B.TECH. CURRICULUM

ACADEMIC YEAR: 2024–25

DEPARTMENT OF MECHANICAL ENGINEERING

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
Competency-Focused Outcome Based Curriculum (CF-OBC)

DEPARTMENT OF MECHANICAL ENGINEERING

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 506 015 TELANGANA

(UGC Autonomous Institute Under Kakatiya University, Warangal)

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DEPARTMENT OF MECHANICAL ENGINEERING

History:

PROGRAM	DESCRIPTION	
	INTAKE	NBA ACCREDITATION
UG in B.Tech. Mechanical Engineering	• Started with 40 seats in 1980 • Intake increased to 120 in 2002 • Intake increased to 180 in 2016 • Present Intake 60	• First time accreditation: 2001 • Reaccreditation-1: 2006 • Reaccreditation-2: 2011 • Reaccreditation-3: 2016 • Reaccreditation-4: 2019 (Tier-I) • Reaccreditation-5: 2022 (Tier-I)

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 MECHANICAL ENGINEERING: VISION AND MISSION

VISION

To be a centre of excellence in Mechanical Engineering, to provide the best teaching-learning and research environment, to produce high quality professionals and entrepreneurs to cater the needs of society.

MISSION

M1:	To impart quality education that builds strong ethical attitude, technical knowledge and professional skills by providing congenial teaching-learning environment.
M2:	To nurture the reasoning, problem solving and research capabilities of learners by providing the state-of–the-art facilities, to meet the changing needs of society.
M3:	To inculcate life-long learning and leadership traits for successful professional careers, by counseling and mentoring.

PROGRAM EDUCATIONAL OBJECTIVES

PEO		Within first few years after graduation, the MECHANICAL ENGINEERING graduates will be able to …
PEO1	*Technical Expertise (Capability)*	apply a broad understanding of mechanical engineering, as well as concepts from mathematics, science, communication and computing, to solve specific problems in industry and associated engineering fields.
PEO2	*Successful Career (Distinctiveness)*	demonstrate distinctiveness, professional ethics, integrity and innovation in their chosen profession and work well as individuals and in teams to achieve sustainable development in diverse fields.
PEO3	*Lifelong learning (Leadership)*	adapt to a constantly changing field by pursuing higher education, professional development, and self-study in order to contribute to society's well-being.

PEO TO MISSION MAPPING

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

PEO Statements	Mission Statements	Mapping Level	Justification
PEO1	**M1**	**3**	The quality education and technical expertise provided to the students will help them to apply concepts of Mechanical Engineering, Mathematics and sciences to solve specific and multi disciplinary problems in industry.
	M2	**2**	The state of the art facilities, modern computing tools and techniques will improve reasoning and research capabilities of learners.
	M3	**2**	The learner will upgrade in emerging technologies of Mechanical Engineering, sciences, communication and soft computing facilities through lifelong learning and mentoring in chosen fields.

PEO Statements	Mission Statements	Mapping Level	Justification
PEO2	**M1**	**2**	The quality education and strong ethical attitude of learners will build professional ethics and integrity in their chosen careers.
	M2	**3**	The problem solving and research capabilities of learners will lead to innovations in their chosen professions and make them self–reliant and team player for sustainable development in diverse fields.
	M3	**2**	The leadership capabilities will build learners to be self-dependent and work in a group to manage the given tasks/projects in a sustainable manner.

PEO Statements	Mission Statements	Mapping Level	Justification
PEO3	M1	2	A comprehensive technical knowledge and professional skills will prepare learners to pursue higher education, research and professional growth in the fields of Mechanical Engineering.
	M2	2	The learners will meet the changing needs of the society by adopting emerging/latest research facilities and resources in Mechanical Engineering.
	M3	3	The learners will build a successful professional career through professional development, self-study and adaptation of changing technologies in various fields of Mechanical Engineering.

PROGRAM SPECIFIC OBJECTIVES

PSO	*The Mechanical Engineering graduates will be able to*
PSO1	To apply learned principles and knowledge in various applications of materials, design, thermal, production and industrial engineering.
PSO2	To model, analyze, design, develop and implement advanced mechanical systems or processes.

PO/PSO TO PEO MAPPING

Program Outcomes (Pos) / Program Specific Outcomes (PSOs)		PEO1	PEO2	PEO3
PO1	Engineering knowledge	3	2	1
PO2	Problem analysis	3	3	1
PO3	Design/development of solutions	3	2	2
PO4	Conduct investigations of complex problems	2	3	2
PO5	Engineering Tool Usage	3	3	1
PO6	The Engineer and the World	1	3	1
PO7	Ethics	1	3	1
PO8	Individual and Collaborative Team work	1	1	3
PO9	Communication	2	2	1
PO10	Project management and finance	1	1	3
PO11	Life-long learning	1	1	2
PSO1	To apply learned principles and knowledge in various applications of materials, design, thermal, production and industrial engineering.	3	2	2
PSO2	To model, analyze, design, develop and implement advanced mechanical systems or processes.	2	3	2

CURRICULUM DESIGN

Salient Features

- The URR24 regulations are in line with the National Education Policy 2020 (NEP2020) and the AICTE model curriculum to provide multidisciplinary holistic education to produce well-rounded engineering graduates.
- Multiple Entry Multiple Exit (MEME) option.
- Multidisciplinary four year UG programme with award of following degrees
    - B. Tech
    - B. Tech with "Minor"
    - B. Tech "Honours"
    - B. Tech "Honours with Research"
- 170+ Credit Liberal Engineering Education.
- A strong program core of 16 courses and 4 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 Experiential 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	**EXL**	Experiential Learning
MOPEC	Multidisciplinary Open Elective Course	**SEC**	Skill Enhancement Course

Multidisciplinary 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 learning 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 experiential 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 Mechanics of Materials may be

1. *To study the behaviour of materials under compressive loads.*
2. *To study the behaviour of materials under tensile loads.*
3. *Design a mechanical component or system, such as a gearbox or a simple robot*

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 offers sixteen 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 offers four 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 across the verticals.

(For example, the ME programme shall offer verticals in "Thermal Engineering", "Advanced Manufacturing", "Robotics & Automation", etc.)

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 21st century require, that liberal broad-based multidisciplinary education become the basis for all higher education. This will help develop well-rounded individuals that possess critical 21st century 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 21st century."

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 complaining 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 ME; UG Diploma in ME after the study of two academic years (four semesters); and B. Voc in ME degree after the completion of three academic years (six semesters). The successful completion of four years undergraduate programme would lead to B. Tech in ME degree with optional Minor/Honours/ Honours with Research.

4. **Credit Requirement:**

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 Pedagogy:

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 pedagogical approaches:

(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 practicum's 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-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 NEP 2020

10.1 MULTIPLE EXIT OPTIONS

Sl. No.	Exit Description	Exit Point	Degree/ Certificate offered	Goal
1.	First Exit	After completion of First year.	UG Certificate in ME	The student should be employable as Technical Assistant (ME) in any industry/organization.
2.	Second Exit	After completion of Second year.	UG Diploma in ME	The student should be employable as Technician (ME) in any industry/organization.
3.	Third Exit	After completion of Third year.	B. Voc in ME	The student should be employable as Technical Supervisor (ME) in any industry/organization.
4.	Normal Exit	After completion of Fourth year.	B.Tech in ME	The student should be employable as an Engineer (ME) 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 TSEAPCET
2.	Second Entry	III-Sem. of the program	The successful completion of first year with UG certificate in ME from our institute.
3.	Third Entry	V-Sem. of the program	The successful completion of UG Diploma in ME from our institute.
4.	Fourth Entry	VII-Sem. of the program	The successful completion of B. Voc in ME 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 174 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): 174+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): 174+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): 174+18 credits

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)**

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:

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

	I	II	III	IV	V	VI	VII	VIII	Total
B. Tech	23	23	23	24	23	22	21	15	174
B. Tech with Minor	23	23	23	24	23	22	21	15	174 (+18)*
B. Tech with Honours	23	23	23	24	23	22	21	15	174 (+18)*
B. Tech. Honours with Research	23	23	23	24	23	22	21	15	174 (+18)*

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

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

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

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) Basic Science Courses (BSC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	BSC 01	U24MH101	Differential Calculus and Ordinary Differential Equations	I	3
2.	BSC 02	U24CY102A	Engineering Chemistry	I	4
3.	BSC 03	U24MH201	Matrix Theory and Vector Calculus	II	3
4.	BSC 04	U24PY202A	Engineering Physics	II	4
5.	BSC 05	U24MH301B	Applied Mathematics	III	3
				Total Credits	**17**

(ii) Engineering Science Courses (ESC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	ESC 01	U24ME104	Programming for Problem Solving with C	I	4
2.	ESC 02	U24ME107	Engineering Graphics & CAD	I	3
3.	ESC 03	U24ME204	Data Structures through C	II	4
4.	ESC 04	U24EE205A	Basic Electrical & Electronics Engineering	II	4
5.	ESC 06	U24ME305	Python Programming	III	4
				Total Credits	**19**

(iii) Program Core Courses (PCC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	PCC 01	U24ME103	Thermodynamics	I	3
2.	PCC 02	U24ME203	Engineering Materials & Metallurgy	II	3
3.	PCC 03	U24ME302	Mechanics of Materials	III	4
4.	PCC 04	U24ME303	Manufacturing Technology	III	4
5.	PCC 05	U24ME304	Heat Power Engineering	III	3
6.	PCC 06	U24ME401	Heat Transfer	IV	3
7.	PCC 07	U24ME402	Machine Drawing	IV	4
8.	PCC 08	U24ME403	Fluid Mechanics and Hydraulic Machines	IV	4
9.	PCC 09	U24ME404	Design of Machine Elements	IV	3
10.	PCC 10	U24ME405	Machine Tools & Metrology	IV	4
11.	PCC 11	U24ME502	Refrigeration & Air Conditioning	V	4
12.	PCC 12	U24ME503	Mechanism and Machines	V	3
13.	PCC 13	U24ME504	Artificial Intelligence and Machine Learning	V	4
14.	PCC 14	U24ME507	Computer Aided Engineering LAB	V	1
15.	PCC 15	U24ME602	Metal Machining & Automation	VI	4
16.	PCC 16	U24ME603	Dynamics and Control	VI	3
17.	PCC 17	U24ME604	Computational Fluid Dynamics	VI	4
18.	PCC 18	U24ME607	AI & ML core application LAB	VI	1
19.	PCC19	U24ME703	Finite Element Methods	VII	4
20.	PCC20	U24ME704	Additive Manufacturing	VII	3
21.	PCC21	U24ME705	Production and Operations Management	VII	3
				Total Credits	**69**

(iv) Program Elective Courses (PEC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	PEC 01	U24ME601A	Power Plant Engineering	VI	3
		U24ME601B	Design of Transmission systems		
		U24ME601C	Modern Machining Process		
		U24ME601D	Mechatronics		
		U24ME601E	Industrial Engineering		
		U24ME601F	Sustainable Energy Technology		
		U24ME601G	Automotive Chassis and Suspension		
		U24ME601H	OOP through Java		
2.	PEC 02	U24ME702A	Design of Thermal Equipment	VII	3
		U24ME702B	Product Design		
		U24ME702C	Micro & Nano Manufacturing		
		U24ME702D	Robot Kinematics		
		U24ME702E	Industrial Management		
		U24ME702F	Energy Conversion and Waste Heat Recovery		
		U24ME702G	Automotive Electrical and Autotronics		
		U24ME70H	Advanced Data Structures		
3.	PEC 03	U24ME802A	Jet Propulsion and Rocket Engineering	VIII	3
		U24ME802B	Mechanics of Composite Materials		
		U24ME802C	Digital Manufacturing		
		U24ME802D	Mobile Robotics		
		U24ME802E	Supply chain management		
		U24ME802F	Electric and Hybrid Vehicles		
		U24ME802G	Vehicle Body Engineering and Safety		
		U24ME802H	Data Base Management Systems		
4.	PEC 04	U24ME803A	Cryogenics	VIII	3
		U24ME803B	Geometrical Dimensioning and Tolerancing		
		U24ME803C	Sustainability in Manufacturing		
		U24ME803D	Industrial Process Automation		
		U24ME803E	Total Quality Management		
		U24ME803F	Energy Audit and Mangement		
		U24ME803G	Vehicle Dynamics		
		U24ME803H	Cloud Computing		
				Total Credits	**12**

(v) Humanities & Social Sciences including Management (HSMC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	HSM 01	U24MH105	English Communication and Report Writing	I	2
2.	HSM 02	U24MB505	Management Course Basket	V	3
3.	HSM 03	U24MH508	Technical English	V	1
				Total Credits	**06**

(vi) Multidisciplinary Open Electives Courses (MOPEC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	MOPEC 01	U24OE501XX	MOPEC Elective –I#	V	3
2.	MOPEC 02	U24OE701XX	MOPEC Elective –II	VII	3
3.	MOPEC 03	U24OE801XX	MOPEC Elective –III	VIII	3
				Total Credits	**09**

(vii) Experiential Learning Courses (ELC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	ELC 01	U24EL108	Practicum-1	I	1
2.	ELC 02	U24EL209	Practicum-2	II	1
3.	ELC 03	U24EL308	Practicum-3	III	1
4.	ELC 04	U24EL408	Practicum-4	IV	1
5.	ELC 05	U24ME509	Seminar	V	1
6.	ELC 06	U24ME608	Mini Project	VI	1
7.	ELC 07	U24ME706	Internship Evaluation*	VII	1
8.	ELC 08	U24ME707	Major Project, Phase-1 / Industrial Internship - 1	VII	4
9.	ELC 09	U24ME804	Major Project, Phase – 2 / Industrial Internship - 2	VIII	6
				Total Credits	**17**

(viii) Value Added Courses (VAC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	VAC 01	U24VA106	Sports & Yoga	I	1
2.	VAC 02	U24VA109	SEA – I / SAA-I	I	1
3.	VAC 03	U24CY206	Environmental Studies	II	-
4.	VAC 04	U24VA210	SEA-2 / SAA -2	II	1
5.	VAC 05	U24VA306B	Soft & Interpersonal Skills Lab	III	1
6.	VAC 06	U24VA309	SEA-3 / SAA -3	III	1
7.	VAC 07	U24VA406A	QALR	IV	2
8.	VAC 08	U24VA409	SEA - 4 / SAA - 4	IV	1
				Total Credits	**08**

(ix) Skill Enhancement Courses (SEC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	SEC 01	U24SE208	Programming Skill Development (PSD) Lab - 1	II	1
2.	SEC 02	U24SE307	PSD LAB-02	III	1
3.	SEC 03	U24SE407	PSD LAB-03	IV	1
				Total Credits	**03**

(x) Ability Enhancement Courses (AEC)

Sr. 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
5.	AEC 05	U24AE410	Expert Talk Series-4	IV	1
6.	AEC 06	U24AE510	Expert Talk Series-5	V	1
7.	AEC 07	U24AE609	Expert Talk Series-6	VI	1
				Total Credits	**07**

(xi) Indian Knowledge System Courses (IKSC)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	IKSC 01	U24IK100	AICTE Mandated Student Induction Programme (Universal Human Values - I)	Student Induction Programme	-
2.	IKSC 02	U24IK506B	UHV-II	V	2
3.	IKSC 03	U24IK606A	EITK	VI	2
				Total Credits	**04**

(xii) Startups and Entrepreneurship Course (STE)

Sr. No.	Course Type	Course Code	Course Name	Semester	Credits
1.	STE 01	U24ST605	S&E Basket	VI	3

(xiii) 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**	**U24VAYYYSE101**	Clean India—Green India (River/Beach/Mohalla/School/Campus/Govt offices Cleaning)
		U24VAYYYSE102	Waste Management/Waste Segregation Surveys
		U24VAYYYSE103	Village Empowerment / NSS camp in village for a week
		U24VAYYYSE104	Healthy habits-happy schools/Medical camps in schools /peer health
		U24VAYYYSE105	Lifesaving skills /school clinics /First Aid training for a week
		U24VAYYYSE106	Sustainable living /Surveys and Estimation for roof tops
		U24VAYYYSE110	Any other course approved by BoS Chair and Dean AA
SEA Group-2: Shikshit Bharat	**Humanity Club**	**U24VAYYYSE201**	Peer mentoring /Mentoring of School Children
		U24VAYYYSE202	Rural digital revolution / Digital Literacy for yielders & Participation in "Teach-for-India" movement
		U24VAYYYSE203	Empowering learners –schools /Value addition for deprived schools
		U24VAYYYSE204	Peer Mentoring /Mentoring junior (first year) students at KITSW
		U24VAYYYSE205	Learning by Teaching /Teaching Assistantship at KITSW/Teaching AIDE

		U24VAYYYSE206	Enriching Education/Development of learning material for schools/ITIs
		U24VAYYYSE210	Any other course approved by BoS Chair and Dean AA
SEA Group-3: Samruddha Bharat	**C-i²RE**	**U24VAYYYSE301**	Building a Business Model
		U24VAYYYSE302	Innovation, Business Model & Entrepreneurship
		U24VAYYYSE303	Product Development and Prototyping
		U24VAYYYSE304	Design Thinking / Critical Thinking & Problem Solving
		U24VAYYYSE305	Fundraising and Proposal Writing in Entrepreneurship
		U24VAYYYSE306	Digital Marketing & Branding
		U24VAYYYSE307	Identify a Social Problem and Work on the Solution Using AICTE IdeaLab
		U24VAYYYSE308	Meet with Entrepreneurs and Understand Business Models
		U24VAYYYSE309	Entrepreneurial Case Study Analysis
		U24VAYYYSE400	Any other course approved by BoS Chair and Dean AA
SEA Group-4: Surakshit Bharat	**NCC**	**U24VAYYYSE401**	NCC participation/National Integrity
		U24VAYYYSE402	Basics of fire safety/Community safety
		U24VAYYYSE403	Disaster Management
		U24VAYYYSE404	Environmental health & sustainability
		U24VAYYYSE405	Road safety
		U24VAYYYSE406	Pollution control
		U24VAYYYSE410	Any other course approved by BoS Chair and Dean AA

Table: SAA

Group	Guiding club/ center	Code of activity (U24VAYYY)*	Title of activity
SAA Group-1: Socho Bharat	**Literary Club**	**U24VAYYYSA101**	Study of Green & White Revolutions in India
		U24VAYYYSA102	Study of any 2 Government Missions or National Policies
		U24VAYYYSA103	Study of India's top 2 problems
		U24VAYYYSA104	Study of World's top 2 problems
		U24VAYYYSA105	Study of one department of the Central/ State Government
		U24VAYYYSA106	Study of one of the identified Books on leadership or innovation
		U24VAYYYSA110	Any other course approved by BoS Chair and Dean AA
SAA Group-2: Sanskarit Bharat	**Team - UHV**	**U24VAYYYSA201**	Values and Ethos of KITSW
		U24VAYYYSA202	Philosophy of religion (any)
		U24VAYYYSA203	Study of Life Management / Kindle Life / Life Empowerment and Enriching Program or any other book cited.

