Fog and Edge computing Middleware, Design goals, State-of-the-art middleware infrastructures, System model, Proposed architecture, Case study example – data analytics ***Self Learning Topics(SLTs): M****obility support, Scheduling and security*
Textbook(s): 1. Rajkumar Buyya and Satish Narayana Srirama - *Fog and Edge Computing: Principles and Paradigms,* 1st Edition, USA, Wiley Series on Parallel and Distributed Computing, 2019.
Reference Book(s): 1. Assad Abbas, Samee U. Khan, Albert Y. Zomaya - *Fog Computing: Theory and Practice*, 1st Edition, USA: Wiley Series on Parallel and Distributed Computing, 2020. 2. David Jensen - *Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge*, 1stEdition, USA: MICROSOFT AZURE, 2021. 3. Zaigham Mahmood - *Fog Computing Concepts, Frameworks and Technologies*, 1st Edition, UK: Springer publication, 2018.
Web and Video link(s): 1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs30; *NPTEL Video Lecture on Fog & Edge Computing by Prof. Rajiv Mishra, Professor of CSE, IIT Patna.*

Course Articulation Matrix (CAM):		**U24IT801D : FOG & EDGE COMPUTING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT801D.1**	2	2	2	1	1	-	-	-	-	-	1	2	1
CO2	**U24IT801D.2**	2	2	2	2	2	-	-	-	-	-	1	2	2
CO3	**U24IT801D.3**	2	3	2	2	2	-	-	-	-	-	1	2	2
CO4	**U24IT801D.4**	2	3	2	3	2	-	-	-	-	-	1	2	2
U24IT801D		2	2.5	2	2	1.75	-	-	-	-	-	1	2	1.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Design applications based on Fog computing technologies	SDG9	Industry, Innovation and Infrastructure	Fog computing supports distributed intelligent systems, industrial IoT, smart transportation, and scalable digital infrastructures, enabling innovation and reliable networked services.
CO2	Design applications based on Edge computing technologies	SDG11	Sustainable Cities and Communities	Edge computing enables smart city applications such as smart homes, wearable healthcare systems, intelligent surveillance, and real-time urban monitoring, contributing to sustainable and connected communities.
CO3	Apply network slicing in 5G, software defined networks, Fog and Edge applications	SDG9	Industry, Innovation and Infrastructure	Network slicing, SDN, and 5G technologies improve communication efficiency, scalability, virtualization, and reliability in distributed networks, supporting advanced digital infrastructure and industrial innovation.
CO4	Analyze optimization problems and apply metrics with middleware technologies in Fog and Edge applications	SDG7	Affordable and Clean Energy	Optimization techniques and middleware technologies in Fog and Edge computing reduce energy consumption, improve resource utilization, and enhance efficient computing operations, supporting sustainable and energy-efficient technological solutions.

PRIVACY AND SECURITY IN IoT

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT801E**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: identify security threats, vulnerabilities, and attack vectors in cyber-physical IoT systems and apply countermeasures and security engineering principles to the IoT security lifecycle

CO2: apply block cipher algorithms, hash functions, public-key cryptographic primitives, and digital signature schemes to ensure integrity, confidentiality, and authentication in IoT systems

CO3: analyze privacy-preserving data dissemination techniques, trust frameworks, and authentication protocols to ensure secure data sharing, identity protection, and location privacy in mobile, vehicular, and sensor-based IoT networks

CO4: analyze secure IoT networking protocols, back-end security mechanisms, and IoT security products to evaluate their effectiveness in protecting communication, access control, and data security in real-world IoT deployments

UNIT-I	**9 Hrs**

Cyber Physical Systems and Interconnection of Threats: IoT security goals – vulnerabilities, attacks, and countermeasures; common attack types – authentication attacks, DDoS, physical attacks, wireless reconnaissance; attack trees and fault tree analysis

IoT Security Lifecycle: Operational security lifecycle – configuring gateway and network security, bootstrapping devices, vulnerability tracking, managing firmware and patch updates; secure device disposal

Network Robustness and Threat Scenarios: Sybil attack detection in vehicular networks; malware propagation and control in IoT; solution-based analysis of attack vectors on smart home systems

Self LearningTopics(SLTs): *IoT and cyber-physical systems – definition, characteristics, and architecture*

UNIT-II	**9 Hrs**

Hash Functions and Merkle Trees: Hash functions – SHA-256, SHA-3, collision resistance; Merkle trees – construction, applications in IoT data integrity verification

Public-Key Cryptography: Elliptic curve cryptography (ECC) – principles and advantages for resource-constrained IoT devices; Public Key Infrastructure (PKI) for IoT – X.509 certificates, certificate authorities, trust stores, revocation (OCSP); signature algorithms – ECDSA, RSA signatures

Cryptographic Controls in IoT Protocols: Cryptographic controls built into IoT communication protocols – ZigBee, Bluetooth-LE; cryptographic controls in IoT messaging protocols – MQTT (over TLS), CoAP (over DTLS), REST; key management fundamentals – key generation, establishment, storage, and rotation

Self LearningTopics(SLTs): *Block ciphers – AES structure, modes of operation (CBC, CTR); message integrity – MAC (HMAC); authenticated encryption*

UNIT-III	9 Hrs
Location Privacy and Vehicular Networks: Social features for location privacy enhancement in Internet of Vehicles (IoV); lightweight and robust schemes for privacy protection in mobile Wireless Body Sensor Networks (WBSN) and participatory sensing **Authentication in IoT:**Authentication credentials – passwords, symmetric keys, certificates, biometrics, identity lifecycle management, secure bootstrap, IoT IAM infrastructure, OAuth 2.0 for IoT authorization, access controls within publish/subscribe protocols ***Self LearningTopics(SLTs):*** *Privacy challenges in IoT data dissemination – data minimization, anonymization, pseudonymization, privacy-preserving data aggregation schemes*	
UNIT-IV	**9 Hrs**
IoT Security and Mobile Networks: Networking function security; secure IoT access network protocols – security protocols for IoT access networks **Secure IoT Networking Protocols:** Secure IoT lower layers – MAC layer security, link-layer encryption; secure IoT higher layers – application-layer security; secure communication links in IoT; network segmentation and access controls for IoT **Back-End Security:** Secure resource management; secure IoT databases – data integrity, access control, and encryption at rest; cloud security for IoT – device onboarding, identity registries, key and certificate management, gateway security ***Self Learning Topics(SLTs):*** *Security and impact of IoT on mobile networks*	
Textbook(s): 1. Hu, Fei, *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations*, CRC Press, 1st edition, 2016. Chapter:1,2,6,8,9,10,11,12 2. Russell, Brian, and Drew Van Duren, *Practical Internet of Things Security*, Packt Publishing Ltd, 1st edition, 2016. Chapter:3,4,5,6,7,9,10	
Reference Book(s): 1. Whitehouse, O., *Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond*, NCC Group, 1st edition, 2014. 2. DaCosta, Francis, and Byron Henderson, *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*, Springer Nature, 1st edition, 2013.	
Web and Video link(s): 1. https://onlinecourses.nptel.ac.in — NPTEL Video Lecture on Security in Internet of Things by Prof. Sudip Misra, Professor, IIT Kharagpur	