		U24VAYYYSA204	Study of any of GREAT sons of INDIA (Ex. Gandhi, Ambedkar, Phule, Savarkar, Sardar Patel, Nehru, Shivaji, JRD Tata etc)
		U24VAYYYSA205	Harmony in FAMILY & SOCIETY
		U24VAYYYSA206	Harmony in NATURE
		U24VAYYYSA210	Any other course approved by BoS Chair and Dean AA
SAA Group-3: Saksham Bharat	**Sports Club**	**U24VAYYYSA301**	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
		U24VAYYYSA302	Sports – Representation of Institute at University level/Inter college level and above in ANY sport
		U24VAYYYSA303	Pran-vidya (Yoga & Pranayama), Jeevan-vidya (work-life balance)
	Technical club	**U24VAYYYSA304**	Participation in National Tech Fest, AICTE-Hackathon, industry floated global and National competitions, Robocon, BAHA etc
		U24VAYYYSA305	Participation in National level or State level bodies in professional bodies like ISTE/IEEE/CSI/IETE etc.
		U24VAYYYSA306	Present research papers at National and international conferences
		U24VAYYYSA310	Any other course approved by BoS Chair and Dean AA
SAA Group-4: Sunder Bharat	**MDF**	**U24VAYYYSA401**	Institute representation in prestigious cultural fests/competitions
		U24VAYYYSA402	Dance (Bharatanatyam /Kathak /Lavani /Western Dance). *Only for beginners*
		U24VAYYYSA403	Music composition / Learning musical instrument (Any type). *Only for beginners.*
		U24VAYYYSA404	Film Appreciation/Dramatics/Seeing through Painting
		U24VAYYYSA405	Making short film/Photography
		U24VAYYYSA406	Sculptures (focusing on themes of unity, peace and environmental conservation)
		U24VAYYYSA410	Any other course approved by BoS Chair and Dean AA

13. SUMMARY OF CURRICULUM COMPONENTS

S. No.	CATEGORY	COURSE COMPONENT	TOTAL COURSES	TOTAL CREDITS	CURRICULUM CONTENT (%OF CREDITS)
1	BSC	Basic Science Courses	05	17	9.77
2	ESC	Engineering Science Courses	05	19	10.92
3	PCC	Program Core Courses	21	69	39.66
4	PEC	Program Elective Courses	04	12	6.90
5	HSMC	Humanity, Social Sciences and Management Courses	03	06	3.45
6	MOPEC	Multidisciplinary Open Elective Courses	03	09	5.17
7	ELC	Experiential Learning Courses	09	17	9.77
8	VAC	Value Added Courses	08	08	4.60
9	SEC	Skill Enhancement Courses	03	03	1.72
10	AEC	Ability Enhancement Courses	07	07	4.02
11	IKSC	Indian Knowledge System Courses	02	04	2.30
12	STE	Startups and Entrepreneurship Courses	01	03	1.72
		Total	**71**	**174**	**100**

14. SEMESTER WISE COURSE / CREDIT DISTRIBUTION

Semester	Number of Courses / Number of Credits (*Course Category wise*)												
	BSC	**ESC**	**PCC**	**PEC**	**HSMC**	**MOPEC**	**ELC**	**VAC**	**SEC**	**AEC**	**IKSC**	**STE**	**TOTAL**
I	2/7	2/7	1/3	-	1/2	-	1/1	2/2	-	1/1	-	-	10/23
II	2/7	2/8	1/3	-	-	-	1/1	2/1	1/1	2/2	-	-	11/23
III	1/3	1/4	3/11	-	-	-	1/1	2/2	1/1	1/1	-	-	10/23
IV	-	-	5/18	-	-	-	1/1	2/3	1/1	1/1	-	-	10/24
V	-	-	4/12	-	2/4	1/3	1/1	-	-	1/1	1/2	-	10/23
VI	-	-	4/12	1/3	-	-	1/1	-	-	1/1	1/2	1/3	9/22
VII	-	-	3/10	1/3	-	1/3	2/5	-	-	-	-	-	7/21
VIII	-	-	-	2/6	-	1/3	1/6	-	-	-	-	-	4/15
Total	**5/17**	**5/19**	**21/69**	**4/12**	**3/6**	**3/9**	**9*/17**	**8/8**	**3/3**	**7/7**	**2/4**	**1/3**	**71/174**
% Weightage of Course Category	**9.77%** (17/174)	**10.92%** (19/174)	**39.66%** (69/174)	**6.90%** (12/174)	**3.45%** (6/174)	**5.17%** (9/174)	**9.77%** (17/174)	**4.60%** (8/174)	**1.72%** (3/174)	**4.02%** (7/174)	**2.30%** (4/174)	**1.72%** (3/174)	**100 %** (174/174)

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

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
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website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

Scheme of Instructions

Abbreviations

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

I SEMESTER

Stream - II

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	-	6	9	3
2	BSC	U24CY102A	Engineering Chemistry	2	1	2	5	10	4
3	PCC	U24ME103	Thermodynamics	2	1	-	4	7	3
4	ESC	U24ME104	Programming for Problem Solving with C	2	1	2	5	10	4
5	HSMC	U24MH105	English Communication and Report Writing	2	-	-	3	5	2
6	VAC	U24VA106	Sports & Yoga	-	-	2	2	4	1
7	ESC	U24ME107	Engineering Graphics & CAD	1	-	4	4	9	3
8	ELC	U24EL108	Practicum-I	-	-	-	4	4	1
9	VAC	U24VA109	SEA – I / SAA-I	-	-	-	2	2	1
10	AEC	U24AE110	Expert Talk Series-1	-	-	-	1	1	1
Total:				**11**	**4**	**10**	**36**	**61**	**23**
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)									

Pool – III (Chemistry)		
Sr. 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

Stream-II

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	-	6	9	3
2	BSC	U24PY202A	Engineering Physics	2	1	2	5	10	4
3	PCC	U24ME203	Engineering Materials and Metallurgy	2	1	-	4	7	3
4	ESC	U24ME204	Data Structures through C	2	1	2	5	10	4
5	ESC	U24EE205A	Basic Electrical & Electronics Engineering from Pool - II	2	1	2	5	10	4
6	VAC	U24CY206	Environmental Studies	2	-	-	2	4	-
7	AEC	U24AE207	IDEA Lab Makerspace	-	-	2	2	4	1
8	SEC	U24SE208	Programming Skill Development (PSD) Lab - 1	-	-	2	2	4	1
9	ELC	U24EL209	Practicum-2	-	-	-	4	4	1
10	VAC	U24VA210	SEA-2 / SAA -2	-	-	-	2	2	1
11	AEC	U24AE211	Expert Talk Series-2	-	-	-	1	1	1
Total:				**12**	**5**	**10**	**38**	**65**	**23**
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)									

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

Pool – II (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)*

Bridge 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 ME)

(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 ME: Any Two (02) Courses during the 2 - Months internship									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	PCC	U24ME212X	Performance of IC Engines	**2**	**-**	**2**	**-**	**4**	**3**
2	PCC	U24ME213X	Machine Drawing & Modelling	**2**	**-**	**2**	**-**	**4**	**3**
3	PCC	U24ME214X	Basic Mechanical Engineering	**2**	**-**	**2**	**-**	**4**	**3**
4	PCC	U24ME215X	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 Certification.

Exit Option to Qualify UG Certificate in ME: Any Two (02) Skill based Courses -:									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	SEC	U24SE212X	Certificate course in Product Design and Development (Offered by MSME CITD)	**-**	**-**	**6**	**-**	**6**	**3**
2	SEC	U24SE213X	Foundry men (NSQF)	**-**	**-**	**6**	**-**	**6**	**3**
3	SEC	U24SE214X	Mechanic Diesel (NSQF)	**-**	**-**	**6**	**-**	**6**	**3**
4	SEC	U24SE215X	Certificate Course in Product Design and Manufacturing (CITD)	**-**	**-**	**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	BSC	U24MH301B	Applied Mathematics	2	1	-	6	9	3
2	PCC	U24ME302	Mechanics of Materials	2	1	2	5	10	4
3	PCC	U24ME303	Manufacturing Technology	2	1	2	5	10	4
4	PCC	U24ME304	Heat Power Engineering	2	1	-	4	7	3
5	ESC	U24ME305	Python Programming	2	1	2	5	10	4
6	VAC	U24VA306B	Soft & Interpersonal Skills*			2	2	4	1
7	SEC	U24SE307	PSD LAB-02	-	-	2	2	4	1
8	ELC	U24EL308	Practicum-3	-	-	-	4	4	1
9	VAC	U24VA309	SEA-3 / SAA -3	-	-	-	2	2	1
10	AEC	U24AE310	Expert Talk Series-3	-	-	-	1	1	1
			Total:	**12**	**5**	**8**	**36**	**61**	**23**
			Additional Learning@:Maximum credits allowed for Honours/Minor	-	-	-	-	-	05
			Total credits for Honours/Minor students:	-	-	-	-	-	**28**
			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)	**-**	**-**	**-**	**-**	**-**	**-**

*** Branch Specific Mathematics:**

Branch Specific Mathematics (Pool-IV)		
S. No.	**Course Code**	**Course Title**
1.	U24MH301A	Numerical and Statistical Methods ***(for Civil Engineering)***
2.	U24MH301B	Applied Mathematics ***(for Mechanical Engineering)***
3.	U24MH301C	Mathematical foundations for Signal Processing ***(for ECI)***
4.	U24MH301D	Discrete Mathematics and Probability Statistics ***(Common to CSE, CSN, CSO & IT)***
5.	U24MH301E	Essential Mathematics and Statistics for Machine learning ***(for CSM)***
6.	U24MH301F	Essential Mathematics and Statistics for Data science ***(for CSD)***

@U24VA306 T & P Basket		
S. No.	**Course Code**	**Course Title**
1.	U24VA306A	Quantitative Aptitude and Logical Reasoning ***(for Stream I)***
2.	U24VA306B	Soft and Interpersonal Skills Lab ***(for Stream II)***

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	PCC	U24ME401	Heat Transfer	2	1	-	4	7	3
2	PCC	U24ME402	Machine Drawing	2	1	2	5	10	4
3	PCC	U24ME403	Fluid Mechanics and Hydraulic Machines	2	1	2	5	10	4
4	PCC	U24ME404	Design of Machine Elements	2	1	-	4	7	3
5	PCC	U24ME405	Machine Tools & Metrology	2	1	2	5	10	4
6	VAC	U24VA406A	Quantitative Aptitude & Logical Reasoning	2	-	-	2	4	2
7	SEC	U24SE407	PSD LAB -03	-	-	2	2	4	1
8	ELC	U24EL408	Practicum-4	-	-	-	4	4	1
9	VAC	U24VA409	SEA - 4 / SAA - 4	-	-	-	2	2	1
10	AEC	U24AE410	Expert Talk Series-4	-	-	-	1	1	1
11	VAC*	U24CY411*	Environmental Studies*	2*	-	-	3*	5*	-
Total:				**12**	**5**	**8**	**34**	**59**	**24**
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	-	05
Total credits for Honours/Minor students:				-	-	-	-	-	29
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

@U24VA306 T & P Basket		
S. No.	**Course Code**	**Course Title**
1.	U24VA406A	Quantitative Aptitude and Logical Reasoning *(for Stream II)*
2.	U24VA406B	Soft and Interpersonal Skills Lab *(for Stream I)*

Bridge 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 ME)

(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 ME: Any Two (02) Courses during the 2 - Months internship									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	PCC	U24ME412X	Theory of Machines	**2**	**-**	**2**	**-**	**4**	**3**
2	PCC	U24ME413X	Workshop Technology	**2**	**-**	**2**	**-**	**4**	**3**
3	PCC	U24ME414X	Refrigeration Systems	**2**	**-**	**2**	**-**	**4**	**3**
4	PCC	U24ME415X	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 ME: Any Two (02) Skill based Courses -:									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	SEC	U24SE412X	Certificate Course in Product Design and Analysis (Offered by MSME-CITD)	**-**	**-**	**6**	**-**	**6**	**3**
2	SEC	U24SE413X	Certificate Course in Design Of Plastic Injection Moulds (CITD)	**-**	**-**	**6**	**-**	**6**	**3**
3	SEC	U24SE414X	Certificate Course in Design of Press Tools (CITD)	**-**	**-**	**6**	**-**	**6**	**3**
4	SEC	U24SE415X	Mechanic Motor Vehicle (NSQF)	**-**	**-**	**6**	**-**	**6**	**3**
5	SEC	U24SE416X	Any other skill based course approved by BoS Chair and Dean AA	**-**	**-**	**6**	**-**	**6**	**3**

B. Tech Honors with Research:

Students opting for B. Tech Honors 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	O	E	C
1	MOPEC	U24OE501YYX	MOPEC Elective –I#	2	1	-	3	6	3
2	PCC	U24ME502	Refrigeration & Air Conditioning	2	1	2	5	10	4
3	PCC	U24ME503	Mechanism and Machines	2	1	-	4	7	3
4	PCC	U24ME504	Artificial Intelligence and Machine Learning	2	1	2	5	10	4
5	HSMC	U24MB505X	Management Course Basket	2	1	-	2	5	3
6	IKSC	U24IK506B	Universal Human Values-II	2	-	-	2	4	2
7	PCC	U24ME507	Computer Aided Engineering LAB	-	-	2	2	4	1
8	HSMC	U24MH508	Technical English	-	-	2	2	4	1
9	ELC	U24ME509	Seminar	-	-	-	2	2	1
10	AEC	U24AE510	Expert Talk Series-5	-	-	-	1	1	1
Total:				**12**	**5**	**8**	**28**	**53**	**23**
Additional Learning@:Maximum credits allowed for Honors/Minor				**-**	**-**	**-**	**-**	**-**	**05**
Total credits for Honors/Minor students:				**-**	**-**	**-**	**-**	**-**	**28**
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)				**-**	**-**	**-**	**-**	**-**	**-**

#MULTIDISCIPLINARY OPEN ELECTIVES: Student has to select one course as multidisciplinary open elective from any of the MOPEC Basket of courses offered by other departments.

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

Management Courses Basket		
Sr. No.	**Course Code**	**Course Title**
1.	**U24MB505A/ U24MB605A**	Management Economics and Accountancy
2.	**U24MB505B/ U24MB605B**	Industrial Psychology
3.	**U24MB505C/ U24MB605C**	E-Commerce and Digital Marketing
4.	**U24MB505D/ U24MB605D**	Organizational Behaviour
5.	**U24MB505E/ U24MB605Z**	Any other course approved by BoS Chair and Dean AA

Indian Knowledge System Courses (IKSC)		
Sr. No.	**Course Code**	**Course Title**
1.	U24IK506A	Essence of Indian Traditional Knowledge
2.	U24IK506B	Universal Human Values-II

VI SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	PEC	U24ME601	Program Elective –I / MOOCs-I	2	1	-	4	7	3
2	PCC	U24ME602	Metal Machining & Automation	2	1	2	5	10	4
3	PCC	U24ME603	Dynamics of Machinery	2	1	-	4	7	3
4	PCC	U24ME604	Computational Fluid Dynamics	2	1	2	5	10	4
5	STE	U24ST605X	Startups & Entrepreneurship Basket	2	1	-	2	5	3
6	IKSC	U24IK606A	Essence of Indian Traditional Knowledge	2	-	-	2	4	2
7	PCC	U24ME607	AI & ML core application LAB	-	-	2	2	4	1
8	ELC	U24ME608	Mini Project	-	-	2	2	4	1
9	AEC	U24AE609	Expert Talk Series-6	-	-	-	1	1	1
Total:				**12**	**5**	**8**	**27**	**52**	**22**
Additional Learning@:Maximum credits allowed for Honors/Minor				**-**	**-**	**-**	**-**	**-**	**05**
Total credits for Honors/Minor students:				**-**	**-**	**-**	**-**	**-**	**27**
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)				**-**	**-**	**-**	**-**	**-**	**-**

#MULTIDISCIPLINARY OPEN ELECTIVES: Student has to select one course as multidisciplinary open elective from any of the MOPEC Basket of courses offered by other departments.

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

B. Tech Honors with Research:

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

Startups & Entrepreneurship Basket		
Sr. No.	**Course Code**	**Course Title**
1.	**U24ST505A / U24ST605A**	Design Thinking
2.	**U24ST505B / U24ST605B**	Innovative Product Design and Development
3.	**U24ST505C / U24ST605C**	Entrepreneurship
4.	**U24ST505D / U24ST605D**	Design Studio
5.	**U24ST505Z / U24ST605E**	Any other course approved by BoS Chair and Dean AA

Indian Knowledge System Courses (IKSC)		
Sr. No.	**Course Code**	**Course Title**
1.	U24IK606A	Essence of Indian Traditional Knowledge
2.	U24IK606B	Universal Human Values-II

Bridge 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. Voc. in ME)

(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 ME: Any Two (02) Courses during the 2 - Months internship									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	PCC	U24ME610X	Industrial Robotics	**2**	**-**	**2**	**-**	**4**	**3**
2	PCC	U24ME611X	Computer Integrated Manufacturing	**2**	**-**	**2**	**-**	**4**	**3**
3	PCC	U24ME612X	Dynamics of Fluids	**2**	**-**	**2**	**-**	**4**	**3**
4	PCC	U24ME613X	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. Voc in ME Degree.