Course Articulation Matrix (CAM):		**U24IT801E: PRIVACY AND SECURITY IN IoT**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT801E.1**	2	2	2	1	1	-	1	-	-	-	1	2	1
CO2	**U24IT801E.2**	2	2	2	2	2	1	2	-	-	-	1	3	2
CO3	**U24IT801E.3**	2	2	2	2	2	2	2	-	-	-	1	2	2
CO4	**U24IT801E.4**	2	3	2	3	2	2	2	-	-	-	1	3	2
U24IT801E		2.0	2.25	2.0	2.0	1.75	1.25	1.75	-		-	1	2.5	1.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify security threats, vulnerabilities, and attack vectors in cyber-physical IoT systems and apply countermeasures and security engineering principles to the IoT development lifecycle	SDG9	Industry, Innovation and Infrastructure	Understanding IoT security threats and applying security engineering in cyber-physical systems supports the design of resilient, innovation-ready industrial and smart infrastructure
CO2	apply block cipher algorithms, hash functions, public-key cryptography, and digital signature schemes to secure IoT data and communications	SDG9	Industry, Innovation and Infrastructure	Cryptographic foundations ensure secure and tamper-resistant data exchange in IoT-driven industrial systems, directly advancing reliable and innovative infrastructure
CO3	implement privacy-preserving data dissemination schemes, trust models, and authentication mechanisms for IoT systems including mobile and vehicular networks	SDG11	Sustainable Cities and Communities	Privacy-preserving and trust-based frameworks enable secure smart city and vehicular IoT applications, contributing to safer and more sustainable urban communities
CO4	evaluate secure IoT networking protocols, back-end security mechanisms, and analyze existing security products and testbeds for real-world IoT deployments	SDG16	Peace, Justice and Strong Institutions	Secure IoT networking, resource management, and governance frameworks reinforce trustworthy and accountable digital systems, supporting institutional integrity in the IoT domain

COMPUTER FORENSICS

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT802A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand the fundamentals of computer forensics, its methodologies, technologies, and evidence handling techniques for data recovery and investigation purposes.

CO2 : apply systematic procedures for conducting computer investigations and performing reliable data acquisition using appropriate forensic tools and techniques.

CO3 : apply appropriate procedures and tools to identify, collect, secure, and analyze digital evidence from crime scenes while evaluating and using computer forensic tools effectively.

CO4 : Analyze e-mail and mobile device forensic techniques to investigate cybercrimes and acquire digital evidence from communication systems and portable devices.

UNIT-I	**9 Hrs**

ComputerForensicsFundamentals: Computerforensics, Use of computer forensics in law enforcement, Computer forensics assistance to human resources/employment proceedings, Computer forensics services, Benefits of professional forensics methodology, Steps taken by computer forensics specialists

TypesofComputer ForensicsTechnology: Typesof militarycomputer forensictechnology, Types of law enforcement, Computer forensic technology, Types of business computer forensic technology

Computer Forensics Evidence and capture: Data Recovery Defined-Data Back-up and Recovery-The Role of Back -up in Data Recovery-The Data -Recovery Solution

UNIT-II	**9 Hrs**

Understanding Computer Investigations: Preparing a computer investigation, Taking a systematic approach, Procedures for corporate high-tech investigations, Understanding data recovery workstations and software, Conducting an investigation

Data Acquisition: Understandingstorage format for digital evidence, Determining the best acquisition method, Contingency planning for image acquisitions, Using acquisition tools, Validating data acquisitions, Performing RAID data acquisitions, Using remote network acquisition tools, Using other forensics acquisition tools

UNIT-III	**9 Hrs**

Processing Crime IncidentScenes:Identifying digital evidence, Collecting evidence in private-sector incident scenes, Processing law enforcement crime scenes, Preparing for search, Securing a computer incident or crime scene, Seizing digital evidence at the scene, Storing digital evidence, Reviewing a case

Current Computer Forensic Tools: Evaluating computer forensic tool needs, Computer forensic software tools, Computer forensic hardware tools, Validating and testing forensic software

UNIT-IV	**9 Hrs**

E-**mail investigations:** Exploring the role of email in investigations, exploring the role of client and server in email, investigating email crimes and violations, understanding email servers,

using specialized email forensic tools

Cell phone and mobile device forensics: Understanding mobile device forensic, understanding acquisition procedures for cell phones and mobile devices

Textbook(s):

1. JohnR,Vacca,ComputerForensics,*ComputerCrimeSceneInvestigation*,2nded.,New Delhi: Firewall Media, 2012.
2. Nelson, PhillipsEnfinger andSteuart,*ComputerForensicsandInvestigations*,5thed.,New Delhi: Cengage Learning, 2015.

Reference Book(s):

1. KeithJ.Jones,RichardBejtiich,CurtisW.Rose,*RealDigitalForensics*,NewDelhi:Addison Wesley Pearson Education, 2005.
2. TonySammesandBrianJenkinson,*ForensicCompiling*,2nded.,London:Springer-Verlag, 2007.
3. WarrenG.KruseIIandJayG.Heiser,*ComputerForensics:IncidentResponseEssentials*,USA: Addison Wesley, 2002.

Web and Video link(s):

1. **https://onlinecourses.swayam2.ac.in/e-learning/preview/cec21_ge10**
2. **https://onlinecourses.swayam2.ac.in/e-learning/preview/cec20_1b06**
3. **https://dipeshagrawal.wordpress.com/computer-security-digital-forensics**

Course Articulation Matrix (CAM):		**U24IT802A : COMPUTER FORENSICS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT802A.1**	1	1	1	1	-	-	-	-	1	1	-	1	-
CO2	**U24IT802A.2**	1	2	2	1	-	-	-	-	1	1	-	1	-
CO3	**U24IT802A.3**	1	2	1	2	1	-	-	-	2	1	-	1	1
CO4	**U24IT802A.4**	1	1	2	1	1	-	-	-	2	1	-	1	1
U24IT802A		**1**	**1.5**	**1.5**	**1.25**	**1**	**-**	**-**	**-**	**1.5**	**1**	**-**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	understand the fundamentals of computer forensics, its methodologies, technologies, and evidence handling techniques for data recovery and investigation purposes.	SDG 16	Peace, Justice and Strong Institutions	Focuses on identifying forensic methodologies and services, which directly support digital investigations and legal processes, strengthening justice systems and institutional accountability.
CO2	apply systematic	SDG 4	Quality Education	Learning and analyzing computer investigation

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	procedures for conducting computer investigations and performing reliable data acquisition using appropriate forensic tools and techniques.			techniques enhances technical expertise and professional skills in cybersecurity and digital forensics, contributing to high-quality education and workforce readiness.-
CO3	apply appropriate procedures and tools to identify, collect, secure, and analyze digital evidence from crime scenes while evaluating and using computer forensic tools effectively.	SDG 9	Industry, Innovation and Infrastructure	CO3 applies forensic tools and technologies to investigate cyber incidents, contributing to innovation in cybersecurity infrastructure and digital resilience.
CO4	Analyze e-mail and mobile device forensic techniques to investigate cybercrimes and acquire digital evidence from communication systems and portable devices.	SDG 16:	Peace, Justice and Strong Institutions-	Developing solutions for cybercrime requires analyzing threats, investigating digital evidence, and strengthening legal and security frameworks to support justice systems. -

DEEP LEARNING

Class: B. Tech. VIII – Semester		**Branch:IT**	
Course Code:	**U24IT802B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply deep learning fundamentals and regularization techniques for tuning the performance of the deep learning models

CO2 : design and analyze deep convolutional neural network models for image recognition

CO3 : apply recurrent and recursive neural network architectures for handling long-term dependencies and vanishing gradient problems

CO4 : design deep learning models for computer vision, speech and natural language processing applications

UNIT-I	**9 Hrs**

Introduction: Deep learning architecture, Historical trends in deep learning and its performance, deep feed forward networks, Gradient based learning, Hidden Units, Back propagations and differentiation algorithms, Case study: Deep learning applications and societal impact

Regularization for Deep learning: Parameters norm penalties, Norm penalties as constrained optimization, Regularization and under constrained problems, Dataset augmentation, Noise robustness, Parameter tying and sharing, Sparse representation

Self Learning Topics(SLTs): *Why Deep Learning?, Semi-supervised learning, Multitask learning*

UNIT-II	**9 Hrs**

Optimization for Training Deep Models: Pure optimization, challenges in neural network optimization, Basic algorithms, Parameter initialization strategies, Algorithms with adaptive learning rates

Convolutional Neural Networks: Convolution operations, Motivation, Pooling, Convolution and pooling as an infinitely strong prior, Variants of the basic convolution functions, Data types, Efficient convolution algorithms, random or unsupervised features, Convolution networks

TensorFlow case study: Using Convolutional Neural Networks for recognizing and classifying images

Self LearningTopics(SLTs):: *Structured outputs, History of deep learning*

UNIT-III	**9 Hrs**

Recurrent Neural Networks: Architecture, Unfolding computational graphs, Recurrent neural networks, Encoder-decoder architectures, Deep recurrent networks

Recursive Neural networks: Architecture, Challenges of long-term dependencies, Leaky units, Strategies for multiple time scales, Long and short term memory for recursive neural networks, Gated recursive neural networks, optimization for long term dependencies, Explicit memory

Case study: Tensor flow modeling for recognition of hand-written digits

Self Learning Topics: Bidirectional Recurrent neural networks,Echo state networks	
UNIT-IV	**9 Hrs**
Practical Methodology: Performance Metrics, Default baseline models, selecting hyper parameters, debugging strategies, Case study: Multi digit number recognition **Applications:** Large scale deep learning, Computer vision using deep learning, Natural language processing using deep learning, other deep learning applications **TensorFlow case studies:** Textual document processing, Deep learning on cloud ***Self LearningTopics(SLTs):*** *Speech recognition using deep learning, Deep learning on cloud*	
Textbook(s): 1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, *Deep Learning*, 1st edition, MIT Press, 2017. 2. Antonio Gulli, Amita Kapoor, Sujit Pal, *Deep Learning with TensorFlow 2.0 and Keras*, 2nd edition, Mumbai: Packt, 2019	
Reference Book(s): 1. Deng & Yu, *Deep Learning: Methods and Applications,* 1st edition, USA:Now Publisher, 2013. 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, 1stedition, Massachusetts: MIT Press, 2016. 3. Sebastian Raschka, Vahid Mirjalili - *Python Machine Learning*, 2nd edition, Mumbai: Packt, 2019.	
Web and Video link(s): 1. ***https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs66;*** *NPTEL Video Lecture on Deep Learning by Prof. Mitesh M. Knapra, Professor of CSE, IIT Madras.*	

Course Articulation Matrix (CAM):		**U24IT802B : DEEP LEARNING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT802B.1**	2	2	2	1	-	1	-	-	-	-	1	2	1
CO2	**U24IT802B.2**	2	2	2	2	2	-	-	-	-	-	1	2	1
CO3	**U24IT802B.3**	2	2	2	3	2	-	-	-	-	-	1	2	1
CO4	**U24IT802B.4**	2	2	3	3	2	-	-	-	-	-	1	2	1
U24IT802B		2	2	2.5	2.25	2	1	-	-	-	-	1	2	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply deep learning fundamentals and regularization techniques for tuning the performance of deep	SDG 9	Industry, Innovation and Infrastructure	Deep learning fundamentals and optimization techniques improve the efficiency and reliability of intelligent systems used in industrial automation, predictive analytics, and smart

	learning models			infrastructure development.
CO2	Design and analyze deep convolutional neural network models for image recognition	SDG 9	Industry, Innovation and Infrastructure	Deep learning optimization techniques, convolutional neural networks, and TensorFlow-based implementations enhance intelligent automation, image recognition systems, and efficient computational infrastructure for advanced industrial and technological applications.
CO3	Apply recurrent and recursive neural network architectures for handling long-term dependencies and vanishing gradient problems	SDG 4	Quality Education	Recurrent and recursive neural networks enable intelligent educational technologies such as speech recognition, language translation, and personalized learning systems, improving access to quality education.
CO4	Design deep learning models for computer vision, speech, and natural language processing applications	SDG 11	Sustainable Cities and Communities	Deep learning applications in computer vision, speech processing, and NLP support smart city solutions such as intelligent surveillance, traffic monitoring, virtual assistants, and automated public services for sustainable urban development.