Exit Option to Qualify B. Voc in ME: Any Two (02) Skill based Courses -:									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	SEC	U24SE614X	Certificate Course in Design and Analysis of Mechanical Systems using NX and SIMCENTER (Offered by: Centre of excellence by Digital Manufacturing and Automation, NIT, Warangal)	**-**	**-**	**6**	**-**	**6**	**3**
2	SEC	U24SE615X	Certificate Course in CNC Programming & Machining (CITD)	**-**	**-**	**6**	**-**	**6**	**3**
3	SEC	U24SE616X	Refrigeration and Air Conditioning Technician (NSQF)	**-**	**-**	**6**	**-**	**6**	**3**
4	SEC	U24SE617X	Certificate Course in Product Design and Development (CITD)	**-**	**-**	**6**	**-**	**6**	**3**
5	SEC	U24SE618X	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	O	E	C
1	MOPEC	U24OE701YYX	MOPEC Elective –II	2	1	-	3	6	3
2	PEC	U24ME702	Program Elective - II/ MOOCs-II	2	1	-	4	7	3
3	PCC	U24ME703	Finite Element Methods	2	1	2	4	9	4
4	PCC	U24ME704	Additive Manufacturing	2	1	-	4	7	3
5	PCC	U24ME705	Production and Operations Management	2	1	-	4	7	3
6	ELC	U24ME706	Internship Evaluation*	-	-	2	-	2	1
7	ELC	U24ME707	Major Project, Phase-1 / Industrial Internship - 1	-	-	8	6	14	4
Total:				**10**	**5**	**12**	**25**	**52**	**21**
Additional Learning@:Maximum credits allowed for Honors/Minor				**-**	**-**	**-**	**-**	**-**	**04**
Total credits for Honors/Minor students:				**-**	**-**	**-**	**-**	**-**	**25**

#MULTIDISCIPLINARY OPEN ELECTIVES: Student has to select one course as multidisciplinary open elective from any of the MOPEC Basket of courses offered by other departments.

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

B. Tech Honors with Research

Students opting for B. Tech Honors with Research, shall complete Research Methodology Course (4 Credits) through MOOCS (OR) a workshop / FDP of not less than one week on "Research Methodologies" (4 Credits).

Internship Evaluation for the students opting B. Tech Honors with Research, will be done on the 2-Month Research internship-II.

VIII SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	MOPEC	U24OE801YYX	MOPEC Elective –III	2	1	-	3	6	3
2	PEC	U24ME802	Program Elective - III / MOOCs-IV	2	1	-	4	7	3
3	PEC	U24ME803	Program Elective - IV / MOOCs-V	2	1	-	4	7	3
4	ELC	U24ME804	Major Project, Phase – 2 / Industrial Internship - 2	-	-	12	4	16	6
Total:				**6**	**3**	**12**	**15**	**36**	**15**
Additional Learning@:Maximum credits allowed for Honors/Minor				**-**	**-**	**-**	**-**	**-**	**04**
Total credits for Honors/Minor students:				**-**	**-**	**-**	**-**	**-**	**19**

#MULTIDISCIPLINARY OPEN ELECTIVES: Student has to select one course as multidisciplinary open elective from any of the MOPEC Basket of courses offered by other departments.

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

B. Tech Honors with Research

Students opting for B. Tech Honors with Research, shall Publish a research paper in reputed journal indexed by SCI / SCOPUS/Web of Science (4 Credits).

SUMMARY

SEMESTER	I	II	III	IV	V	VI	VII	VIII	TOTAL
CREDITS	23	23	23	24	23	22	21	15	174

MULTIDISCIPLINARY OPEN ELECTIVE COURSES (MOPEC) BASKETS:

There are three slots for MOPEC Courses (5th, 7th& 8th semesters). Students can opt any four courses (one course per semester under MOPEC slot) from the available 19 MOPEC Baskets.

Students those who opt open elective courses will be thinking to get introduced to the courses other than their program courses to start rooting their professional goals in their breadth component of study to explore the jobs in different fields. Hence the department shall carefully offer courses under the MOPEC Basket which create interest and impart basic knowledge and skills across the domains. For example the CS/IT MOPEC basket shall consist of courses like Introduction to AI&ML, Intro. To web programming, Introduction to Computer Networking, Introduction to Operating Systems and etc.

Course code to be followed for all MOPE Courses:

U	2	4	O	E	X	0	1	C	E	A
URR24 Curriculum			MOPEC Elective		Semester in which MOPEC opted (5/7/8)	1st Subject in that Semester		MOPECs offered by CE Dept.		Serial Order

(I) CIVIL ENGINEERING:CE-MOPEC BASKET

The following Courses will be offered by Civil Engineering Department under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01CEA	Engineering Mechanics
2	U24OEX01CEB	Strength of Materials
3	U24OEX01CEC	Fluid Mechanics
4	U24OEX01CED	Advanced Surveying
5	U24OEX01CEE	Energy Efficient Buildings
6	U24OEX01CEF	Net Zero Buildings
7	U24OEX01CEG	Forensic Engineering
8	U24OEX01CEH	Smart and Resilient Buildings
9	U24OEX01CEI	Infrastructure Engineering & Management
10	U24OEX01CEJ	Disaster Response & Preparedness
11	U24OEX01CEK	Introduction to Sustainable Development
12	U24OEX01CEL	Lifeline Services & Disasters
13	U24OEX01CEZ	Any other course approved by BoS Chair and Dean AA

(II) ECE: EC -MOPEC BASKET

The following Courses will be offered by ECE and ECI Departments under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01ECA	Analog and Digital Electronics
2	U24OEX01ECB	Digital Electronics
3	U24OEX01ECC	Signals and Systems
4	U24OEX01ECD	Computer Architecture and Organization
5	U24OEX01ECE	Embedded System Design
6	U24OEX01ECF	Microprocessor and Microcontrollers

7	**U24OEX01ECG**	Linear Integrated Circuits
8	**U24OEX01ECH**	Digital Image Processing
8	**U24OEX01ECI**	Principles of Communication Systems
10	**U24OEX01ECJ**	Digital Signal Processing and Applications
11	**U24OEX01ECK**	Basic VLSI Design
12	**U24OEX01ECL**	Radar Engineering
13	**U24OEX01ECM**	Optical Communications and Networks
14	**U24OEX01ECN**	Wireless and Mobile Communications
15	**U24OEX01ECO**	Satellite Communications
16	**U24OEX01ECP**	Wireless Sensor Networks
17	**U24OEX01ECQ**	Microwave Communications
18	**U24OEX01ECR**	Introduction to Nanotechnology
19	**U24OEX01ELZ**	Any other course approved by BoS Chair and Dean AA

(III) ECI: CI-MOPEC BASKET

The following Courses will be offered by ECI Departments under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	**U24OEX01CIA**	Fundamentals of Instrumentation
2	**U24OEX01CIB**	Switching Theory and Logic Design
3	**U24OEX01CIC**	Signals and Systems
4	**U24OEX01CID**	Digital Signal Processing and Applications
5	**U24OEX01CIE**	Sensors and Actuators
6	**U24OEX01CIF**	Fundamentals of VLSI
7	**U24OEX01CIG**	Lab VIEW Programming
8	**U24OEX01CIH**	PLC and DCS
8	**U24OEX01CII**	Microcontrollers and Applications
10	**U24OEX01CIJ**	Internet of Things
11	**U24OEX01CIK**	Non - Destructive Testing
12	**U24OEX01CIZ**	Any other course approved by BoS Chair and Dean AA

(IV) CSE: CS-MOPEC BASKET

The following Courses will be offered by CSE Departments under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	**U24OEX01CSA**	Operating Systems
2	**U24OEX01CSB**	Design and Analysis of Algorithms
3	**U24OEX01CSC**	Software Engineering
4	**U24OEX01CSD**	Compiler Design
5	**U24OEX01CSE**	Data Mining
6	**U24OEX01CSF**	Cryptography & Network Security
7	**U24OEX01CSG**	High Performance Computing
8	**U24OEX01CSH**	Software Quality Assurance & Testing
9	**U24OEX01CSZ**	Any other course approved by BoS Chair and Dean AA

(V) IT ENGINEERING: IT-MOPEC BASKET

The following Courses will be offered by IT Departments under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01ITA	Computer Networks
2	U24OEX01ITB	Ethical hacking
3	U24OEX01ITC	Programming with C++
4	U24OEX01ITD	Web Design Technologies
5	U24OEX01ITE	Software Project Management
6	U24OEX01ITF	Java Full stack development
7	U24OEX01ITG	DevOps
8	U24OEX01ITH	NET Programming
9	U24OEX01ITI	Software Testing and Quality Assurance
10	U24OEX01CSZ	Any other course approved by BoS Chair and Dean AA

(VI) ELECTRICAL ENGINEERING: EE-MOPEC BASKET

The following Courses will be offered by EEE Department under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01EEA	Linear Control Systems
2	U24OEX01EEB	Introduction to Electric Vehicles
3	U24OEX01EEC	Renewable Energy Systems
4	U24OEX01EED	Smart Electric Grid
5	U24OEX01EEE	Generation &Utilization of Electric Energy
6	U24OEX01EEF	Energy Auditing
7	U24OEX01EEG	Network Analysis and Synthesis
8	U24OEX01EEH	Power Electronics
9	U24OEX01EEZ	Any other course approved by BoS Chair and Dean AA

(VII) CSE (DATA SCIENCE): DS-MOPEC BASKET

The following Courses will be offered by CSE(D) Department under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01DSA	Exploratory Data Analysis with R Programming
2	U24OEX01DSB	Predictive Analytics and Data Mining
3	U24OEX01DSC	Big data Analytics
4	U24OEX01DSD	Machine Learning
5	U24OEX01DSE	Deep Learning
6	U24OEX01DSF	Data Visualization
7	U24OEX01DSG	Social and Information Network Analysis
8	U24OEX01DSH	Web Scraping with Python
9	U24OEX01DSI	Introduction to MLOps
10	U24OEX01DSZ	Any other course approved by BoS Chair and Dean AA

(VIII) CSE (AM&ML) : AI-MOPEC BASKET

The following Courses will be offered by the CSE (AM&ML) Department under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01AIA	Artificial Intelligence
2	U24OEX01AIB	Machine Learning
3	U24OEX01AIC	Deep Learning
4	U24OEX01AID	Computer Vision and Image Processing
5	U24OEX01AIE	Natural Language Processing
6	U24OEX01AIF	Exploratory Data Analysis with Python
7	U24OEX01AIG	Robotic Process Automation
8	U24OEX01AIH	Prompt Engineering for Generative AI
9	U24OEX01AII	MLOps Architecture for LLMs
10	U24OEX01AIZ	Any other course approved by BoS Chair and Dean AA

(IX) CSE (NETWORKS): CN-MOPEC BASKET

The following Courses will be offered by CSE(N) Department under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01CNA	Computer Networks
2	U24OEX01CNB	Cloud Computing
3	U24OEX01CNC	Block Chain Technologies
4	U24OEX01CND	Internetworks and Virtualization
5	U24OEX01CNE	Network Automation
6	U24OEX01CNF	Platforms and System Security
7	U24OEX01CNG	Data Centre Networking
8	U24OEX01CNH	Fundamentals of Cyber Security & Tools
9	U24OEX01CNI	SDN for real networks
10	U24OEX01CNZ	Any other course approved by BoS Chair and Dean AA

(X) CSE (IOT) : IN-MOPEC BASKET

The following Courses will be offered by CSE(IOT) Department under MOPEC basket to the students of other branches:

V/VII/VIII SEMESTER		
1	U24OEX01INA	Programming with IoT boards
2	U24OEX01INB	Python for IoT
3	U24OEX01INC	IoT Architecture and Protocols
4	U24OEX01IND	Artificial IoT
5	U24OEX01INE	IoT frameworks
6	U24OEX01INF	IIoT
7	U24OEX01ING	Cyber Physical Systems
8	U24OEX01INH	Privacy & Security for IoT
9	U24OEX01INI	Edge and fog computing
10	U24OEX01INZ	Any other course approved by BoS Chair and Dean AA

(XI) MATHEMATICS: MT-MOPEC BASKET

The following Courses will be offered by M&H Department under MOPEC basket to the students of all branches:

V/VII/VIII SEMESTER		
1	U24OEX01MTA	Operations Research
2	U24OEX01MTB	Computational Number Theory
3	U24OEX01MTC	Integral Equations & Integral Transforms
4	U24OEX01MTD	Fuzzy Set Theory and Its Applications
5	U24OEX01MTE	Complex Analysis and Applications
6	U24OEX01MTF	Discrete Mathematics and Graph Theory
7	U24OEX01MTA	Partial Differential Equations and Applications
8	U24OEX01MTB	Probability Theory and Stochastic Processes
9	U24OEX01MTC	Descriptive Statistics with R software
10	U24OEX01MTD	Numerical Linear Algebra
11	U24OEX01MTE	Applied Linear Algebra in AI and ML
12	U24OEX01MTF	Matrix Computation and Applications
13	U24OEX01MTA	Reliability Theory
14	U24OEX01MTB	Numerical Methods for Partial Differential Equations
15	U24OEX01MTZ	Any other course approved by BoS Chair and Dean AA

(XII) ENGLISH :EN-MOPEC BASKET

The following Courses will be offered by M&H Department under MOPEC basket to the students of all branches:

V/VII/VIII SEMESTER		
1	U24OEX01ENA	Creative Writing
2	U24OEX01ENB	Public Speaking
3	U24OEX01ENC	Conversational English
4	U24OEX01END	Exam Skills
5	U24OEX01ENE	English for Competitive Examinations
6	U24OEX01ENF	Comprehensive Reading
7	U24OEX01ENG	Corporate Writing
8	U24OEX01ENH	Scientific English
9	U24OEX01ENI	Foundation for IELTS/TOEFL
10	U24OEX01ENJ	Narrative Skills
11	U24OEX01ENK	Professional Writing
12	U24OEX01ENL	English Language Enhancement
13	U24OEX01ENZ	Any other course approved by BoS Chair and Dean AA

(XIII) PHYSICS: PY-MOPEC BASKET

The following Courses will be offered by PS Department under MOPEC basket to the students of all branches:

V/VII/VIII SEMESTER		
1	U24OEX01PYA	Science and Technology of Non-Conventional Energy
2	U24OEX01PYB	Laser Systems for Industrial and Engineering Applications
3	U24OEX01PYC	Optical Fiber Communication
4	U24OEX01PYD	Nanomaterials
5	U24OEX01PYE	Fundamentals of Electromagnetism
6	U24OEX01PYF	Solid State Physics
7	U24OEX01PYG	Modern Materials

8	**U24OEX01PYH**	Experimental Physics
9	**U24OEX01PYI**	Thermodynamics
10	**U24OEX01PYZ**	Any other course approved by BoS Chair and Dean AA

(XIV) CHEMISTRY :CY-MOPEC BASKET

The following Courses will be offered by PS Department under MOPEC basket to the students of all branches:

V/VII/VIII SEMESTER		
1	**U24OEX01CYA**	Nano Bio-Technology
2	**U24OEX01CYB**	Computational Chemistry
3	**U24OEX01CYC**	Biosensors and Applications
4	**U24OEX01CYD**	Fundamentals of Quantum Chemistry
5	**U24OEX01CYE**	Stereochemistry
6	**U24OEX01CYF**	Advanced Polymer Chemistry
7	**U24OEX01CYG**	Principles and Applications of NMR Spectroscopy
8	**U24OEX01CYH**	Organic Reaction Mechanisms
9	**U24OEX01CYI**	Basic Organic Chemistry
10	**U24OEX01CHZ**	Any other course approved by BoS Chair and Dean AA

(XV) COMMERCE &MANAGEMENT :CM-MOPEC BASKET

The following Courses will be offered by MBA Department under MOPEC basket to the students of all branches:

V/VII/VIII SEMESTER		
1	**U24OEX01CMA**	Principles of Accountancy
2	**U24OEX01CMB**	Finance for Engineers
3	**U24OEX01CMC**	Management Principles
4	**U24OEX01CMD**	Organizational Behavior
5	**U24OEX01CME**	Project Management
6	**U24OEX01CMF**	Operations Management
7	**U24OEX01CMG**	Consumer Psychology
8	**U24OEX01CMH**	Principles of Marketing Management
9	**U24OEX01CMZ**	Any other course approved by BoS Chair and Dean AA

(XVI) LIBERAL ARTS* :LI-MOPEC BASKET

Students opting Liberal Art courses under MOPEC shall complete the courses through SWAYAM / NPTEL or any other MOOCS platform:

V/VII/VIII SEMESTER		
1	**U24OEX01LIA**	Indian Language-I
2	**U24OEX01LIB**	Indian Language-II
3	**U24OEX01LIC**	Psychology for Well-Being
4	**U24OEX01LID**	Foreign Language-I
5	**U24OEX01LIE**	Foreign Language-II
6	**U24OEX01LIF**	Introduction to Indian Art -An Appreciation
7	**U24OEX01LIG**	Drama Appreciation
8	**U24OEX01LIH**	Cultural Studies
9	**U24OEX01LII**	Film Appreciation
10	**U24OEX01LIJ**	Ethics in Engineering Practice
11	**U24OEX01LIZ**	Any other course approved by BoS Chair and Dean AA

* Through MOOCS only

(XVII) ARTS*: AR-MOPEC BASKET

Students opting Arts courses under MOPEC shall complete the courses through SWAYAM / NPTEL or any other MOOCS platform:

V/VII/VIII SEMESTER		
1	U24OEX01ARA	Anthropology
2	U24OEX01ARB	Ancient India
3	U24OEX01ARC	Constitution of INDIA
4	U24OEX01ARD	Medieval India
5	U24OEX01ARE	Geography
6	U24OEX01ARF	Modern India
7	U24OEX01ARG	Indian Polity
8	U24OEX01ARH	Indian Economy
9	U24OEX01ARZ	Any other course approved by BoS Chair and Dean AA

* Through MOOCS only

(XVIII) LAW*: LW-MOPEC BASKET

Students opting Laws courses under MOPEC shall complete the courses through SWAYAM / NPTEL or any other MOOCS platform:

V/VII/VIII SEMESTER		
1	U24OEX01LWA	Law for Engineers
2	U24OEX01LWB	Environmental Law
3	U24OEX01LWC	Labour Law
4	U24OEX01LWD	IPR and Patent Law
5	U24OEX01LWE	Industrial Law
6	U24OEX01LWF	Companye Law
7	U24OEX01LWG	Administritative Law
8	U24OEX01LWH	Alternative Dispute Resolution
9	U24OEX01LWZ	Any other course approved by BoS Chair and Dean AA

(XIX) I²RE :IE-MOPEC BASKET

Students opting I²RE courses under MOPEC shall complete the courses through SWAYAM / NPTEL or any other MOOCS platform:

V/VII/VIII SEMESTER		
1	U24OEX01IEA	Understanding Incubation & Entrepreneurship
2	U24OEX01IEB	Innovation, Business Models & Entrepreneurship
3	U24OEX01IEC	Innovation & Start-up Policy
4	U24OEX01IED	Entrepreneurship & IP Strategies
5	U24OEX01IEE	Digital Marketing Strategies
6	U24OEX01IEF	Leadership, Innovation and Entrepreneurship
7	U24OEX01IEG	Economics of Innovation
8	U24OEX01IEH	Strategic Management
9	U24OEX01IEI	Social Innovation in Industry 4.0
10	U24OEX01IEJ	Design, Technology & Innovation
11	U24OEX01IEZ	Any other course approved by BoS Chair and Dean AA

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM ELECTIVE COURSES (PEC)

There are four slots allotted to Program Elective Courses (PECs). An example for ME is given below: Each major specialization of the B. Tech Programme is treated as a vertical.