WIRELESS SENSOR NETWORKS

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT802C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : develop wireless sensor networks to support a wide range of applications

CO2 : design medium access control protocols and routing protocols for wireless sensor networks

CO3 : analyze the performance of transport control protocols, and understanding the principles & architecture of middleware for wireless sensor networks

CO4 : developnew network management models by identifying the design issues of network management and operating systems for wireless sensor networks

UNIT-I	**9 Hrs**

Overview of Wireless Sensor Networks: Introduction, Basic overview of the technology

Applications of Wireless Sensor Networks: Background, Examples of category-2 WSN applications and Examples of Category-1 WSN applications

Basic Wireless Sensor Technology: Sensor node technology, Sensor taxonomy, Wireless node operating environment, Wireless node trends

SelfLearningTopics(SLTs):Introduction to Wireless Sensor Networks Applications

UNIT-II	**9 Hrs**

MAC Protocols for Wireless Sensor Networks: Background, Fundamentals of MAC protocols, MAC protocols for WSNs, Sensor-MAC case study, IEEE 802.15.4 LR-WPANs standard case study

Routing Protocols for Wireless Sensor Networks: Background, Data dissemination and gathering, Routing challenges and design issues, Routing strategies in wireless sensor networks

SelfLearningTopics(SLTs):Introduction to MAC Protocols for Wireless Sensor Networks,Introduction to Routing Protocols for Wireless Sensor Networks

UNIT-III	**9 Hrs**

Transport Control Protocols for Wireless Sensor Networks: Traditional transport control protocols, Transport protocol design issues, Examples of existing transport control protocols, Performance of transport control protocols

Middleware for Wireless Sensor Networks: Introduction, WSN middleware principles, Middleware architecture, Existing middleware

UNIT-IV	**9 Hrs**

Network Management for Wireless Sensor Networks: Introduction, Network management requirements, Traditional network management models, Network management design issues, Network management architecture -MANNA, Naming and Localization

Operating Systems for Wireless Sensor Networks: Introduction, Operating system design

issues, Examples of operating systems

Performance and Traffic Management: Introduction, Background, WSN design issues, Performance modeling of WSNs, Case study- Simple computation of the system life span

SelfLearningTopics(SLTs):SenOS, EYES Operating System

Textbook(s):

1. Kazem Sohraby, Daniel Minoli and TaiebZnati, *Wireless Sensor Networks-Technology, Protocols and applications*, New Jersy: John Wiley & Sons. 2007.

Reference Book(s):

1. C.S. Raghavendra, K. M. Sivalingam, T. Znati, *Wireless Sensor Networks*, New York: Springer US, 2006.
2. Holger Karl and Andreas Willig, *Protocols and Architectures for Wireless Sensor Networks*, Chichester: John Wiley & Sons. 2007.
3. Ankur Dumka, Sandip K. Chaurasiya, Arindam Biswas, Hardwari Lal Mandoria, *A Complete Guide to Wireless Sensor Networks from Inception to Current Trends*, Florida: CRC Press, 2019.
4. Feng Zhao, Leonidas Guibas, *Wireless Sensor Networks-An Information processing approach*, Burlington: Morgan Kaufmann, 2004.

Web and Video link(s):

1. https://youtu.be/uZjNNjyq25I?si=eihP3acDxtADW5mH*NPTEL Video Lecture on* Wireless sensor networking.
2. https://youtu.be/CUyF0YGIA5Y?si=oRoAgNtHZjM_ojUb*NPTEL Video Lecture on* Motivation and Introduction of WSN.

Course Articulation Matrix (CAM):		**U24IT802C :WIRELESS SENSOR NETWORKS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT802C.1**	2	2	2	1	-	1	-	1	1	-	1	1	1
CO2	**U24IT802C.2**	2	2	2	-	-	1	-	1	1	-	1	1	2
CO3	**U24IT802C.3**	2	2	2	-	1	1	-	1	1	-	1	1	2
CO4	**U24IT802C.4**	2	2	2	1	1	1	-	1	1	-	1	1	1
U24IT802C		**2**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	develop wireless sensor networks to support a wide range of applications	SDG 9	Industry, Innovation and Infrastructure	Wireless sensor networks support smart infrastructure, innovative communication, and sustainable technological development in various real-time applications.
CO2	design medium access control protocols and	SDG 9	Industry, Innovation	MAC and routing protocols that improve efficient wireless

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	routing protocols for wireless sensor networks		and Infrastructure	communication, reliable data transmission, and smart networking infrastructure for wireless sensor networks.
CO3	analyze the performance of transport control protocols, and understanding the principles & architecture of middleware for wireless sensor networks	SDG 11	Sustainable Cities and Communities	The study of middleware architecture, transport protocols, and performance management in wireless sensor networks supports smart monitoring systems and efficient urban infrastructure for sustainable communities.
CO4	developnew network management models by identifying the design issues of network management and operating systems for wireless sensor networks	SDG 11	Sustainable Cities and Communities	Developing efficient network management models and operating systems for wireless sensor networks supports smart city infrastructure, resource monitoring, and sustainable urban services.

AUGMENTED REALITY & VIRTUAL REALITY

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT802D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply the fundamentals of Augmented Reality (AR), Virtual Reality (VR), displays, tracking systems, and interaction techniques in immersive environments.

CO2 : analyze the efficiency of computer vision methods, geometric modelling techniques, and software architectures used in AR & VR systems.

CO3 : analyze the performance of VR hardware devices, rendering techniques, physical simulation methods, and immersive interaction models in virtual environments.

CO4 : apply AR & VR development tools and case studies to design to evaluate real-world immersive applications.

UNIT-I	**9 Hrs**

Augmented Reality: Defining augmented reality, history of augmented reality, examples, related fields

Virtual Reality and VirtualEnvironment: Introduction to VR, benefits of VR, AR vs VR, historical development of VR, applications of AR&VR

Displays: Multimodal displays, visual perception, requirements and characteristics, spatial display model, visual displays

Tracking: Tracking, calibration and registration, coordinate systems, characteristics of tracking technology, stationary tracking systems, mobile sensors

Interaction: Output modalities, input modalities, tangible interfaces, augmented paper, haptic interaction

SelfLearning Topics (SLTs):*Applications of AR and VR in Education and Healthcare, Types of Tracking Systems in AR/VR*

UNIT-II	**9 Hrs**

Computer Vision for Augmented Reality: Marker tracking, natural feature tracking, outdoor tracking

Computer Graphics and Geometric Modelling: The virtual world space, positioning the virtual observer, perspective projection, color theory, conversion from 2D to 3D, simple 3D modelling

Geometrical Transformations: Frames of reference, modelling transformations, scaling, collision detection

Software Architectures – AR application requirements, distributed object systems, dataflow, scene graphs