VERTICAL / PE	PE1	PE2	PE3	PE4
VERTICAL-1: Thermal Engineering	U24ME601A: Power Plant Engineering	U24ME702A: Design of Thermal Equipment	U24ME802A: Jet Propulsion and Rocket Engineering	U24ME803A: Cryogenics
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-2: Design Engineering	U24ME601B: Design of Transmission systems	U24ME702B: Product Design	U24ME802B: Mechanics of Composite Materials	U24ME803B: Geometrical Dimensioning and Tolerancing
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-3: Advanced Manufacturing	U24ME601C: Modern Machining Processes	U24ME702C: Micro & Nano Manufacturing	U24ME802C: Digital Manufacturing	U24ME803C: Sustainability in Manufacturing
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-4: Robotics & Automation	U24ME601D: Mechatronics	U24ME702D: Robot Kinematics	U24ME802D: Mobile Robotics	U24ME803D: Industrial Process Automation
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-5: Industrial Engineering and Management	U24ME601E: Industrial Engineering	U24ME702E: Industrial Management	U24ME802E: Supply chain Management	U24ME803E: Total Quality Management
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-6: Energy Systems	U24ME601F: Sustainable Energy Technology	U24ME702F: Energy Conversion and Waste Heat Recovery	U24ME802F: Electric and Hybrid Vehicles	U24ME803F: Energy Audit and Management
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-7: Automobile Engineering	U24ME601G: Automotive Chassis and Suspension	U24ME702G: Automotive Electrical and Autotronics	U24ME802G: Vehicle Body Engineering and Safety	U24ME803G: Vehicle Dynamics
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			
VERTICAL-8: IT & ITES	U24ME601H: OOP through Java	U24ME702H: Advanced Data Structures	U24ME802H: Data Base Management Systems	U24ME803H: Cloud Computing
	(OR)			
	Equivalent MOOCs approved by BoS Chair and Dean AA			

I SEMESTER

Stream - II

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	-	6	9	3
2	BSC	U24CY102A	Engineering Chemistry	2	1	2	5	10	4
3	PCC	U24ME103	Thermodynamics	2	1	-	4	7	3
4	ESC	U24ME104	Programming for Problem Solving with C	2	1	2	5	10	4
5	HSMC	U24MH105	English Communication and Report Writing	2	-	-	3	5	2
6	VAC	U24VA106	Sports & Yoga	-	-	2	2	4	1
7	ESC	U24ME107	Engineering Graphics & CAD	1	-	4	4	9	3
8	ELC	U24EL108	Practicum-I	-	-	-	4	4	1
9	VAC	U24VA109	SEA – I / SAA-I	-	-	-	2	2	1
10	AEC	U24AE110	Expert Talk Series-1	-	-	-	1	1	1
Total:				**11**	**4**	**10**	**36**	**61**	**23**
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)									

Pool – III (Chemistry)		
Sr. 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:** Common to all branches	
Course Code:	**U24MH101**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: convergence of an infinite series and differential calculus
LO2: partial differentiation and its applications
LO3: differential equations of first order and first degree along with certain applications
LO4: higher order linear differential equations and applications

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-Tangentplane 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 $Q(X)=X^mV(X)$ *[(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)]

Course Learning Outcomes (COs):
After completion of this course, the students should be able to…
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 appropriate methods of differential equations of first order and first degree to solve real life engineering problems.
CO4:analyze the solutions of higher order linear differential equation with constant coefficients

Textbook(s):
1. Grewal, B.S., *Higher Engineering Mathematics*, 44th ed., Delhi: Khanna Publishers, 2017

Reference Book(s):
1. Shanti Narayan, Dr. Mittal P.K, *Differential Calculus*, 1st ed., Reprint New Delhi: S. Chand & Co., 2014
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, 10th ed., U.K: John wiely & sons, 2020
3. S.S. Sastry, *Engineering Mathematics,* Vol.II, 3rd ed., Prentice Hall of India, 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		**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	**U24MH101.1**	2	2	1	1	-	-	-	1	1	-	1	1	1
CO2	**U24MH101.2**	2	2	1	1	-	-	-	1	1	-	1	1	1
CO3	**U24MH101.3**	2	2	1	1	-	-	-	1	1	-	1	1	1
CO4	**U24MH101.4**	2	2	1	1	-	-	-	1	1	-	1	1	1
U24MH101		**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

ENGINEERING CHEMISTRY (*for Mechanical Engineering*)

Class: B.Tech. I-Semester		**Branch:** ME	
Course Code:	**U24CY102A**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: electrochemical energy systems, batteries and fuel cells
LO2: water analysis and corrosion with its preventive methods
LO3: ferrous, non-ferrous, super alloys and polymers
LO4: lubricants, combustion, chemistry of carbon and hydrogen

THEORY COMPONENT

UNIT-I — 9 Hrs

Electrochemical Energy Systems: 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, Electrode potential, Electro motive force, Nernst equation; Potentiometric titrations-Acid base titrations, advantages; Biosensors
Batteries: Classification of batteries, Construction, Working principle, Advantages, Disadvantages and applications of Lead-acid battery and Li-ion battery

Self Learning Topics (SLTs): *Types of conductors (Text1: chapter 5 topic 1), Ohms law (Text1: chapter 5 topic 5), Commercial cells (Text1: chapter 6 topic 12)*

UNIT-II — 9 Hrs

Water Analysis and Treatment: Hardness of water, Determination of hardness of water by using EDTA, Determination of alkalinity, Determination of fluoride by spectrophotometry, Determination of dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Softening of water-ion exchange process, Desalination of brackish water, Reverse osmosis, Electro dialysis
Corrosion: Introduction, Corrosion by pure chemical reaction (Dry corrosion), Electrochemical corrosion (Wet corrosion); Factors influencing corrosion; Prevention methods of corrosion-Cathodic protection; Electroplating

Self Learning Topics (SLTs): *Units of hardness (Text1: chapter 1 topic: 5), Introduction to corrosion (Text1: chapter 7 topic: 1)*

UNIT-III — 9 Hrs

Ferrous Metals and Alloys: Types of steels, Types of cast irons, Effect of common alloying elements on plain carbon steels
Non-Ferrous Metals and Alloys: Composition, Properties, Applications of aluminium and its alloys, Copper and its alloys, Titanium and its alloys
Super Alloys: Importance, Classification, Titanium based, Nickel based, Cobalt based [Inconel 718, Ti-6 Al-4v], Chemical composition, Properties and applications
Polymers: Introduction, Classification of polymers-Natural and synthetic polymers; Thermoplastic and thermosetting polymers; Functionality, Molecular weight of polymers, Plastics, Rubbers (Elastomers), Liquid Silicone Rubber (LSR), Fibers, Properties of polymers, Degradation of polymer, Polymer composites

Self Learning Topics (SLTs): *Types of metal alloys (Text2: chapter 11 topic 11), Nomenclature of polymers (Text1: chapter 3 topics: 2,3)*

UNIT-IV	9 Hrs

Fuels: Properties of solid, liquid and gaseous fuels; Flash and fire points, Viscosity measurement–Redwood and Saybolt viscometer; Measurement of calorific value, Exploration of crude petroleum, Evaluation of crude, Distillation; Characteristics of fuels for internal combustion engines-Knocking, Octane number, Cetane number; Compressed natural gas (CNG), Liquefied Natural Gas (LPG), Power alcohol and Biodiesel

Combustion: Stoichiometric air-fuel ratio, Air-fuel ratio from analysis of products of combustion, Conversion of volumetric analysis to mass analysis and vice versa, Mass of dry flue gases per kg of fuel burnt, Mass of excess air supplied

Wear and Lubrication: Types of wear, Lubricants, Types, Properties and functions

Chemistry of Carbon and Hydrogen: Hydrogen-industrial method of preparation, Properties, Storage, Applications, Carbon **-** isotopes, Allotrope, Chemical properties and uses.

Self Learning Topics (SLTs): *Introduction and classification of fuels (Text1: chapter 2 topics 1,2), Comparison of diesel fuel and gasoline fuel (Text1: chapter 2 topic 18, table 5)*

LABORATORY COMPONENT

List of Experiments

1. Estimation of hydroxide ion [OH^-] by acidimetry using standard sodium carbonate solution
2. Estimation of alkalinity of water sample containing (i) carbonate (ii) carbonate & bicarbonate in ground water
3. Estimation of alkalinity of water sample containing (i) bi carbonate (ii) carbonate & hydroxide in potable water
4. Standardization of sodium hydroxide (NaOH) by conductometry using standard hydrochloric acid (HCl)
5. Standardization of acetic acid (CH_3COOH) by conductometry using standard sodium hydroxide (NaOH)
6. Standardization of strong acid (HCl) by potentiometry using standard sodium hydroxide (NaOH)
7. Determination of hardness of water by complexometric method
8. Kinematic and dynamic viscosity measurement of a given fuel/lubricating oil using Redwood viscometer/Saybolt apparatus
9. Flash and fire points of a given fuel using Cleveland's/Abel's apparatus
10. Carbon residue of a given fuel using Rams bottom apparatus
11. a). Synthesis of polymer (phenol- formaldehyde)
    b). Fabrication of polymer composite using hand layup technique and evaluate the defects of fabrication
12. Determination of resistance to wear rate of polymer composite in accordance with ASTM D1242 using pin on disc test rig

Textbook(s):

1. Jain and Jain, *Engineering Chemistry*, 17th ed., Dhanpat Rai Publishing Company, 2019
2. William D. Callister Jr & David G. Rethwisch, *Material Science Engineering*, 10th ed., Wiley, 2018 (Chapter 11)

Reference Book(s):

1. S. Agarwal, *Engineering Chemistry Fundamentals and Applications*. Cambridge University Press, May 23, 2019
2. Rajesh K., Prasad, Ojha T. P., *Non-Conventional Energy Sources,* 4th ed., Jain Brothers, 2014 (Chapter 6)

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*

Laboratory Manual (for laboratory component):

Engineering chemistry laboratory manual, Department of physical sciences/Chemistry, KITSW

Course Learning Outcomes (COs): 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 in engineering practice
CO2: adapt the essential techniques of water analysis, treatment and corrosion & it's control.
CO3: appraise applications of ferrous, non-ferrous, super alloys and polymers
CO4: apply the knowledge of lubricants, combustion in the field of engineering

(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: measure viscosity, flash and fire point of a fuel
CO8: design synthesis of polymer

Course Articulation Matrix (CAM):		**U24CY102A ENGINEERING CHEMISTRY (*for Mechanical 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	**U24CY102A.1**	2	-	-		1	1	1	-	1	-	1	1	1
CO2	**U24CY102A.2**	2	-	-	-	1	1	1		1	-	1	1	1
CO3	**U24CY102A.3**	2	1	-	-	-	1	1	-	1	-	1	1	1
CO4	**U24CY102A.4**	2	-	-	-	1	1	1	-	1	-	1	1	1
CO5	**U24CY102A.5**	2	1	-	-	-	1	1	-	1	-	1	1	1
CO6	**U24CY102A.6**	2	1	-	-	2	1	1	-	1	-	1	1	1
CO7	**U24CY102A.7**	2	1	-	-	2	1	2	1	1	-	1	1	1
CO8	**U24CY102A.8**	2	1	-	-	-	1	1	-	1	-	1	1	1
	U24CY102A	**2**	**1**	**-**	**-**	**1.4**	**1**	**1.13**	**1**	**1**	**-**	**1**	**1**	**1**

U24ME103 THERMODYNAMICS

Class: B.Tech. I -Semester		**Branch:** Mechanical Engineering (ME)	
Course Code:	**U24ME103**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: concept of heat and work, and first law of thermodynamics applied to closed systems

LO2: steady flow energy equation, its applications and second law of thermodynamics

LO3: entropy for various processes, availability, irreversibility and second law efficiency

LO4: thermodynamic relations and gas turbines

UNIT-I	**9 Hrs**

Fundamental Concepts: Introduction, units, types of systems, control volume, control mass, continuum, macroscopic and microscopic point of view thermodynamics, Thermodynamic state, property, process, cycle, Intensive and extensive properties; Heat and Work, Thermodynamic Equilibrium, point and path functions, cyclic process, reversibility, quasi static process, irreversible process, Zeroth law of Thermodynamics and its applications

First Law of Thermodynamics to closed system: Statement of First law, applications to closed systems- internal energy, enthalpy and specific heats; Processes of closed system-constant volume, constant pressure, isothermal, adiabatic and polytrophic; P-V-T relations, Perfect and real gases, Joule-Thomson coefficient, inversion curve, Vander walls equation of state

Self Learning Topics (SLTs): *Macroscopic and Microscopic Viewpoint, Units and Dimensions, Measurement of Temperature, Other Types of Work Transfer, Different Forms of Stored Energy(Text1: topics 1.6, 1.15, 2.2, 3.4, 4.4), Practice problems (Text1: Prob 1.1, 1.5, 2.1,2.3, 3.4, 3.6, 4.2, 4.3 4.4)*

UNIT-II	**9 Hrs**

First law applied to open system: Steady flow energy equation (SFEE); applications to thermodynamic devices- boiler, turbine, nozzle, compressor, pump, heat exchangers

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin Planck Statement, Clausius statement, Equivalence of Kelvin and Clausius Statements, Heat engine, Heat pump, Refrigerator, relation between COP of Heat pump and Refrigerator, Reversibility, Irreversibility, Causes of irreversibility, Conditions for reversibility, Carnot cycle, Carnot theorem, Thermodynamic temperature scales

Self Learning Topics (SLTs): *Steady flow Process involving two fluid streams at the inlet and exit (Text1: topics 5.3.1, 5.3.2), Solved problems (Text1: Prob 5.1, Prob 5.5, Prob 5.7), Irreversibility due to Lack of Equilibrium (Text1: topics 6.9.1), Solved problems (Text1: Prob 6.1, Prob 6.2, Prob 6.5)*

UNIT-III	**9 Hrs**

Entropy: Concept of Entropy, Clausius inequality, Entropy principle and its applications, property of entropy, entropy change in various processes, entropy change mechanism, entropy generation in open and closed system, Entropy and Disorder, Third law of Thermodynamics

Availability: Available energy, unavailable energy, Available energy referred to a cycle, irreversibility, second law efficiency, Helmholtz and Gibb's functions

Self Learning Topics (SLTs): *Processes exhibiting external mechanical irreversibility (Text1: topics 7.9.5), Solved problems (Text1: Prob 7.3, Prob 7.6, Prob 7.9)*

UNIT-IV	9 Hrs

Thermodynamic Relations: Max-well relations, coefficient of volume expansion, isothermal compressibility factor, T-ds Equations, difference in heat capacities, ratio of heat capacities, change in internal energy, entropy and enthalpy equations

Gas Turbines: Classification; comparison between open and closed cycle gas turbine; deviation of actual gas turbine cycle from Brayton Cycle-Isentropic efficiencies of compressor and gas turbine; methods of improving thermal efficiencies of gas turbine power plant - reheating, regeneration and inter cooling; applications

Self Learning Topics (SLTs): *Solved problems (Text1: Prob 11.1, Prob11.2, Prob 11.7) Solved problems (Text1: Prob 13.5, Prob13.7, Prob 13.8)*

Textbook(s):

1. Nag P.K., *Engineering Thermodynamics*, 6th ed., McGraw Hill Education, 2017.

Reference Book(s):

1. Vanwylen G.J. and Sonntag R.E., *Fundamentals of Thermodynamics*, 7th ed., Wiley India Pvt. Ltd., 2009.
2. Yonus A Cengel and Michale A Boles, *Thermodynamics: an Engineering Approach*, 9th ed., McGraw Hill Education, 2019.
3. Mahesh M Rathore, *Thermal Engineering*, McGraw Hill Education, 2010.
4. Ganesan V., *Gas Turbines*, 3rd ed., McGraw Hill Education, 2018.

Web and Video link(s):

1. https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8; N*PTEL Video Lecture on Basic Thermodynamics by Prof. S. K. Som, Professor of Mechanical Engineering, IIT Kharagpur.*
2. https://nptel.ac.in/courses/112102255; *NPTEL Video Lecture on Thermodynamics by Prof. S. R. Kale, Professor of Mechanical Engineering, IIT Delhi.*

Course Learning Outcomes (COs):

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

CO1: distinguish heat & work and determine energy transfer for a closed system

CO2: evaluate the performance of various thermodynamic devices by applying steady flow energy equation (SFEE) and second law of thermodynamics principles

CO3: estimate entropy change, availability, irreversibility and second law efficiency for various processes

CO4: analyze the thermodynamic relations and performance of a gas turbine power plant

Course Articulation Matrix (CAM):		**U24ME103**					**THERMODYNAMICS**						
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	**U24ME103.1**	2	2	1	-	-	-	1	1	1	-	1	2	1
CO2	**U24MH103.2**	2	2	1	-	-	-	1	1	1	-	1	2	1
CO3	**U24MH103.3**	2	2	1	-	-	-	1	1	1	-	1	2	1
CO4	**U24MH103.4**	2	2	1	-	-	1	1	1	1	-	1	2	1
U24ME103		**2**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PROGRAMMING FOR PROBLEM SOLVING WITH C

Class: B. Tech. I -Semester		**Branch:** Common to all branches	
Course Code:	**U24ME104**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: algorithms, flow charts and develop programs with basic constructs
LO2: control structures and array operations
LO3: string operations and modular programming concepts with functions and recursion
LO4: structures, unions, pointers and files in C programming

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: Understanding pointers, 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 a file, 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

Textbook(s):

1. Balagurusamy.E, *Programming in ANSI C*, 8th ed., McGraw Hill, 2022

Reference Book(s):

1. Paul Deitel, Harvey Deitel, *C How to Program: With Case Studies Introducing Applications Programming and Systems Programming*, 9th ed., Pearson Education Limited, 2022
2. Brian W. Kernighan and Dennis Ritchie, *The C Programming Language*, 2nd ed., Pearson Education India, 2015
3. Reema Thareja, *Programming in C,* 3rd ed., Oxford University Press, 2023
4. Yashavant Kanetkar, *Let Us C,* 19th ed., BPB Publications, 2022
5. A.K.Sharma, *Computer Fundamentals and Programming in C,* 2nd ed., 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):

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

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 a 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-defined functions, recursion, and storage classes.

CO8: develop programs using structures, unions, pointers and files

Course Articulation Matrix (CAM):		**U24ME104: PRAGRAMMING FOR PROBLEM SOLVING WITH 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	**U24ME104.1**	2	1	1	1	-	-	1	1	1	1	2	1	1
CO2	**U24ME104.2**	2	2	2	1	-	-	1	1	1	1	2	1	1
CO3	**U24ME104.3**	2	2	3	1	-	-	1	1	1	1	2	1	1
CO4	**U24ME104.4**	2	2	3	2	-	-	1	1	1	1	2	1	1
CO5	**U24ME104.5**	1	1	1	1	1	-	1	1	1	1	2	1	1
CO6	**U24ME104.6**	1	2	2	2	1	-	1	1	1	1	2	1	1
CO7	**U24ME104.7**	1	2	3	2	1	-	1	1	1	1	2	1	1
CO8	**U24ME104.8**	1	2	3	2	1	-	1	1	1	1	2	1	1
U24ME104		**1.5**	**1.75**	**2.25**	**1.5**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**1**	**1**

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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: basic grammar principles, reading speed, forming new words, making coherent paragraphs and also promoting ethical values for meaningful life.

LO2: speaking or writing correct sentences, writing effective letters and improving their self-worth.

LO3: critical reading ability, writing conclusive reports and additionally inculcating positive thinking.

LO4: abridging varieties of lengthy texts and maintaining 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-(Text 2,Unit-II), English Vocabulary (Text 2,Unit-I, Unit-II, Unit-III)
Verb Forms (Reference book 1,Topic :31), Tenses (Reference book 1,Topics: 16,17,18,19)
Reported Speech (Reference book 2, Exercises for Practice, 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 (Text 2,Unit-I,Unit-II,Unit-III),Tenses (Reference book 3,Topic-30, Exercises,30.1,30.2,30.3)*

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: Positive Attitude

- Be the Best of Whatever You Are: A Poem by Douglas Malloch

Self Learning Topics (SLTs):
Parts of Speech (Text book 1,Unit-I),Tenses
(Reference book 1, Topics-16,17,18,19) Phrasal Verbs (Reference book 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 (Reference book 2, Topics: 152-157))

Text book(s):

1. Sanjay Kumar & Pushp Lata, " *English Language and Communication Skills for Engineers*", 1st ed., Oxford University Press, 2018
2. "*Language and Life: A Skill's Approach*" 2nd ed., Based on the latest AICTE model curriculum Orient Blackswan Private Limited 2019.

Reference Book(s):

1. Thomson A.J. , Martinet A.V., "*A Practical English Grammar*", 3rd ed., Oxford University Press 1997
2. Thomson A.J. ,.Martinet A.V, "*A Practical English Grammar*", Exercise 2, 3rd ed., Oxford University Press 1997
3. Standard Allen W. , "*Living English Structure*", 5th ed., Pearson India Education Pvt. Ltd., 2009

Web and Video link(s):

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

Course Learning Outcomes (COs):

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

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: create effective letters, e-mails, reply to Memos and do the given tasks with confidence.

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.

Course Articulation Matrix (CAM):		**U24MH205: ENGLISH COMMUNICATION & REPORT WRITING**												
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	**U24MH105.1**	-	-	-	-	-	1	2	2	2	1	2	1	1
CO2	**U24MH105.2**	-	-	-	-	-	1	2	2	2	1	2	1	1
CO3	**U24MH105.3**	-	-	-	-	-	1	2	2	2	1	2	1	1
CO4	**U24MH105.4**	-	-	-	-	-	1	2	2	2	1	2	1	1
U24MH105		**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**1**

SPORTS / YOGA

Class: B. Tech. I -Semester		**Branch: common for 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:	**36 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs): This course Sports/Yoga will enable students to:

LO1: know about Yoga and its Benefits

LO2: develop skills and techniques of various Sports &Games.

LO3: inculcate Sportsman spirit.

LO4: all round development of the students to meet the requirements of the society.

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

Textbook(s):

1. Badminton for Schools – Author -Jake Downey, Publisher - S.Chand & Company Ltd., Ram Nagar, New Delhi-110055. Length: 159 Pages.
2. Basketball Skills & Rules – Author – O.P.Sharma, Publisher – Khel Sahitya Kendra, 4264/3, Ansari Road, Darya Ganj, New Delhi-110002, Length : 166 pages.
3. Title. How to Reassess Your Chess: Chess Mastery through Chess Imbalances. Author: Jeremy Silman, Edition, 4, illustrated, reprint, Publisher: Silman-James Press, 2010, ISBN.1890085138, 9781890085131, Length: 658 pages, Subject: Games & Activities, General.
4. Football Skills & Rules – O.P.Sharma, Publisher – Khel Sahitya Kendra, 4264/3, Ansari Road, Darya Ganj, New Delhi-110002, Length: 215 pages.
5. Teaching & Coaching Table Tennis – Author – Deepak Jain, Publisher – Khel Sahitya Kendra, WP-474, Ist Floor, Shiv Market, Ashok Vihar, Delhi-1100052, Length : 196 pages.
6. Volleyball for Schools, Author – Dave James, Publisher - S.Chand & Company Ltd., Ram Nagar, New Delhi-110055. Length: 125 Pages.
7. Yoga Education, Author – Dr. Tarak Nath Pramanik, Publisher – India's First Publisher & Asia's No.1 Stockist of Physical Education & Sports Books, 7/26, Ground Floor, Ansari Road, Daryaganj, New Delhi-110002, Length : 347 pages.
8. Indian Cricket, 1999 compiled by G.VISWANATH, 53rd Edition, Published by Kasturi &Sons Limited, Chennai-600002, Length : 784 pages.
9. Health And Fitness, Author – Dr.A.K.Srivastava, Sports Publication, 7/26, Ground Floor, Ansari Road, Darya Ganj, New Delhi-110002, Length: 72 pages.
10. Modern Kabaddi, AuthorE .Prasad Rao, Published by D.V.S New Delhi-110019.

Reference Book(s):

1. Rules and Skills of Games and Sports, Author – B.K.Chaturvedi, Publisher – Goodwill Publishing House, B-9, Rattan Jyoti, 18 Rajendra Place, New Delhi – 110008 (India)
2. Dare To Be A Champion. Lee Chong Wei (Brand), Genres **Biography**
3. 199 pages, Paperback, First published July 1, 2012
4. This edition, Format, 199 pages, Paperback, Published, January 1, 2012 by Bukuganda Digital & Publication, ISBN, 9789671084328, ASIN, 967108432X, Language, English.
5. ***The Book of Basketball: the NBA according to the Sports Guy*** is the second book by former ESPN columnist Bill Simmons.[1] Published in 2009, it covers the history of the National Basketball Association (NBA). In 2019, Simmons launched a sequel podcast series, **Book of Basketball 2.0**, which analyzes the evolution of the league since the book was published.
6. Title. How to Reassess Your Chess: Chess Mastery through Chess Imbalances. Author: Jeremy Silman, Edition, 4, illustrated, reprint, Publisher : Silman-James Press, 2010, ISBN.1890085138, 9781890085131, Length : 658 pages, Subject : Games & Activities, General.
7. The Stars of Football: The World's Best Players Kindle Edition by Rodolphe Gaudin (Author) Format: Kindle Edition, Games & Activities / Chess, Games & Activities / General
8. The Complete Volleyball Handbook Kindle Edition, by Bob Bertucci (Author), Makoto Katsumoto (Author), Yasumi Nakanishi (Author), Toshiaki Yoshida (Author) Format: Kindle Edition. 4.5.4.5 out of 5 stars 15 ratings.
9. Cricket skills& Rules, Author.V.Thani, khel sahitya Kendra, 4264/3, Ansari Road, Darya Ganj, New Delhi-110002. Length: 202 pages
10. Health Exercise And Fitness, Author – J.P.Muller, Sports Publication, WP-474, 1st Floor, Shiv Market, Ashok Vihar, Delhi -110052, Length: 117 Pages.
11. Yogic Science, Author – Dr.T.Thangamani, Dr.T.Godwin Vedanayagam Rajkumar, Publisher - Physical Education & Sports Books, 7/26, Ground Floor, Ansari Road, Daryaganj, New Delhi-110002, Length: 274 pages.

Web and Video link(s):

Badminton game Video Link :
https://www.youtube.com/watch?v=HucIqi8Lw3E&t=22s

Basket Ball game Video Link :
https://www.youtube.com/watch?v=-tkE2lJoR58

Chess Video Link :
https://www.youtube.com/watch?v=mDw7lgM8ePo

Carrom game Video Link :
https://www.youtube.com/watch?v=z8vvJpNceeg

Football game Video Link :
https://www.youtube.com/watch?v=mXjW78AgGu4

Table Tennis game Video Link :
https://www.youtube.com/watch?v=bLrJGWvWI4U

Volleyball game Video Link :
https://www.youtube.com/watch?v=BJJb3-O0Q1U

Cricket game Video Link :
https://www.youtube.com/watch?v=87hO_Vs3-wQ
Handball game Video Link :
https://www.youtube.com/watch?v=VCa_0USaq8k
Kabaddi game Video Link :
https://www.youtube.com/watch?v=ai1m7ARNyNI
Kho-Kho game Video Link :
https://www.youtube.com/watch?v=P3_z3LKdLdg
Yoga Aasanas Video Link :
https://www.youtube.com/watch?v=e0Q88DUOXjk
https://www.youtube.com/watch?v=JoDKbXEUrvQ

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 benchmarks.

CO3: demonstrate Sportsman spirit and ethics..

CO4: demonstrate Physical, Psychological, Social and Emotional balance.

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**	**PSO 1**	**PSO 2**
CO1	**U24VA106.1**	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	**U24VA106.2**	-	-	-	-	-	-	-	1	-	-	-	1	-
CO3	**U24VA106.3**	-	-	-	-	-	-	2	-	1	-	-	1	-
CO4	**U24VA106.4**	-	-	-	-	-	-	2	1	1	-	1	-	-
	U24VA106	-	-	-	-	-	-	2	1	1		1	1	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

ENGINEERING GRAPHICS & CAD

Class: B.Tech. I -Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME107A**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**1-0-4-4-9**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**72 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: projections of points and straight lines-I
LO2: projections of straight lines-II and planes
LO3: projections of solids and sections of solids
LO4: isometric and orthographic projections using AutoCAD

UNIT-I	**6+12 =18 hours**

Introduction: Importance of Engineering Drawing, principles of engineering drawing, dimensioning, geometrical constructions.

Projection of Points: Introduction to orthographic projections-Vertical Plane, Horizontal plane; Views-Front view, Top view, and Side view; Projection of Points-different quadrants.

Projection of Straight lines - I: Line parallel to both the planes, Line parallel to one plane and perpendicular to the other reference plane, Line parallel to one plane and inclined to the other reference plane.

Self-Learning topics (SLTs) : *Lettering and types of lines*

UNIT-II	**6+12=18 Hrs**

Projection of Straight Lines – II: Line- inclined to both the planes and Traces

Projection of Planes: Planes - Perpendicular and Oblique planes; Projections of planes - parallel to one of the reference planes, inclined to one of the reference planes and perpendicular to the other; Projections of oblique planes.

Self –learning topics (SLTs): *Projection of straight lines inclined to both the planes using trapezoidal method*

UNIT-III	**6+12 =18 Hrs**

Projection of Solids: Types-prisms, pyramids, cylinders, and cone; Simple Positions-axis parallel to a reference plane and perpendicular to the other plane, axis parallel to one plane and inclined to other reference plane; axis inclined to both the reference planes.

Sections of Solids: Types-prisms and pyramids; Section planes, Sectional views, and true shape of a section.

Self-learning Topics(SLTs) : *Projections of solids in auxiliary plane method*

UNIT-IV	**6+12 =18 Hrs**

Orthographic projections: Conversion of isometric views into orthographic views.

Isometric Projections: Isometric axis, Isometric Planes, Isometric View, Isometric projection, Construction of isometric view from orthographic views

Introduction to AutoCAD: Importance of AutoCAD, Standard toolbar, toolbars - draw, modify, dimension and properties, construction of simple diagrams in orthographic and isometric projections.

Self-Learning Topics (SLTs): *AutoCAD commands*

Course Learning Outcomes (COs):

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

CO1*: develop the projections of points and straight lines-I*
CO2*: develop the projections of straight lines-II and planes.*
CO3*: construct projections of solids and analyze internal details of an object through sectional views*
CO4*: construct 2D orthographic views from 3D isometric views and develop 3D isometric views from 2D views (practice in AutoCAD).*

Textbook(s):

1. Bhatt N.D., Panchal V.M. & Ingle P.R., *Engineering Drawing*, Charotar Publishing House, 2014.

Reference Book(s):

1. Shah M.B. & Rana B.C., *Engineering Drawing and Computer Graphics*, Pearson Education, 2008.
2. Agrawal B. & Agrawal C. M., *Engineering Graphics*, TMH Publication, 2012
3. Narayana K.L. & Kannaiah P, *Text Book On Engineering Drawing*, SciTech publishers (Corresponding Set of), 2008.

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.*

Course Articulation Matrix (CAM):		**U24ME107A ENGINEERING GRAPHICS & CAD**												
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	**U24ME107A.1**	2	1	1	-	-	-	1	1	1	1	1	1	1
CO2	**U24ME107A.2**	2	1	1	-	-	-	1	1	1	1	1	1	1
CO3	**U24ME107A.3**	2	1	1	-	-	-	1	1	1	1	1	1	1
CO4	**U24ME107A.4**	2	1	1	-	2	-	1	1	1	1	1	1	1
U24ME107A		**2**	**1**	**1**	**-**	**2**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PRACTICUM-1			
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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparing well-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

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	U24PS102	U24EC103	U24CS104	U24EE105	U24CH106
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053
	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- 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 timetable 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 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 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 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

Course Articulation Matrix (CAM):		**U24EL108 PRACTICUM-1**											
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:** Common to all branches		
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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentation through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

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/ 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 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. 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/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 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 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. ***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.

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 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

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 Articulation Matrix (CAM):		**U24VA109 (SE/SA)ZZZ- Courses listed under SEA/ SAA**											
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	**U24VA109.1**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO2	**U24VA109.2**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO3	**U24VA109.3**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO4	**U24VA109.4**	-	-	-	-	-	2	2	2	2	2	2	-	-
	U24VA109	-	-	-	-	-	2	2	2	2	2	2	-	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course Code: **U24VA109 (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

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

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice and applying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

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 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 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

Course Articulation Matrix (CAM):		**U24AE110 EXPERT TALK SERIES-1**												
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	U24AEX110.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AEX110.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AEX110.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AEX110.4	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***

II SEMESTER

Stream-II

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	-	6	9	3
2	BSC	U24PY202A	Engineering Physics	2	1	2	5	10	4
3	PCC	U24ME203	Engineering Materials and Metallurgy	2	1	-	4	7	3
4	ESC	U24ME204	Data Structures through C	2	1	2	5	10	4
5	ESC	U24EE205A	Basic Electrical & Electronics Engineering from Pool - II	2	1	2	5	10	4
6	ESC	U24CY206	Environmental Studies	2	-	-	2	4	-
7	AEC	U24AE207	IDEA Lab Makerspace	-	-	2	2	4	1
8	SEC	U24SE208	Programming Skill Development (PSD) Lab - 1	-	-	2	2	4	1
9	ELC	U24EL209	Practicum-2	-	-	-	4	4	1
10	VAC	U24VA210	SEA-2 / SAA -2	-	-	-	2	2	1
11	AEC	U24AE211	Expert Talk Series-2	-	-	-	1	1	1
Total:				**12**	**5**	**10**	**38**	**65**	**23**
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)									

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

Pool – II (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)*

Bridge 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 ME)

(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 ME: Any Two (02) Courses during the 2 - Months internship									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	PCC	U24ME212X	Performance of IC Engines	**2**	**-**	**2**	**-**	**4**	**3**
2	PCC	U24ME213X	Machine Drawing & Modelling	**2**	**-**	**2**	**-**	**4**	**3**
3	PCC	U24ME214X	Basic Mechanical Engineering	**2**	**-**	**2**	**-**	**4**	**3**
4	PCC	U24ME215X	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 Certification.