SelfLearning Topics (SLTs):*Marker-based and Markerless Tracking Techniques, Basics of 3D Modelling and Perspective Projection*

UNIT-III	**9 Hrs**

Introduction to Virtual Reality: Defining virtual reality, history of VR, human physiology and perception

The Geometry of Virtual Worlds: Geometric models, viewing transformations

Light and Optics: Basic behavior of light, lenses, the human eye, cameras, displays

Visual Perception: Perception of depth, motion, and color

Virtual Environment and Devices: Tracker, Sensor, Digital Gloves, 3D Scanner, visual, auditory and haptic devices

Generic VR System: Virtual environment, VR technology, model of interaction, VR systems

Animating the Virtual Environment: Linear interpolation, animation of objects, translation methods

SelfLearning Topics (SLTs):*Marker-based and Markerless Tracking Techniques, Basics of 3D Modelling and Perspective Projection*

UNIT-IV	**9 Hrs**

Visual Rendering: Ray tracing and shading models, rasterization, correcting optical distortions

Motion in Real and Virtual Worlds: Velocities and accelerations, vestibular system, physics in virtual worlds

Physical Simulation: Objects falling in gravitational field, elastic collisions, projectiles, simple pendulum

Interaction in VR: Motor programs, locomotion, social interaction

Audio in VR: Physics of sound, auditory perception, auditory rendering

Case Studies:AR in healthcare and medical training, VR in education and simulation learning, AR &VR in gaming and entertainment

SelfLearning Topics (SLTs):*Audio Rendering in Virtual Reality, Applications of AR/VR in Gaming and Entertainment*

Textbook(s):

1. Schmalstieg, D., Hollerer, T., *Augmented Reality: Principles & Practice*, Pearson, 2016. (Chapters 1, 2, 3, 4, 5, 6, 7 and 8)
2. LaValle, S. M., *Virtual Reality*, Cambridge University Press, 1st Edition, 2016.(Chapters 1, 2, 3, 4, 5, 7, 9, 10, 11 and 13)

Reference Book(s):

1. Coiffet, P., Burdea, G. C., *Virtual Reality Technology*, Wiley-IEEE Press, 2003.
2. Craig, A. B., *Understanding Augmented Reality: Concepts and Applications*, Morgan Kaufmann, 2013.
3. Craig, A. B., Sherman, W. R., Will, J. D., *Developing Virtual Reality Applications: Foundations of Effective Design*, Morgan Kaufmann, 1st Edition, 2009.
4. Sherman, W. R., Craig, A. B., *Understanding Virtual Reality: Interface, Application and Design*, Morgan Kaufmann Publishers, 1st Edition, 2002.
5. O'Connell, K., *Designing for Mixed Reality*, O'Reilly Media, 1st Edition, 2016.
6. Fowler, A., *Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#,*Apress, 2019.

Web and Video link(s):

1. https://nptel.ac.in/courses/121106013, *NPTEL Video Lecture on: Virtual Reality Engineering by Prof. Manivannan, IIT Madras.*

Course Articulation Matrix (CAM):		U24IT802D– AUGMENTED REALITY & VIRTUAL REALITY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT802D.1	3	2	2	2	2	-	-	-	-	-	1	2	2
CO2	U24IT802D.2	2	3	2	3	2	-	-	-	-	-	1	2	2
CO3	U24IT802D.3	3	2	3	3	3	2	-	-	-	-	1	3	2
CO4	U24IT802D.4	2	2	3	2	3	2	2	-	-	-	1	3	3
U24IT802D		2.5	**2.25**	**2.5**	**2.5**	**2.5**	**2**	**2**	**-**	**-**	**-**	**-**	**2.5**	**2.25**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply the fundamentals of AR, VR, displays, tracking systems, and interaction techniques in immersive environments.	SDG9	Industry, Innovation and Infrastructure	AR/VR technologies support innovation in immersive systems, industrial training, and advanced digital infrastructure.
CO2	Analyze computer vision methods, geometric modelling techniques, and software architectures used in AR/VR systems.	SDG4	Quality Education	AR/VR concepts strengthen technical skills, simulation-based learning, and practical knowledge development.
CO3	Analyze VR hardware devices, rendering techniques, physical simulation methods, and immersive interaction models in virtual environments.	SDG9	Industry, Innovation and Infrastructure	VR hardware and rendering support innovation in simulation systems, digital engineering, industrial design, and immersive infrastructure.
CO4	Apply AR/VR development tools and case studies to design to evaluate real-world immersive applications.	SDG11	Sustainable Cities and Communities	AR & VR tools and real-world applications contribute to smart city visualization, sustainable training, healthcare systems, and digital community development.

IoT ARCHITECTURES AND PROTOCOLS

Class: B. Tech. VIII – Semester		**Branch:** IT	
Course Code:	**U24IT802E**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze the IoT landscape including definitions, frameworks, application domains, and the role of IPv6 in enabling large-scale IoT deployments across real-world sectors

CO2 : identify fundamental IoT mechanisms and enabling technologies such as RFID and sensor systems, and utilize IoT standards including CoAP, RPL, 6LoWPAN, ZigBee IP, and 3GPP MTC to support interoperable and efficient IoT communication and networking

CO3 : select and utilize Layer 1/2 wireless technologies including ZigBee/IEEE 802.15.4, Bluetooth Low Energy, IEEE 802.15.6, NFC, DSRC, and cellular/LTE for reliable, energy-efficient, and application-oriented communication in diverse IoT deployment scenarios

CO4 : apply IPv6, Mobile IPv6, and 6LoWPAN protocols to design end-to-end addressing, mobility management, and communication architectures for constrained mobile IoT systems

UNIT-I	**9 Hrs**

Need of Internet of Things: MiH communication paradigms, areas of development and standardization, role of IPv6 in IoT deployment

IoT Definitions and Frameworks: ITU-T views and working definitions of IoT, IoT frameworks and reference models, basic nodal capabilities

IoT Application Domains: Smart metering and Advanced Metering Infrastructure (AMI), e-Health and body area networks, city automation, automotive applications, home automation, smart cards, object tracking, over-the-air surveillance

SelflearningTopics(SLTs):: *Overview and motivations, evolution from M2M to IoT, H2M, M2M*

UNIT-II	**9 Hrs**

Key IoT Technologies: Device intelligence; communication capabilities, mobility support,device power management, sensor technology – temperature, chemical, and motion sensors; RFID technology – passive, active, and semi-passive tags, EPC, RFID readers, satellite technology

Evolving IoT Standards: Overview of standards landscape, IETF RPL – IPv6 routing protocol for low-power and lossy networks (ROLL), CoAP – messaging model, request/response model, intermediaries and caching, REST for IoT, ETSI M2M, 3GPP MTC – service requirements and architectural reference model, CENELEC, IETF 6LoWPAN, ZigBee IP (ZIP), IP in Smart Objects (IPSO)

SelfLearningTopics(SLTs):*Identification of IoT objects and services; structural aspects – environment characteristics, traffic characteristics, interoperability, security and privacy, open architecture*

UNIT-III	9 Hrs

ZigBee/IEEE 802.15.4: IEEE 802.15.4 PHY and MAC layer, ZigBee protocol stack, ZigBee Smart Energy profile, cluster library, smart metering applications, RF4CE for consumer electronics

Bluetooth Low Energy (BLE): BLE architecture, GAP and GATT profiles, advertising and connection procedures, IEEE 802.15.6 wireless body area networks (WBANs), IEEE 802.15 TG4j medical body area networks (MBANs), ETSI TR 101 557

NFC, DSRC, and Cellular Technologies: Near Field Communication (NFC) – operating modes and IoT applications, Dedicated Short-Range Communications (DSRC) and WAVE protocols for vehicular IoT, cellular and mobile network technologies for IoT/M2M – UMTS, LTE overview and MTC support

SelfLearningTopics(SLTs):*Wireless Personal Area Network (WPAN) technologies for IoT/M2M – overview and comparison*

UNIT-IV	9 Hrs

IPv6 Technologies for IoT: IPv6 protocol overview – header structure, extension headers; IPv6 tunneling; IPsec in IPv6; header compression schemes; QoS in IPv6; migration strategies from IPv4 to IPv6

Mobile IPv6 (MIPv6) for IoT: Overview and motivations for mobility in IoT; MIPv6 protocol details – generic mechanisms, new IPv6 protocol and message types, destination options; modifications to IPv6 Neighbor Discovery; correspondent node, home agent (HA), and mobile node (MN) operations; relationship to Mobile IPv4

IPv6 over Low-Power WPAN (6LoWPAN): Background and introduction to 6LoWPAN; 6LoWPAN goals – addressing, header compression, fragmentation, and mesh networking; transmission of IPv6 packets over IEEE 802.15.4; 6LoWPAN in the context of IoT protocol stack

SelfLearningTopics(SLTs):*IPv4 addressing limitations; IPv6 address space and address types*

Textbook(s):

1. Daniel Minoli, *Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications*, Wiley Publications, 1st edition, 2013.

Reference Book(S):

1. Dimitrios Serpanos and Marilyn Wolf, *Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies*, Springer, 1st edition, 2018.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, and David Boyle, *From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, Academic Press, 1st edition, 2015.
3. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach,* Universities Press, 1st Edition, 2015.
4. Raj Kamal, *Internet of Things: Architecture and Design Principles,* McGraw Hill Education, 2nd Edition, 2017.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in -NPTEL Video Lectures on Internet of Things by Prof. Sudip Misra, Professor, IIT Kharagpur

Course Articulation Matrix (CAM):		U24IT802E: IoT ARCHITECTURES AND PROTOCOLS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IT802E.1	2	2	2	2	2	-	-	-	-	-	1	2	2
CO2	U24IT802E.2	2	2	2	2	2	1	-	-	-	-	1	2	2
CO3	U24IT802E.3	2	2	2	2	2	-	-	-	-	-	1	3	2
CO4	U24IT802E.4	2	2	3	3	2	1	-	-	-	-	1	3	2
U24IT802E		2.0	2.0	2.25	2.25	2.0	1.0	-	-	-	-	1	2.50	2.0
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze IoT definitions, frameworks, and application domains and evaluate the role of IPv6 in enabling large-scale IoT deployments across real-world sectors	SDG9	Industry, Innovation and Infrastructure	Understanding the IoT landscape, definitions, frameworks, and application domains lays the foundation for designing scalable, innovative connected infrastructure across industrial, healthcare, and smart city sectors
CO2	identify fundamental IoT mechanisms and enabling technologies such as RFID and sensor systems, and utilize IoT standards including CoAP, RPL, 6LoWPAN, ZigBee IP, and 3GPP MTC to support interoperable and efficient IoT communication and networking	SDG9	Industry, Innovation and Infrastructure	Mastery of IoT mechanisms, RFID, sensor technologies, and standards like CoAP and RPL enables students to build efficient, standards-compliant smart industrial and infrastructure systems
CO3	select and utilize Layer 1/2 wireless technologies including ZigBee/IEEE 802.15.4, Bluetooth Low Energy, IEEE 802.15.6, NFC, DSRC, and cellular/LTE for reliable, energy-efficient, and application-oriented communication in diverse IoT deployment scenarios	SDG11	Sustainable Cities and Communities	Selecting appropriate short-range and cellular wireless technologies for IoT enables the deployment of reliable smart city systems such as smart metering, body area networks, and connected transportation
CO4	apply IPv6, Mobile IPv6, and 6LoWPAN protocols to design end-to-end addressing, mobility, and communication architectures for constrained mobile IoT systems	SDG11	Sustainable Cities and Communities	IPv6 and 6LoWPAN enable scalable addressing and connectivity for dense urban IoT deployments, supporting sustainable city applications including smart grids, traffic management, and environmental monitoring

MAJOR PROJECT PHASE – 2

Class: B. Tech. VIII – Semester		**Branch: IT**	
Course Code:	**U24IT803**	**Credits:**	**6**
Hours/Week (L-T-P- E):	**0-0-12-12**	**CIE:**	**60%**
Total Number of Teaching Hours:	**-**	**ESE:**	**40%**

Course Learning Outcomes (COs):

Upon completion of the major project work, students will be able to…

CO1: review research literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)

CO2: design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)

CO3: apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (Ethics and teamwork)

CO4: collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (Communication skills and life-long learning)

1. **Major project work shall be continued in 8thsemester as major project *phase-II*:** All the major project teams shall take the *phase -I* work forward and complete the remaining work as *Phase-II* in the 8thsemester.
2. Final Year Major Project work represents the culmination of study towards the B. Tech degree. **Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems**. The **student learning assessment process** (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project
3. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
4. **Team work:** Major project work is a team work
   (i) The students of a project team shall work together to achieve a common objective.
   (ii) Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of team having knowledge diversity, gender diversity, social and cultural diversity among its members.
5. Every student is expected to put approximately **144 hours of work** into the major project phase-II course over the 12 weeks of 8th semester.
6. **Major project *Phase-II*: 8thsemester**
   (i) The convener DPEC shall release complete schedule of *phase-II* CIE during last week of 7thsemester (*well in advance before start of 8th semester*), immediately after completion of Progress Presentation-I, so that student teams would complete the

scheduled works during inter-semester break and get ready with informative, confident and comfortable presentation for progress presentation-II.