Exit Option to Qualify UG Certificate in ME: Any Two (02) Skill based Courses -:									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	SEC	U24SE212X	Certificate course in Product Design and Development (Offered by MSME CITD*)	**-**	**-**	**6**	**-**	**6**	**3**
2	SEC	U24SE213X	Foundry men (NSQF#)	**-**	**-**	**6**	**-**	**6**	**3**
3	SEC	U24SE214X	Mechanic Diesel (NSQF#)	**-**	**-**	**6**	**-**	**6**	**3**
4	SEC	U24SE215X	Certificate Course in Product Design and Manufacturing (CITD*)	**-**	**-**	**6**	**-**	**6**	**3**
5	SEC	U24SE216X	Any other skill based course approved by BoS Chair and Dean AA	**-**	**-**	**6**	**-**	**6**	**3**

* Central Institute of Tool Design
\# National Skill Qualification Framework

MATRIX THEORY AND VECTOR CALCULUS

Class: B.Tech. II -Semester		**Branch:** Common to all branches	
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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: various methods of solving system of linear equations and eigen value problems
LO2: double integral, triple integral and their applications
LO3: vector differential calculus and applications
LO4: integration of vector valued functions and applications

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 linear system 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, Eigen value problems arising from Markov processes, Eigen value problems arising from population models, Leslie model

Self-Learning Topics (SLTs): *Review of Matrices [Text 1: topics 2.1,2.2,2.3,2.4,2.5]*
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 scalar point functions - Gradient, Geometrical interpretation, Directional derivative, Del applied to vector point functions -Divergence, Curl, Physical interpretation of divergence, 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:
Line integral, 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)]

Course Learning Outcomes (COs):
After completion of this course, the students should be able to…
CO1: analyze eigen value problems using matrix theory
CO2: apply basic concepts of multiple integrals in evaluating physical quantities of real-life engineering 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

Textbook(s):
1. Grewal, B.S., *Higher Engineering Mathematics*, 44th ed., Delhi: Khanna Publishers, 2017 (Chapters 2,7,8)
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, 10th ed., U.K: John Wiely & Sons, 2020 (Chapter 8(8.2))

Reference Book(s):
1. Spiegel M, *Vector Analysis -Schaum's Series,* 2nd ed., McGraw Hill, 2017
2. S.S. Sastry, *Engineering Mathematics,* Vol.II, 3rd ed., Prentice Hall of India, 2014.
3. Gilbert Strang, *Introduction to Linear Algebra*, 5th ed., Wellesley-Cambridge Press

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		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	U24MH201.1	2	2	1	1	-	-	-	1	1	-	1	1	1
CO2	U24MH201.2	2	2	1	1	-	-	-	1	1	-	1	1	1
CO3	U24MH201.3	2	2	1	1	-	-	-	1	1	-	1	1	1
CO4	U24MH201.4	2	2	1	1	-	-	-	1	1	-	1	1	1
U24MH201		**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

ENGINEERING PHYSICS (*for Mechanical Engineering)*			
Class: B.Tech. II -Semester		**Branch:** ME	
Course Code:	**U24PY202A**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: crystal structure, imperfections in solids and instrument characteristics
LO2: force systems, concepts and applications of friction
LO3: centroid, moment of inertia of different objects and operation of lasers
LO4: V-I characteristics, materials performance and applications of solar PV systems

THEORY COMPONENT

UNIT-I	**9 Hrs**

Crystallography: Space lattices, Unit cells, Crystal structure, Crystal systems, Atomic packing factors, Crystal planes and directions, Miller indices, Bravais lattices, Crystal imperfections- Point defects, Line defects and Surface defects, Crystal deformation- Slip and Twinning

Characteristics of Instruments: Static characteristics- Range and span, Accuracy, Error and correction, Calibration, Hysteresis and dead zone, Drift, Sensitivity, Threshold and resolution, Precision, Repeatability and reproducibility, Linearity; Dynamic characteristics- Speed of response and Measuring lag, Fidelity and dynamic error, Overshoot, Dead time and dead zone; Linear measurement- Vernier caliper and Micrometer

***Self Learning Topics (SLTs)**: Slip and Twinning (Text1: topics 2.1, 2.2), threshold and resolution, precision, repeatability and reproducibility (Text4: topics 2.2.7, 2.2.8).*

UNIT-II	**9 Hrs**

Force Systems: Types of forces- Coplanar, Concurrent and Parallel forces, Moment and couple, Free body diagram, Resultant of force systems, Resolution of forces, Composition of forces, Equilibrium equations of forces and Moment equilibrium equations

Friction: Introduction, Classification, Laws of friction, Coefficient of friction, Angle of friction, Ladder friction and Wedge friction

***Self Learning Topics (SLTs):** resolution of forces (Text5: topic 3.1), Solved problems (Text5: Prob 3.1, Prob 3.2, Prob 3.3), Solved problems (Text5: Prob 6.1 to 6.7).*

UNIT-III	**9 Hrs**

Centroid, Radius of gyration and Moment of Inertia: Centroid and Moment of inertia of figures like Rectangle, Circle and I-section

Applied Optics and Laser: Principles of interference, Diffraction phenomena and applications (qualitative); Difference between conventional light and laser, Basic principles and characteristics of 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

***Self Learning Topics (SLTs):** centre of mass, centre of gravity (Text5: topics 4.1, 4.2), Solved problems (Text5: Prob 4.1, Prob 4.3), Einstein coefficients and their relation, metastable state (Text2: topics 44.3, 44.5).*

UNIT-IV	**9 Hrs**

Solar Photovoltaic Systems: Introduction, Solar cell fundamentals, Semiconductor materials- Classification, PN junction- Biasing, Break down, V-I characteristics; Photo voltaic effect-materials, Operation of a solar cell, Types of solar cells, Performance parameters of a single crystal solar cell- Short circuit current, Open circuit voltage, Fill factor and efficiency, I-V characteristics of solar cell and its effects based on insolation and temperature

Solar PV Module: Working principle of solar panels, Circuit diagram, Series and parallel connection of PV modules, Cell mismatch in a module, Solar array; PV systems for power generation- Stand alone and Grid alone PV systems, Applications- Street lighting, Water pumping, Refrigeration and telecommunications

Self Learning Topics (SLTs): *Semiconductor principles (Text6: topic 15.3), Applications-Street lighting, Water pumping, Refrigeration and Tele communications (Text6: topic 15.10).*

LABORATORY COMPONENT

List of Experiments

1. Determination of the linear measurements using Vernier callipers and screw gauge
2. Preparation and study of body centred cubic and face centred cubic crystal models
3. Determination of (a) rigidity modulus of a given wire (b) moment of inertia of a ring using torsional pendulum
4. Radius of gyration (k) and acceleration due to gravity(g) using compound pendulum
5. Determination of the radius of gyration of given bar using Bi-Filar suspension
6. Determination of force constant of a spiral spring using static method
7. Determination of coefficient of friction using pin on disc machine
8. Determination of slit width using He-Ne laser
9. Determination of wavelength of He-Ne laser-using reflection and transmission diffraction grating
10. Performance parameters of a solar PV module
11. I-V characteristics of a solar PV module connected in series and parallel
12. Performance study of solar PV panel with surrounding temperature and intensity

Textbook(s):

1. V.D. Kodgire, *Material Science & Metallurgy,* 42nd ed., Pune: Everest Publishing House, 2018
2. M. Avadhanulu and Kshirsagar, TVS Arun Murthy, *A Text Book of Engineering Physics,* 11th ed., S. Chand & Company Ltd, 2018.
3. Rajesh K., Prasad, Ojha T. P., *Non-Conventional Energy Sources*, 4th ed., Jain Brothers, 2014

Reference Book(s):

1. D. S. Kumar, *Mechanical Measurements & Control,* 5th ed., Metropolitan Book Co. Pvt. Ltd, 2015
2. Tayal A.K., *Engineering Mechanics: Statics and Dynamics*, 14th ed., New Delhi: Umesh Publishers, 2014
3. G.D. Rai., *Solar Energy Utilization*, 5th ed., Khanna Publishers, 1997
4. D. Halliday, R. Resnick, and J. Walker, *Fundamentals of Physics*, 10th ed., USA: Wiley, 2013

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_ph26/preview, *NPTEL video lecture on Solar Photovoltaics Fundamentals, Technology and Applications by Prof. Soumitra Satapathi, IIT Roorkee*
2. https://onlinecourses.nptel.ac.in/noc24_mm28/preview, *NPTEL video lecture on Defects in Crystalline Solids (Part - I) by Prof. Shashank Shekhar, IIT Kanpur*
3. https://onlinecourses.nptel.ac.in/noc24_ph45/preview, *NPTEL video lecture on Introduction to LASER by Prof. M. R. Shenoy, IIT Delhi*

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,* 2nd ed., Wiley India Pvt. Ltd., 2017

Course Learning Outcomes (COs):

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

(based on cognitive skills acquired from theory component)

CO1: draw and analyse crystal structures, imperfections in solids; list and define static and dynamic characteristics with examples

CO2: analyse various systems involving forces, moments and friction

CO3: determine moment of inertia of different objects and evaluate the properties of lasers

CO4: calculate the performance parameters of solar PV systems and explain its applications

(based on psychomotor skills acquired from laboratory component)

CO5: measure diameter of wire using Vernier callipers and screw gauge, rigidity modulus of wire and prepare BCC and FCC crystal models

CO6: determine coefficient of friction using pin on disc machine, radius of gyration (k) of a bar and force constant of a spiral spring

CO7: determine the width of a narrow slit and wavelength of laser using diffraction phenomenon

CO8: analyze I-V characteristics and performance of a solar PV module systems

Course Articulation Matrix (CAM):		**U24PY202A- ENGINEERING PHYSICS** (*for Mechanical 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	**U24PY202A.1**	2	1	1	-	1	1	1	1	1	-	1	1	1
CO2	**U24PY202A.2**	2	1	-	-	-	1	1	1	1	-	1	1	1
CO3	**U24PY202A.3**	2	1	1	-	-	1	1	1	1	-	1	1	1
CO4	**U24PY202A.4**	2	1	1	1	-	1	1	1	1	1	1	1	1
CO5	**U24PY202A.5**	2	1	-	-	1	1	1	1	2	-	1	1	1
CO6	**U24PY202A.6**	2	1	-	-	1	1	1	1	2	-	1	1	1
CO7	**U24PY202A.7**	2	1	-	-	1	1	1	1	2	-	1	1	1
CO8	**U24PY202A.8**	2	1	1	1	1	1	1	1	2	1	1	1	1
	U24PY202A	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1.5**	**1**	**1**	**1**	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

ENGINEERING MATERIALS AND METALLURGY

Class: B.Tech. II -Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME203**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: phase diagrams of binary alloys and iron-iron carbide equilibrium diagram

LO2: TTT diagrams and heat treatment processes

LO3: alloy steels, tool steels and powder metallurgy

LO4: materials testing methods and composites

UNIT-I	**9 Hrs**

Solidification, Solid solutions & Phase diagrams: Solidification of pure metals and alloys, nucleation and growth; Solid solutions - types, rules governing the formation of solid solutions and cooling curves

Phase diagrams: Basic terms, Gibb's phase rule, types of phase diagrams, construction of phase diagrams, interpretation of equilibrium diagrams - eutectic, eutectoid, peritectic & peritectoid, lever rule and problems on phase diagrams; Fe-Fe_3C equilibrium diagram

Self Learning Topics (SLTs): *Hume-Rothery's, rules of solid solubility (Text1: topics 5.2) and classifications and applications of steels and cast irons (Text1: topics 9.10)*

UNIT-II	**9 Hrs**

TTT diagrams: construction of TTT diagram of Eutectoid steel, superimposition of cooling curves on TTT diagram

Heat treatment processes: annealing, normalizing, hardening, tempering, martempering and austempering; effect of heat treatment processes on micro-structures and mechanical properties
Surface hardening : case hardening, carburizing, cyaniding, nitriding, Induction hardening and Age hardening

Self Learning Topics (SLTs): TTT diagram of hypo and hyper eutectoid steels *(Text1: topics 9.13)*

UNIT-III	**9 Hrs**

Alloy steels: Nickel steels, chromium steels, nickel-chromium steels, manganese steels, molybdenum steels, tungsten steel, vanadium steels and stainless steels

Tool Steels: Water-hardening tool steels, shock-resisting tool Steels, cold-worked tool steels, hot-work tool steels; cutting tools-types and applications
Introduction to smart materials, types and applications

Powder metallurgy: Introduction to powder metallurgy, powder fabrication methods**-** mechanical method, mechanical and electrolytic method, chemical method and atomization; characteristics of metal powders, powder packing, mixing and blending; sintering and applications of powder metallurgy

Self Learning Topics (SLTs): *Air hardening steels and high carbon high chromium steels(Text1: topics 10.7)*

UNIT-IV	**9 Hrs**

Destructive Testing: Tensile test, hardness tests- Brinell, Vickers and Rockwell; Impact tests-lzod and Charpy

Non-destructive Testing: Dye penetrant test, ultrasonic test, magnetic particle inspection and X–Ray radiography

Composite materials: Introduction, classification of composites, advantages and dis-advantages of composite materials, applications of composite materials; particle-reinforced composites, fiber-reinforced composites- carbon fiber–reinforced polymer composites; metal-matrix composites- Al and Cu matrix composites; ceramic-matrix composites

Self Learning Topics (SLTs): *compression test (Text1: topics 3.9),eddy current testing and visual inspection (Text1: topics 4.6 & 4.7)*

Course Learning Outcomes (COs):

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

CO1: construct phase diagram, Iron-Iron carbon diagram; classify steels and select them for given applications in engineering field

CO2: analyze isothermal transformation diagrams (TTT) and continuous cooling transformation diagrams (CCT)

CO3: analyze and select an appropriate alloy steel for a structural application

CO4: propose mechanical properties required for given engineering applications of materials; classify composites and select them for given applications in engineering.

Textbook(s):

1. Kodgirie. V. D. and Kodgirie S. V., *Material Science and Metallurgy*, 44th ed., Everest Publishing House, 2018.

Reference Book(s):

1. Avener S., *Introduction to Physical Metallurgy*, 2nd ed., Tata McGraw Hill Education (India) Pvt. Ltd., 2017.
2. Raghavan. V., *Material Science and Metallurgy*, 5th ed., PHI Learning Pvt. Ltd., 2013.
3. William D. Callister Jr & David G. Rethwisch, *Material Science Engineering*, Wiley, 10th ed., 2020.
4. Rajput R. K., *Material Science and Engineering*, 4th ed., S. K. Kataria & Sons, 2009.

(E-resources and other digital material)

Web and Video link(s):

1. Prof. R. N. Ghosh, IIT Kharagpur, Solidification Binary Alloys, Iron-Carbon Phase Diagram, https://www.youtube.com/results?search_query=prof.r.n+ghosh+lecturers
2. Prof. S. K. Gupta, IIT Delhi, Phase Diagrams, Crystal imperfections [English] Web Available: https://www.youtube.com/watch?v=x3n9ht-eRfg n
3. Prof. Ranjit Bauri Department of Metallurgical and Materials Engineering, Indian Institute of Technology, Madras, Powder Metallurgy https://drive.google.com/file/d/1dG5kL2cLNs_4p3M5EM1s3yHRXTzUJUiQ/view
4. Prof. Bishakh Bhattacharya. Department of Mechanical Engineering, Smart Materials and Intelligent System Design. https://drive.google.com/file/d/1991bAO08h5Fd1NiWQb5iaYXI0wqnzw6l/view

Course Articulation Matrix (CAM):		**U24ME203 ENGINEERING MATERIALS AND METALLURGY**												
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	**U24ME203.1**	2	1	1	-	-	-	1	1	1	1	1	1	1
CO2	**U24ME203.2**	2	1	1	-	-	-	1	1	1	1	1	1	1
CO3	**U24ME203.3**	2	2	1	-	-	-	1	1	1	1	1	1	1
CO4	**U24ME203.4**	2	2	1	1	-	-	1	1	1	1	1	1	1
U24ME203		**2**	**1.5**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

DATA STRUCTURES THROUGH C

Class: B.Tech. II –Semester		**Branch:** Common to all branches	
Course Code:	**U24ME204**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: time complexity, space complexity, array operations, and dynamic memory allocation
LO2: stacks and various forms of queues
LO3: various types of linked lists
LO4: various sorting techniques and hashing techniques

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,Prob 2,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. Debasis Samanta, *Classic Data Structures*, 2nd ed., Prentice Hall India, 2009

Reference Book(s):

1. Reema Thareja, *Data Structures Using C*, 2nd ed., Oxford University Press, 2014
2. Balagurusamy E, *Data Structure Using C*, 1st ed., McGraw Hill Education, 2017
3. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach with C*, 2nd ed., Cengage Learning, 2007

Web and Video link(s):

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. *Data Structures through C Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW.

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

Course Articulation Matrix (CAM):		**U24ME204 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	**U24ME204.1**	2	2	2	1	-	-	1	1	1	1	1	1	2
CO2	**U24ME204.2**	2	2	2	2	-	-	1	1	1	1	2	1	2
CO3	**U24ME204.3**	2	2	2	2	-	-	1	1	1	1	2	1	2
CO4	**U24ME204.4**	2	2	2	2	-	-	1	1	1	1	2	1	2
CO5	**U24ME204.5**	2	2	2	1	-	-	1	1	1	1	1	1	1
CO6	**U24ME204.6**	2	2	2	2	-	-	1	1	1	1	2	1	1
CO7	**U24ME204.7**	2	2	2	2	-	-	1	1	1	1	2	1	1
CO8	**U24ME204.8**	2	2	2	2	-	-	1	1	1	1	2	1	1
U24ME204		**2**	**2**	**2**	**1.75**	**-**	**-**	**1**	**1**	**1**	**1**	**1.75**	**1**	**1.5**

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Class: B.Tech. II -Semester		**Branch:** Common to CE & ME	
Course Code:	U24EE205A	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: network elements and DC circuits
LO2: 1- Ø AC and 3-Ø AC circuits
LO3: construction, operating principles & applications of DC & AC machines and renewable energy sources
LO4: concepts of diodes, rectifiers and transistors

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, Mesh analysis & Nodal analysis.

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, Prob 4,5,7&8).*

UNIT-II	**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 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: Prob 4.10, 4.12, 4.13 & 4.14), Practice problems (Text1: Chap-4,Prob 8,9,10 & 12).*

UNIT-III	**9 Hrs**

Electrical Machines and Renewable Energy Sources (Qualitative treatment):
Construction, Principle of operation, characteristics & applications of 1- Ø transformer, 3- Ø induction motor, 1- Ø induction motor, DC motor, Stepper motor, and BLDC motor

Renewable Energy Sources: Solar Photovoltaic, Wind, Waste to energy & Bioenergy

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)*

UNIT-IV	**9 Hrs**

Electronic Devices and Circuits:
P-N Junction diode, volt-amp characteristics, Zener diode, volt-amp characteristics, Half-wave rectifier and Full-wave rectifier (centre tapped), Bi-polar Junction Transistor-symbol, Construction and operation of N-P-N and P-N-P transistors, Characteristics of BJT (CE, CB & CC configurations), Applications of diodes and transistors for civil and mechanical engineers.

Self-Learning Topics (SLTs): C*lassification of Semiconductors (Text2: topics 1.2), Solved problems (Text2: Prob 1.2,), Zener diode Applications (Text2: 1.15), Solved problems (Text2: Prob 2.1 & 2.4), Types of transistors (Text2: topics 3.5)*

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. Determination of internal parameters of a choke coil
5. Impedance calculations and phasor representation of RL series circuit
6. Impedance calculations and phasor representation of RC series circuit
7. Load test on 1-phase transformer
8. Single phase bridge rectifier using R load
9. Zener diode as voltage regulator
10. Input and output characteristics of BJT
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. Uma Rao, *Basic Electrical Engineering*, Pearson Education, 2011 (Unit-I, II & III)
2. S Salivahanan & N Suresh Kumar , *Electronic Devices and Circuits*, 5th ed., Tata McGraw Hill (Unit -IV)

Reference Book(s):

1. B.L.Thereja, A.K.Thereja, *Electrical Technology Vol. I & II* , S.Chand & Company Ltd, 2005.
2. Edward Hughes, *Electrical & Electronics Technology*, 10th ed., Pearson Education, 2010.
3. D. P. Kothari and I. J. Nagrath, *Basic Electrical Engineering*, Tata McGraw Hill, 2010.
4. Chakravarthy A, Sudhipanath and Chandan Kumar, *Basic Electrical Engineering*, 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 & Electronics Engineering Laboratory Manual and Record Book,* Department of EEE, KITSW.