(ii) The project supervisors: The project supervisors are expected to guide the students to systematically continue the phase-I work, useful work during inter-semester break, meeting the deadlines as proposed in project timeline.

(iii) The project supervisors shall ensure students focus on the project objectives and expected deliverables

(iv) The project supervisors shall ensure students have sufficient resources for successful project completion.

(v) The project supervisors shall ensure students have sufficient resources for successful project completion.

(vi) The project supervisors shall continue guiding students on

i. *Engineering Knowledge* - Applies engineering fundamentals, computing knowledge, and domain-specific concepts to solve the selected project problem.

ii. *Problem Analysis* - Identifies, formulates, and analyzes a real-world engineering problem through literature review and requirement analysis.

iii. *Design/Development of Solutions* - Designs and develops an innovative solution, system, or application that satisfies functional requirements while considering societal and environmental aspects.

iv. *Conduct Investigations of Complex Problems* - Conducts experiments, collects and analyzes data, validates results, and draws meaningful conclusions using research methodologies.

v. *Engineering Tool Usage* - Uses modern engineering and IT tools, software frameworks, simulation tools, IDEs, databases, AI tools, and testing platforms for implementation.

vi. *The Engineer and the World* - Evaluates the project's impact on society, sustainability, economy, health, safety, legal, cultural, and environmental aspects wherever applicable.

vii. *Ethics* - Follows professional ethics by ensuring originality, respecting intellectual property, maintaining data privacy, and adhering to ethical standards.

viii. *Individual and Collaborative Team Work* - Works effectively as an individual and as a member of a multidisciplinary project team, demonstrating leadership and collaboration.

ix. *Communication* - Prepares project reports, technical documentation, presentations, demonstrations, and communicates project outcomes effectively.

x. *Project Management and Finance* - Plans project activities, schedules tasks, manages resources, estimates costs (where applicable), and completes milestones within timelines.

xi. *Life-Long Learning* - Learns emerging technologies, research methodologies, and new tools independently to successfully complete the project.

(vii) The project supervisors are also expected to continuously emphasize and guide the students on

(a) **Following project timeline**: completing the tasks as planned in projecttimeline

(b) **Meeting Cadence:**

i. **Regular meetings with supervisor:** Short and frequent meetings increase a team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.

ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week.** Due weightage will be given to meeting cadence

and considered for evaluation during presentations,i.e., number of planned meetings and number attended by students

(c) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).

ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-II*, the supervisor shallspecifically comment, in the project log book, on whether the project team met each of the project work outcomes and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(d) **Writing down whatever is done and making notes of whatever is read**. Writing down the procedures / models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, ***difficulties faced and how they were fixed*** are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well- documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on. This information will be needed for the bibliography in your project report. On the other hand, documenting a report ***on the spur of the moment*** would end upcopying things from other sources resulting in a plagiarized document.

(e) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, whichcan bespecially acquiredby participating in major project work

(f) **Good and sufficient literature review**: Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

(g) Completing the proposed work by the end of *phase-II*

(h) Right conduct of research to promote academic integrity, honesty and time management

(i) Preparing a well-documented overall project report in proper format, covering the complete work carried out during both the phases (*phase-I and phase-II*).

(j) Consequences of plagiarism, and use of anti-plagiarism software to detect plagiarism in the report

(k) Submission of major project work report within acceptable plagiarism levels (including AI Plagiarism), as per the ***Anti-plagiarism policy-2020 of our***

institute (Allowed Similarity % : Maximum 24%, From single Source : Max. 4% & No. of consecutive words: max. 6)

(l) **Video pitch on complete project work**: Capturing short videos, photos, screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the complete work done during both phases (*phase-I and phase-II*).

(m) **Project Paper**: Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.

(n) **Project poster**: At the end of phase-II, the project teams shall have to present their project in the form of posters, at the time of demonstration of complete porotype / working model / software package / system developed.

(viii) **Phase – II evaluation**: There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components

(a) **Progress Presentation -II** *(during third / fourth week of 8thsemester):* The progress presentation-II shall include the identified problem, objective(s), literature review, expected outcome(s), results of work done as per project plan timeline.

i. **Following project timeline**: The project timeline shall be meticulouslyfollowed and the tasks shall be completed as planned in project timeline.
ii. 80-85% of work is expected to be completed
iii. Project teams shall compulsorily show the following as part of their progress presentation-II
    1. *The slides on project timeline and*
    2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*
iv. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (with due signatures of project supervisor) during presentations

(b) **Final Presentation** *(during penultimate week of 8thsemester):* **Project supervisor shall ensure that the project team has accomplished 100% of work proposed**. The project team shall

i. **Follow project timeline**: The project timeline shall be meticulouslyfollowed and the tasks shall be completed as planned in project timeline.
ii. compulsorily show the following as part of their final presentation
    1. *The slides on project timeline and*
    2. *A table showing targeted tasks as per timeline and whether all the identified tasks accomplished?*
iii. **show project log book**: Every student of the Project team shall compulsorily show the complete activity journaling in the log book (*with due signatures of project supervisor*)
iv. present complete results & analysis
v. **demonstrate the completed project**: working model / process / software package / system developed
vi. demonstrate the completed project with the **project poster presentation**

(ix) **Evaluation for Major project phase-II:**There shall be continuous internal evaluation (CIE) and end semester examination (ESE).

The evaluation for *phase-II* shall be as given below:

S.No	Assessment Component	Weightage (%)	CO Mapping	PO Mapping
A.	**CIE**	**60%**		
1	Supervisor Assessment (Individual Contribution & Teamwork)	10	CO1, CO2	PO9, PO10
2	Implementation & Working Model	10	CO2, CO3	PO3, PO5
3	Project Video Pitch	5	CO3, CO4	PO9, PO10
4	Project Poster	5	CO3, CO4	PO9, PO10
5	Research Alignment	10	CO2, CO3	PO2, PO3
6	Oral Presentation /Viva Voce	20	CO3, CO4	PO9, PO10
B.	**ESE**	**40%**		
1	Major Project Thesis Report	10	CO1, CO4	PO1, PO8
2	Final Oral Presentation/ Viva Voce	30	CO3, CO4	PO9, PO10
Total		**100**		

(a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system on the chosen work. The completed working model/ process/software package/system shall be demonstrated during the final presentation at the end of *phase-II*.

(b) **Video pitch**: Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I & phase-II*. The project team shall present the produced video pitch during Final presentation. The produced video pitch should

(i) be 3 to 5-minute-long video (no longer than 5 minutes)

(ii) be concise and to the point, on the problem, proposed solution and its salient features.

(iii) show project timeline and sample page of log book

(iv) highlight the various stages during project implementation with the help of short videos / photos / screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project.

(v) discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts.*

(vi) emphasize key points about *business idea, potential market for the proposed solution*

(c) **Project poster**: At the end, the project teams shall present their project in the form of posters (A2 size). The teams shall have to present their work during the poster presentation session scheduled at the end of the 8thsemester, at the time of demonstration of complete porotype / working model / software package / system developed.

(d) **Well-documented plagiarism-cleared project report**: Every project team shall be required to submit a well-documented project report on the work carried out, as per the format specified by the DPEC. The report should clear

plagiarism check as per the anti-plagiarism policy-2020 of the institute. The following shall compulsorily be included in the Results-Chapter of the project report

(i) Photos / screen shots taken at various stages during the development of working model/ process/software package/system as part of Results-Chapter

(ii) Snapshot of final working model/ process/software package/system developed

(iii) Pictures of the team working in the lab, the team discussing with the project supervisor, working on creative project, or an event they are attending for work.

(iv) All *these photos / screen shots shall be properly referred in the project report by assigning figure numbers*

(e) **Tangible outcomes of project work in Conclusions - Chapter:** These are the lessons learnt from doing a project work. The students have to describe in their own wordswhat they learnt from the project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of major project work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be shown in the conclusions chapter.

(f) **Student feedback on major project in Conclusions - Chapter:** To gatherinformation on whether project work was useful and gave practical experience on chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*) with closed and open questions shall be kept in the conclusions chapter of the project report.

(x) It is mandatory for

(a) every student of the team to appear for ESE oral presentation and viva-voce, to qualify for course evaluation

(b) every project team to write a technical paper based on the solution(s) proposed, results obtained and prototype/working model/process/software package/system developed, for submission to a reputed non-predatoryconference/non-paid peer-reviewed journal

(c) every project team shall be required to create a pitch video, which is a video presentation on their major project work phase-I & phase-II

(d) every project team shall present their project in the form of a poster, during the demonstration of complete prototype/working model/software package/system developed

(xi) The student has to register for the Major project work phase-IIas supplementary examination in the following cases:

(a) he/she is absent for oral presentation and viva-voce as part of ESE presentation

(b) he/she fails to fulfill the requirements of Major project work phase-IIevaluation as per specified guidelines

(xii) Supplementary examination for Major project work phase-II

(a) The CoE shall send the list of students registered for supplementary examination to the HoDs concerned

(b) The DPEC, duly constituted by the HoD, shall conduct Major Project Phase-IIsupplementary exam and send the award list to the CoE within the stipulated time

Major Project Phase-2 Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
A. CIE Evaluation – 60 %			
1	Supervisor Assessment	Individual Contribution & Regularity (5M)	10
		Teamwork & Collaboration (5M)	
2	Implementation & Working Model	Implementation & Functionality (5M)	10
		Innovation (5M)	
3	Project Video Pitch	Visual Quality, Content Clarity & Delivery (5M)	5
4	Project Video Poster	Content, Design & Clarity (5M)	5
5	Research Alignment	Publication Quality & Indexing (5M)	10
		Research Contribution & Novelty (5M)	
6	Oral Presentation & Viva Voce	PPT & Delivery (5M)	20
		Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
B. ESE Evaluation – 40 %			
1	Major Project Thesis Report	Structure, Clarity & Writing (5M)	10
		Technical Content & Analysis (5M)	
2	Final Oral Presentation/ Viva Voce	PPT & Delivery (5M)	30
		Conceptual Understanding (5M)	
		Implementation Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
		Confidence and Body language (5M)	

Course Articulation Matrix (CAM):		**U24IT803: MAJOR PROJECT PHASE – 2**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24IT803.1**	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	**U24IT803.2**	3	2	3	2	2	1	2	1	1	2	2	2	1
CO3	**U24IT803.3**	1	1	1	1	1	2	1	1	2	2	1	2	1
CO4	**U24IT803.4**	1	1	1	2	2	1	2	1	2	1	2	2	2
U24IT803		**2**	**1.75**	**1.75**	**2**	**1.75**	**1.25**	**1.5**	**1**	**1.5**	**1.5**	**1.75**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for	**SDG 13**	Industry, Innovation and Infrastructure	Research-based innovation and development of advanced ECE solutions contribute to technological progress, industrial growth, and infrastructure development.

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	real- world complex engineering problems (Technical skills)			
CO2	design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)	**SDG 12**	Responsible Consumption and Production	Sustainable design practices, efficient resource utilization, and environmentally responsible engineering solutions promote responsible production and innovation.
CO3	Apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader of a multidisciplinary team.	**SDG 11**	Sustainable Cities and Communities	Collaborative development of engineering solutions addressing societal needs contributes to sustainable and resilient communities.
CO4	Collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (Communication skills and life-long learning)	**SDG 4**	Quality Education	Technical communication, knowledge dissemination, and self-directed learning support continuous education and professional growth.

PROGRAM ELECTIVE COURSES (PEC)

There are four slots allotted to Program Elective Courses (PECs).

Each major specialization of the B. Tech Programme is treated as a vertical.

PROGRAM ELECTIVE COURSES - VERTICALS

VERTICAL/ PE	PE1	PE2	PE3	PE4
VERTICAL 1: Cyber Security	U24IT602A: Cyber Security	U24IT702A: Ethical Hacking	U24IT801A: Blockchain Technologies	U24IT802A: Computer Forensics
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL 2: Artificial Intelligence& Machine Learning	U24IT602B: Generative Artificial Intelligence	U24IT702B: Computer Vision & Image Processing	U24IT801B: Natural Language Processing	U24IT802B: Deep Learning
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL 3: Computer Networks	U24IT602C: Advanced Computer Networks	U24IT702C: Mobile Computing	U24IT801C: Wireless Adhoc Networks	U24IT802C: Wireless Sensor Networks
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL4: High Performance Computing	U24IT602D: Parallel Programming	U24IT702D: High Performance Computing Architecture	U24IT801D: Fog & Edge Computing	U24IT802D: Augmented Reality &Virtual Reality
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			
VERTICAL5: Internet of Things	U24IT602E: Applications of IoT	U24IT702E: Industrial IoT	U24IT801E: Privacy and Security in IoT	U24IT802E: IoT Architectures and Protocols
	(OR)			
	Equivalent MOOC approved by BoS Chair and Dean AA			