Course Learning Outcomes (COs):

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

(based on cognitive skills acquired from the theory component)

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

CO2: determine impedance, voltage, current, and power in 1- Ø AC circuits & determine line and phase quantities in 3- Ø AC circuits

CO3: select a suitable electrical machine for the given applications

CO4: determine the voltage and current characteristics of diodes and transistors

(based on psychomotor skills acquired from laboratory component)

CO5: validate mesh and nodal analysis

CO6: determine the impedance of series RL & RC circuits

CO7: determine the efficiency of a transformer by conducting a load test and verify Kirchhoff's laws using PSPICE

CO8: determine the characteristics of BJT and determine the parameters of a rectifier circuit

Course Articulation Matrix (CAM):		**U24EE205A : BASIC ELECTRICAL & ELECTRONICS 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	**U24EE205A.1**	2	1	-	-	-	-	1	1	1	1	**1**	2	1
CO2	**U24EE205A.2**	2	2	-	-	-	-	1	1	1	1	**1**	2	1
CO3	**U24EE205A.3**	3	3	1	1	1	1	1	1	1	1	**1**	2	1
CO4	**U24EE205A.4**	3	3	1	1	1	1	1	1	1	1	**1**	2	1
CO5	**U24EE205A.5**	2	1	-	-	-	-	1	1	1	1	**1**	2	1
CO6	**U24EE205A.6**	2	2	-	-	-	-	1	1	1	1	**1**	2	1
CO7	**U24EE205A.7**	3	3	1	1	1	1	1	1	1	1	**1**	2	1
CO8	**U24EE205A.8**	3	3	1	1	1	1	1	1	1	1	**1**	2	1
U24EE205A		**2.5**	**2.25**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

ENVIRONMENTAL STUDIES

Class: B. Tech. II Semester		**Branch:** Common to ME, CSM, CSD, IT, CSN & CSO	
CourseCode:	**U24CY206**	**Credits:**	**-**
Hours/Week(L-T-P-O-E):	**2-0-0-2-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

Thiscourse will develop students' knowledge in/on…

LO1:natural resources and their usage more equitably

LO2: ecosystem and the importance of biodiversity conservation

LO3: environmental pollution and it'scontrol measures

LO4: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

Self Learning Topics(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)*

Textbook(s):

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

Reference Book(s):

1. Y. Anjaneyulu, *Introduction to Environmental Science*, B.S. Publications, 2004.
2. Gilbert M. Masters, *Introduction to Environmental Engineering & Science*, 3rd ed., Prentice Hall of India, 1991
3. Anubha Kaushik, C.P. Kaushik, *Environmental Studies*, 4th ed., New Age International Publishers, 2014
4. R.Rajagopalan, *Environmental Studies from crisis to cure*, 2nd ed., Oxford University Press, 2011

Weband Videolink(s):

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

CourseLearningOutcomes(COs):

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

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

Course Articulation Matrix (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	-	1	-	-	-
CO2	**U24CY206.2**	-	-	2	-	-	2	-	1	-	1	-	1	-
CO3	**U24CY206.3**	1	2	1	-	-	1	1	1	-	1	-	1	-
CO4	**U24CY206.4**	-	-	1	-	-	2	-	1	-	1	-	-	-
U24CY206		**1.5**	**1.5**	**1.5**	**1**	**-**	**1.75**	**1**	**1**	**-**	**1**	**-**	**1**	**-**
3–HIGH,2–MEDIUM,1-LOW														

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 :**	**60%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: carpentry and CNC wood router
LO2: mould for sand casting and arc welding joints
LO3: laser engraving, 3D printing and robots in manufacturing
LO4: Printed Circuit Board (PCB) and Internet of Things (IoT)

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:

- ***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*", Vol-I-2008 &Vol-II-2010, Media Promoters and publishers Pvt. Ltd, India,

2. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "*Additive Manufacturing Technologies-3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*" 2nd ed., Springer Nature, 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 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

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	1	1	2
CO2	**U24AE207.2**	2	2	1	1	2	1	1	2	2	1	1	1	2
CO3	**U24AE207.3**	2	2	1	1	2	1	1	2	2	1	1	1	2
CO4	**U24AE207.4**	2	2	1	1	2	1	1	2	2	1	1	1	2
	U24AE207	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PRACTICUM-2			
Class: B.Tech. II-Semester	**Branch:** Common to all branches		
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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparing well-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

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	U24PS102	U24EC103	U24CS104	U24EE105	U24CH106
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053
	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- 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 timetable 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 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 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 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

Course Articulation Matrix (CAM):		**U24EL209 PRACTICUM-2**											
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	**U24EL209.1**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	**U24EL209.2**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	**U24EL209.3**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	**U24EL209.4**	2	2	2	2	2	2	2	2	2	2	2	2	2
	U24EL209	**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. 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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentation through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

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/ 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 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. 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/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 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 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. ***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.

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 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

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 Articulation Matrix (CAM):		**U24VA210 (SE/SA) ZZZ- Courses listed under SEA/ SAA**											
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	**U24VA210.1**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO2	**U24VA210.2**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO3	**U24VA210.3**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO4	**U24VA210.4**	-	-	-	-	-	2	2	2	2	2	2	-	-
U24VA210		-	-	-	-	-	2	2	2	2	2	2	**-**	**-**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course Code: **U24VA 210 (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

EXPERT TALK SERIES-2			
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:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice and applying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

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 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 Learning Outcomes (COs):
After completion of this course, the students should be able to…

CO5: 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

CO6: 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

CO7: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO8: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

Course Articulation Matrix (CAM):		**U24AE211 EXPERT TALK SERIES-2**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 10**	**PO 11**	**PO 12**	**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**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

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

INTERNAL COMBUSTION ENGINES			
Class: B. Tech. II –Semester (Exit)		**Branch:** ME	
Course Code:	**U24ME212X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: Classification, components and nomenclature of an IC Engine

LO2: valve timing diagram of SI and CI engines

LO3: performance parameters of an IC engine

LO4: fuel supply systems of an IC engine

THEORY COMPONENT

UNIT-I	**4 Hrs**

IC Engines: Basic engine components and nomenclature; classification of engines; Working principle of two and four stroke SI & CI engines, Valve and port timing diagrams of IC engines

UNIT-II	**4 Hrs**

Testing of IC Engines: Measurement of brake power, friction power and indicated power; indicator diagram, fuel and air consumption

UNIT-III	**4 Hrs**

IC Engine Characteristics: Mean effective pressure, specific fuel consumption, air-fuel ratio, mechanical, volumetric and thermal efficiencies, effect of clearance volume on volumetric efficiency, Heat balance sheet

UNIT-IV	**4 Hrs**

Fuel Supply Systems: SI Engines - carburetion, mixture requirements; calculation of air fuel ratio; types of carburetors; CI Engines - functional requirements of an injection system, injection pump and injector nozzle

LABORATORY COMPONENT

List of Experiments

1. Load test on conventional single-cylinder four-stroke Compression Ignition Engine with Brake Drum Dynamometer.
2. Heat Balance test on conventional single-cylinder four-stroke Compression Ignition Engine with Brake Drum Dynamometer.
3. Load test on conventional twin-cylinder, four-stroke Compression Ignition engine with hydraulic dynamometer.
4. Heat balance test conventional twin-cylinder, four-stroke, Compression Ignition engine with hydraulic dynamometer
5. Performance test on single-cylinder, four-stroke Compression Ignition engine with eddy current dynamometer with Variable Compression Ratio.
6. Valve Timing Diagram of a single-cylinder four-stroke, Compression Ignition Engine.
7. Morse test on four-stroke, four-cylinder Spark Ignition Engine.
8. Performance test on computer-aided single-cylinder four-stroke, Compression Ignition Engine with eddy current Dynamometer.

Textbook(s):

1. Ganesan V., *Internal Combustion Engines*, 4th ed., New Delhi: Tata McGraw-Hill, 2013. *(Chapters 1, 2,15,16)*
2. Mahesh M Rathore, *Thermal Engineering*, New Delhi: Mc Graw Hill, 2010.

Reference Book(s):

1. Heywood J.B., *Internal Combustion Engine Fundamentals*, revised edition, New Delhi: McGraw-Hill, 1988.
2. Colin Ferguson R., Allan Kirkpatrick T., *Internal Combustion Engines: Applied Thermo sciences*, 2nd ed., New Delhi: Wiley, 2001.
3. Gupta H.N., *Fundamentals of Internal Combustion Engines*, 2nd ed., New Delhi: PHI Pvt. Ltd., 2012.
4. Rajput R.K., *Text book on Internal Combustion Engines*, New Delhi: Laxmi publication Pvt. Ltd., 2013.

Web and Video link(s):

https://archive.nptel.ac.in/courses/112/103/112103262/ ; *NPTEL Video Lecture on IC Engines by Prof. Pranab K. Modal, Professor of ME, IIT Guwahati & Prof. Vinayak N Kulkarni, Professor of ME, IIT Guwahati.*

Laboratory Manual (for laboratory component):

1. *IC Engines laboratory manual,* Department of ME, KITSW

Course Learning Outcomes (COs)

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

(based on cognitive skills acquired from theory component)

CO1: compare SI and CI Engines
CO2: evaluate the performance parameters
CO3: solve the numerical problems on IC engines Characteristics
CO4: analyse the fuel supply systems for SI and CI engines

(based on knowledge acquired from laboratory component)

CO5 : analyse characteristics of an SI engine
CO6 : evaluate performance Characteristics of an CI engine
CO7 : draw the valve timing diagram of a CI engine
CO8 : draw the heat balance sheet of an IC engine

Course Articulation Matrix (CAM)		U24ME212X INTERNAL COMBUSTION ENGINES											
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	U24ME212X.1	-	-	1	-	-	1	1	1	1	1	1	1	1
CO2	U24ME212X.2	-	-	1	-	-	1	1	1	1	1	1	1	1
CO3	U24ME212X.3	1	2	1	-	2	1	1	1	1	1	1	1	1
CO4	U24ME212X.4	1	2	1	-	2	1	1	1	1	1	1	1	1
CO5	U24ME212X.5	-	-	1	-	-	1	1	1	1	1	1	1	1
CO6	U24ME212X.6	-	-	1	-	-	1	1	1	1	1	1	1	1
CO7	U24ME212X.7	1	2	1	-	2	1	1	1	1	1	1	1	1
CO8	U24ME212X.8	1	2	1	-	2	1	1	1	1	1	1	1	1
U24ME212X		**1**	**2**	**1**	**-**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

MACHINE DRAWING AND MODELLING			
Class: B.Tech. II-Semester (Exit)		**Branch:** ME	
Course Code:	**U24ME213X**	**Credits:**	**03**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: conventions, limits, fits & tolerances used in machine drawing.
LO2: screw threads, bolts, nuts and keys
LO3: cotter joint, revolving centre and types of couplings.
LO4: riveted joints, bearings and screw jack

THEORY COMPONENT

UNIT-I	**4 Hrs**

Introduction: Classification of machine drawings, Conventional representation- Materials, Springs, Welded joints, Gears, Machine components and Surface roughness; Limits, Fits and Tolerances- Introduction, representation of fits, hole and shaft basis systems

UNIT-II	**4 Hrs**

Machine Elements: Screw fastening - Screw thread nomenclature, Types of thread profiles; Bolted joints- Hexagonal headed bolt with nut and washer, studded joint; Nuts- Lock nut, castle nut, wile"s lock nut; Foundation bolts- eye foundation bolt; Keys- Representation of saddle key, sunk keys.

UNIT-III	**4 Hrs**

Cotter joints- Cotter joints with sleeve, knuckle joint; **Couplings**- Flexible couplings types of flanged couplings; **Non-aligned couplings**-Universal coupling, Oldham's coupling; Revolving Center.

UNIT-IV	**4 Hrs**

Riveted joint-Types of riveted joints and rivet heads; **Bearings**- Solid journal bearing, bushed journal bearing, Plummer block, collar thrust bearing, foot step bearing, Anti-friction bearings; Screw Jack.

LABORATORY COMPONENT

List of Experiments

1. Draw the Conventional representation of Welded Joints and Materials; introduction to AUTOCAD software-GUI, Settings, Standard toolbar, toolbars - DRAW, MODIFY, DIMENSION and PROPERTIES, design centre and tool palettes
2. Draw the diagram illustrating basic size deviations and tolerances.
3. Draw the different types of Screw thread profiles
4. Draw a hexagonal headed bolt with a nut and a washer in position, Eye foundation bolt.
5. Draw the Assembly of KNUCKLE JOINT
6. Draw the part drawing of Revolving Center
7. Draw the Assembly of BUSHED BEARING.
8. Draw the Assembly of SCREW JACK.

Text book(s):

1. Siddheshwar, Kannaiah and Sastry, *Machine Drawing*, 48th reprint ed., New Delhi: McGraw-Hill Education Pvt. Ltd., 2014.

Reference Book(s):

1. Narayana, Venkat Reddy and Kannaiah, *Machine Drawing*, 3rd ed., New Age International, 2009.
2. Bhatt N. D. and Panchal V. M., *Machine Drawing*, 46th ed., Charotar Publishing House, 2011.

Web and Video link(s):
https://onlinecourses.swayam2.ac.in/aic22_ts41/preview Engineering drawing and computer graphics in Telugu, SWAYAM-NPTEL lecture by Prof. Rajaram Lakkaraju, IIT Kharagpur

Laboratory Manual (for laboratory component): *Modelling Laboratory Manual,* Department of Mechanical Engineering, KITSW.

Course Learning Outcomes (COs): Course Learning Outcomes (COs):

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

CO1: apply the conventions, limits, fits & tolerances in machine drawing
CO2: draw screw threads, bolts, nuts and keys
CO3: draw sectional views of cotter joint and couplings
CO4: draw sectional views of riveted joints and bearings

(based on skills acquired from laboratory component)

CO5: apply the conventions, limits, fits & tolerances in machine drawing
CO6: draw screw thread profiles and bolted joints
CO7: assemble knuckle joint and draw part drawing of revolving center
CO8: draw the assembly of bushed bearing and screw jack

Course Articulation Matrix (CAM):		**U24ME213X MACHINE DRAWING AND MODELLING**											
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	**U24ME213X.1**	2	1	-	-	-	1	1	1	1	1	1	1	1
CO2	**U24ME213X.2**	2	1	-	-	-	1	1	1	1	1	1	1	1
CO3	**U24ME213X.3**	2	1	-	-	-	1	1	1	1	1	1	2	1
CO4	**U24ME213X.4**	2	1	-	-	-	1	1	1	1	1	1	2	-
CO5	**U24ME213X.5**	2	1	-	-	1	1	1	1	1	1	1	1	1
CO6	**U24ME213X.6**	2	1	-	-	1	1	1	1	1	1	1	1	1
CO7	**U24ME213X.7**	2	1	-	-	1	1	1	1	1	1	1	2	1
CO8	**U24ME213X.8**	2	1	-	-	1	1	1	1	1	1	1	2	1
	U24ME213X	**2**	**1**	**-**	-	**1**	1	**1**	**1**	**1**	1	**1**	**1.5**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

BASIC MECHANICAL ENGINEERING			
Class: B.Tech. II-Semester (Exit)		**Branch:** ME	
Course Code:	**U24ME214X**	**Credits:**	**03**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: the basic elements of power transmission and bearings.
LO2: the basic manufacturing processes and sand casting
LO3: principles of welding
LO4: fundamentals of machining

THEORY COMPONENT

UNIT-I	**4 Hrs**

Power Transmission: Classification; Flat belt drives - open and cross belts; Introduction to Gears. **Bearings**: Types - Sliding and rolling contact; Lubricants - Objectives, types, properties and applications.

UNIT-II	**4 Hrs**

Manufacturing Processes: Classification and their applications.
Sand Casting: Terminology; Mould cross section; Moulding sand-types and properties; Patterns-types, materials and allowances.

UNIT-III	**4 Hrs**

Welding: Principle, equipment and applications of gas welding, types of flames; Principle, equipment and applications of arc welding; brazing and soldering

UNIT-IV	**4 Hrs**

Machining: Classification; Lathe machine-line diagram and functions of various parts, lathe operations; milling machine-construction and operations, drilling machine-construction and operations

LABORATORY COMPONENT

List of Experiments

1. Prepare a Square fit using Mild Steel Plates
2. Prepare a Half round fit using Mild Steel Plates
3. Prepare a Sand Mould using bracket pattern
4. Prepare a Sand Mould using dumbbell pattern
5. Prepare a Lap joint on Mild Steel Plates using Arc Welding
6. Prepare a Single V – Butt Joint on Mild Steel Plates using Arc Welding
7. Perform a Step turning operation on mild steel bar
8. Perform a Taper turning operation on mild steel bar

Text book(s):

1. Basant Agrawal and Agrawal C.M., *Basic Mechanical Engineering*, New Delhi: Wiley India Pvt. Ltd.
2. Mathur, Mehta and Tiwari, *Elements of Mechanical Engineering*, New Delhi: Jain Brothers.
3. Hazra Chowdary. S. K and Bose, *Basic Mechanical Engineering*, Media Promoters and Publishers Pvt. Ltd, India.

Reference Book(s):

1. Nag P. K., *Engineering Thermodynamics*, New Delhi: Tata McGraw Hill.
2. Hazra Chowdary S. K and Bose, *Workshop Technology*, Vol. I & II, Media Promoters and publishers Pvt. Ltd., India,

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc24_me104/preview NPTEL Video Lecture on Basics of Mechanical Engineering – 1 Prof. Janakranjan Ramkumar, Prof. Amandeep Singh Oberoi, IIT Kanpur

Laboratory Manual (for laboratory component): *Workshop Laboratory Manual,* Department of Mechanical Engineering, KITSW.

Course Learning Outcomes (COs): Course Learning Outcomes (COs):

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

(based on cognitive skills acquired from theory component)

CO1: differentiate between belt drive and gear drive; Sliding and rolling contact bearings
CO2: classify manufacturing processes and illustrate sand casting process
CO3: compare and contrast arc and gas welding; brazing and soldering
CO4: draw the constructional diagram of lathe, milling, drilling and list their operations

(based on skills acquired from laboratory component)

CO5: Assemble parts of the fitting joints
CO6: design and prepare a mould cavity using single and two piece pattern
CO7: produce weld joints using arc welding and gas welding
CO8: perform various operations on lathe

Course Articulation Matrix (CAM):		**U24ME214X BASIC MECHANICAL 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	**U24ME214X.1**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO2	**U24ME214X.2**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO3	**U24ME214X.3**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO4	**U24ME214X.4**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO5	**U24ME214X.5**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO6	**U24ME214X.6**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO7	**U24ME214X.7**	1	1	-	-	-	-	1	1	1	1	1	1	1
CO8	**U24ME214X.8**	1	1	-	-	-	-	1	1	1	1	1	1	1
U24ME214X		**1**	**1**		-	-	-	1	1	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

III SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	BSC	U24MH301B	Applied Mathematics	2	1	-	6	9	3
2	PCC	U24ME302	Mechanics of Materials	2	1	2	5	10	4
3	PCC	U24ME303	Manufacturing Technology	2	1	2	5	10	4
4	PCC	U24ME304	Heat Power Engineering	2	1	-	4	7	3
5	ESC	U24ME305	Python Programming	2	1	2	5	10	4
6	VAC	U24VA306B	Soft and Interpersonal Skills*			2	2	4	1
7	SEC	U24SE307	PSD LAB-02	-	-	2	2	4	1
8	ELC	U24EL308	Practicum-3	-	-	-	4	4	1
9	VAC	U24VA309	SEA-3 / SAA -3	-	-	-	2	2	1
10	AEC	U24AE310	Expert Talk Series-3	-	-	-	1	1	1
Total:				**12**	**5**	**8**	**36**	**61**	**23**
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	-	05
Total credits for Honours/Minor students:				-	-	-	-	-	**28**
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)				**-**	**-**	**-**	**-**	**-**	**-**

Branch Specific Mathematics (Pool-IV)		
S. No.	**Course Code**	**Course Title**
1.	U24MH301A	Numerical and Statistical Methods *(for Civil Engineering)*
2.	U24MH301B	Applied Mathematics *(for Mechanical Engineering)*
3.	U24MH301C	Mathematical foundations for Signal Processing *(for ECI)*
4.	U24MH301D	Discrete Mathematics and Probability Statistics *(Common to CSE, CSN, CSO & IT)*
5.	U24MH301E	Essential Mathematics and Statistics for Machine learning *(for CSM)*
6.	U24MH301F	Essential Mathematics and Statistics for Data science *(for CSD)*

@U24VA306 T & P Basket		
S. No.	**Course Code**	**Course Title**
1.	U24VA306A	Quantitative Aptitude and Logical Reasoning *(for Stream I)*
2.	U24VA306B	Soft and Interpersonal Skills Lab *(for Stream II)*

APPLIED MATHEMATICS (*for Mechanical Engineering*)			
Class: B.Tech. III -Semester		**Branch: Mechanical Engineering**	
Course Code:	**U24MH301B**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: Laplace transform, Fourier series and applications of partial differential equations
LO2: calculus of complex functions, complex integration
LO3: interpolation, numerical integration, and solution of equations using numerical methods
LO4: statistical methods, probability and distributions

UNIT-I	**9 Hrs**

Laplace Transforms-Definition**,** Conditions for the existence of Laplace transform, transforms of elementary functions, Properties of Laplace transforms- Linearity property, First shifting property, Multiplication by 't^n', Division by 't'. Inverse Transforms—Method of partial fractions, Convolution theorem (statement only), Solution to boundary value problems of ordinary differential equations.

Fourier Series: Periodic functions, Orthogonal and orthonormal functions, Euler's formulae, representation of a function as trigonometric Fourier series (FS) in the intervals $(0, 2\pi)$ and $(-\pi, \pi)$ Conditions for a Fourier series expansion (Dirichlet's conditions), Half range series- half range cosine and sine series expansions in the interval $(0, \pi)$.

Applications of Partial Differential Equations: Method of separation of variables- Solution of one-dimensional wave, One dimensional heat flow, and Laplace's equations.

Self-Learning Topics (SLTs): *Transforms of periodic functions, Evaluation of integrals by Laplace transforms, other methods of finding inverse transforms [Text 1: topics 21.5, 21.11, 21.13]*
Functions having points of discontinuity, Change of interval, half range cosine and sine series expansions in the interval (0, l) [Text 1: topics 10.4, 10.5, 10.7]
Problems on vibrations of a stretched string, Problems on One dimensional heat flow [Text 1: topics 18.4, 18.5]

UNIT-II	**9 Hrs**

Calculus of Complex functions: Functions of complex variables, Limit, Continuity, and derivative of a complex function, Analytic functions- Cauchy-Riemann equations, Harmonic functions, Application to flow problems, Construction of analytic functions-Milne-Thomson method.

Complex Integration: Line integration in complex plane, Cauchy's theorem, Cauchy's integral formula, Series of complex terms-Taylor's series and Laurent's series**.** Cauchy's residue theorem and applications.

Self-Learning Topics (SLTs): *Additional problems on Application to fluid flow [Text 1: topic 20.6, Solved problem: 20.8, Practice problems: exercise 20.1 (17,18,23)], Additional problems on construction of analytic functions [Text 1: topic 20.6, Solved problem: 20.7, Practice problems: exercise 20.1 (14,15)]*
Additional problems on Cauchy's integral formula[Text 1: topic 20.14, Solved problem: 20.22, Practice problems: exercise 20.6 (4)], Additional problems on Taylor's series and Laurent's series [Text 1: topic 20.16, Solved problem: 20.27, 20.29 Practice problems: exercise 20.7 (7)]

UNIT-III	**9 Hrs**

Interpolation: Application of Lagrange interpolation to estimate the value of a dependent variable from the experimental data.

Numerical Integration: Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications of Simpson's rule to find the displacement and velocity of a moving particle.

Solution to System of Linear Equations: Iterative methods of solution-Jacobi's iteration method and Gauss-Seidel iteration method, Operational counts (computational complexity) for Jacobi and Gauss-Seidel iterative methods.

Numerical Solution of Equations: Solution of algebraic and transcendental equations**-** Bisection method, Regula-Falsi method, Secant method and Newton Raphson method.
Numerical Solution of Ordinary Differential Equations: Taylor's series method, Euler's method and Runge - Kutta method of order four.

Self-Learning Topics (SLTs): *Additional problems on Bisection method, Regula-Falsi method and Newton Raphson's method [Text 1: topic 28.2, Solved problem: 28.2,28.4,28.5 Practice problems: exercise 28.1 (1,3,6)], Additional problems on Taylor's series method, Euler's method and Runge - Kutta method of order four [Text 1: topic 32.3, 32.4, 32.7, Solved problem: 32.5,32.7,32.14 Practice problems: exercise 32.3 (3)]*

UNIT-IV	**9 Hrs**

Probability and Distributions: Review of the concepts of probability, Random variable, Discrete probability distribution and continuous probability distribution, Binomial distribution, Poisson distribution, Mean and variance of distributions, Normal distribution and Exponential distribution.
Applications: fitting of Binomial distribution, Poisson distribution to the given real time data.

Self-Learning Topics (SLTs): *Additional problems on Measures of central tendency [Text 1: topic 25.5, Solved problems: 25.2, Practice problems: exercise 25.1 (3)], Additional problems on Binomial distribution[Text 1: topic 26.14, Solved problems: 26.40, Practice problems: exercise 26.5 (15)], Additional problems on Poisson distribution [Text 1: topic 26.15, Solved problems: 26.43, Practice problems: exercise 26.6 (12)]*

Textbook(s):

1. Grewal, B.S., *Higher Engineering Mathematics*, 44rd ed., Delhi: Khanna Publishers, 2017.

Reference Book(s):

1. Kreyszig E, *Advanced Engineering Mathematics*, Inc, 10th ed., U.K: John wiely & sons, 2020
2. S.P.Gupta, *Statistical Methods*, 46th ed., New Delhi: Sultan Chand & Sons, 2023.
3. S.S. Sastry, *Engineering Mathematics,* Vol. II, 3rd ed., Prentice Hall of India, 2014.
4. Richard L. Burden, Douglas Faires J., *Numerical Analysis,* 9th ed., 2011.

Web and Video link(s):

1. https://youtu.be/HoGNkZclxDU?si=K9DFQ4jVL1OQiArb : *NPTEL Video Lecture on Fourier Series and its Convergence/Dr.S.K.Gupta /IIT Roorkee*
2. https://youtu.be/2NcQi41VX9g?si=IY5I42ue87U__EDx: *NPTEL Video Lecture on Numerical methods./Prof.R. Usha / IIT Madras*

Course Learning Outcomes (COs):

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

CO1: apply Laplace transforms to solve differential equations and represent a function as Fourier series

CO2: construct analytic function, represent a complex function in series and evaluate real integrals using integral theorems

CO3: apply numerical methods to solve simultaneous equations, differential equations, and find root of algebraic and transcendental equations

CO4: apply theoretical probability distributions in decision making

Course Articulation Matrix (CAM): U24MH301B APPLIED MATHEMATICS														
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	**U24MH301B.1**	2	2	1	1	-	-	-	1	1	-	1	2	1
CO2	**U24MH301B.2**	2	2	1	1	-	-	-	1	1	-	1	2	1
CO3	**U24MH301B.3**	2	2	1	1	-	-	-	1	1	-	1	2	1
CO4	**U24MH301B.4**	2	2	1	2	-	-	-	1	1	-	1	2	1
	U24MH301B	**2**	**2**	**1**	**1.25**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**1**

MECHANICS OF MATERIALS			
Class: B. Tech. III-Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME302**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: simple stress, strain and thermal stresses
LO2: shear force & bending moment and theory of simple bending
LO3: deflections of beams and shear stresses in beams
LO4: torsion of circular shafts, columns and thin cylinders

THEORY COMPONENT

UNIT-I	9 Hrs

Simple Stress and Strain: Types of loads, Stress, Shear stress, Strain, Poisson's ratio, Modulus of elasticity, Modulus of rigidity, Volumetric strain, Bulk modulus; Relation between elastic constants, Principle of superposition, Bars of varying sections, Bars of uniform strength, Compound bars, Thermal stresses, Factor of safety

Self-Learning Topics (SLTs): *Modulus of elasticity and modulus of rigidity (Textbook 1, Section 1.5); relation between elastic constants (Textbook 1, Section 1.9)*

UNIT-II	9 Hrs

Shear Force and Bending Moment: Types of supports and beams, Shear force, Bending moment, relation between intensity of loading, Shear force and bending moment; Shear force and bending moment diagrams for cantilever, Simply supported beams and overhanging beams
Theory of Simple Bending: Assumptions, Derivation of basic equation, Flexure formula, Modulus of section, Moment of resistance; Determination of bending stresses in beams of various cross-sections—rectangular, Solid circular, Hollow circular and I-sections

Self-Learning Topics (SLTs): *Types of supports (Textbook 1, Section 4.2); Relation between intensity of loading, Shear force and bending moment (Textbook 1, Section 4.6)*

UNIT-III	9 Hrs

Deflections of Beams: Slope and deflection of cantilever and simply supported beams for point loads and uniformly distributed loads; Analysis using the double integration method and Macaulay's method
Shear Stresses in Beams: Equation of shear stress; Shear stress distribution across rectangular, Circular and I-sections

Self-Learning Topics (SLTs): *Step-by-step use of Macaulay's method for beam deflections (Textbook 1, Section 6.5); derivation of shear stress formula (Textbook 1, Section 7.2)*

UNIT-IV	9 Hrs

Torsion of Circular Shafts: Theory of pure torsion, Derivation of basic equation, Solid and hollow circular shafts, Torsional shear stresses and angle of twist; Power transmission
Columns: Euler's crippling load of columns
Thin Cylinder: Hoop stress and longitudinal stress in thin cylinders

Self-Learning Topics (SLTs): *Derivation of torsion equation (Textbook 1, Section 8.3); Types of column end conditions (Textbook 1, Section 11.1)*

LABORATORY COMPONENT

1. Determination of stress–strain characteristics of mild steel / TOR steel
2. Determination of the compressive strength of wood
3. Determination of Brinell's hardness numbers for steel, brass, and aluminum
4. Determination of the modulus of rigidity by conducting a torsion test on a solid shaft/hollow shaft
5. Determination of the modulus of rigidity by conducting a compression test on a spring
6. Determination of the Young's modulus of the given material by conducting a flexural test on a simply supported beam
7. Determination of the Young's modulus of the given material by conducting a flexural test on a continuous beam
8. Determination of the Young's modulus of the given material by conducting a flexural test on a propped cantilever beam
9. Bend and rebend test on a steel specimen
10. Shear test for a mild steel specimen
11. Impact test on metal specimens using the Izod test
12. Impact test on metal specimens using the Charpy test

Textbook:

1. S.S. Rattan, *Strength of Materials*, 3rd ed., New Delhi: McGraw-Hill Education, 2016.

Reference Book(s):

1. B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, *Strength of Materials*, 10th ed., New Delhi: Laxmi Publications, 2015.
2. T.D. Gunneswara Rao and M. Andal, *Strength of Materials: Fundamentals and Applications,* 1st ed., Cambridge: Cambridge University Press, 2018.
3. Egor P. Popov, *Engineering Mechanics of Solids*, 12th ed., USA: Prentice Hall, 2016.
4. James M. Gere and Barry J. Goodno, *Mechanics of Materials*, Enhanced 9th ed., Boston MA: Cengage Learning, 2020.
5. Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, and David F. Mazurek, *Mechanics of Materials*, 8th ed., New York: McGraw-Hill Education, 2019.
6. Irving H. Shames and James M. Pitarresi, *Introduction to Solid Mechanics*, 3rd ed., Upper Saddle River, NJ: Prentice Hall, 2000.
7. S. Ramamrutham and R. Narayanan, *Strength of Materials*, 18th ed., New Delhi: Dhanpat Rai Publications, 2014.
8. E.C. Subba Rao, *Testing and Inspection of Engineering Materials*. 1st ed., New Delhi: Tata McGraw-Hill, 1998.
9. Harmer E. Davis, George Earl Troxell, and Clement T. Wiskocil, *The Testing and Inspection of Engineering Materials*, 2nd ed., New York: McGraw-Hill Book Company, 1955.
10. A.V.K. Suryanarayana, *Testing of Metallic Materials*, 2nd ed., Hyderabad: BS Publications, 2018.

Web and Video link(s):

1. **https://nptel.ac.in/courses/112107147,** *NPTEL video lecture on Characteristics of Stress strain curve for different materials by Prof. S. K. Bhattacharyya, IIT Kharagpur.*
2. **https://nptel.ac.in/courses/105105166,** *NPTEL video lecture on Deflection of beams by Prof. B. Bhattacharjee, IIT Delhi.*

Laboratory Manual (for laboratory component):

Mechanics of Materials Laboratory Manual, Dept. of ME, KITSW.

Course Learning Outcomes (COs): 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 elastic constants & stress-strain relationships to solve problems involving axially loaded members & thermal stresses

CO2: construct shear force and bending moment diagrams for beams subjected to various loads and calculate bending stresses

CO3: determine slope and deflection of beams using analytical methods and analyze shear stress distribution across beam sections

CO4: design circular shafts using torsion theory, evaluate thin cylindrical shells under pressure and analyze column stability using Euler's buckling theory

(based on skills acquired from laboratory component)

CO5: plot and interpret the stress–strain characteristics of mild steel / TOR steel

CO6: determine the hardness of materials using standard hardness tests

CO7: estimate stiffness and modulus of rigidity through compression tests on springs and torsion tests on shafts

CO8: examine the mechanical behavior and limitations of materials through experimental testing

Course Articulation Matrix (CAM):		**U24ME302 Mechanics of Materials**												
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	**U24ME302.1**	3	2	-	2	1	-	-	1	1	1	1	2	1
CO2	**U24ME302.2**	3	2	-	2	1	-	-	1	1	1	1	2	1
CO3	**U24ME302.3**	3	2	-	2	1	-	-	1	1	1	1	2	1
CO4	**U24ME302.4**	3	2	2	2	2	-	-	1	1	1	1	2	1
CO5	**U24ME302.5**	3	2	-	2	2	-	-	1	1	1	1	2	1
CO6	**U24ME302.6**	3	-	-	2	2	-	-	1	1	1	1	2	1
CO7	**U24ME302.7**	3	2	-	2	2	-	-	1	1	1	1	2	1
CO8	**U24ME302.8**	3	2	2	2	2	1	1	1	1	1	1	2	1
U24ME302		**3**	**2**	**2**	**2**	**1.62**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

MANUFACTURING TECHNOLOGY			
Class: B. Tech. III –Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME303**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE Marks (%):**	**60**
Total Number of Teaching Hours:	**60 Hrs**	**ESE Marks (%):**	**40**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: metal casting processes
LO2: metal forming processes
LO3: sheet metal operations
LO4: welding processes

THEORY COMPONENT

UNIT-I	9 Hrs

Metal Casting Processes: Introduction, Pattern-materials, Types and allowances; Moulding materials - sand composition, Types and properties; Sand testing- grain fineness number, Moisture content, Clay content and permeability; Gating system- elements of a gating system, Design of gating system and riser; Casting processes- sand casting, Centrifugal casting, die casting - hot and cold chamber and investment casting; Casting defects

Self-Learning Topics (SLTs): *Sand testing- grain fineness number, Moisture content and clay content (Text 1, chapter - 3)*

UNIT-II	9 Hrs

Metal Forming Processes: Classification; cold and hot working; Rolling - principle and operation, Calculation of rolling load & roll pass design; Forging - principle, Operations and types - open and closed die forging, Drop and upset Forging; Extrusion - principle, Operation and types; Drawing - principle, Operation and types - wire drawing, Rod drawing and tube drawing

Self-Learning Topics (SLTs): *Rod drawing and tube drawing (Text 1, chapter - 7)*

UNIT-III	9 Hrs

Sheet Metal Operations: Types of sheet metals – cold rolled, Close annealed and hot rolled; Shearing principle; Shearing operations-blanking, Punching, Drawing, Bending, Stretch forming, metal spinning, Hemming, embossing and coining; Press tools: types - simple die, Compound die and progressive die; Design of punch and die for punching and blanking; Design of strip layout

Self-Learning Topics (SLTs): *Sheet metal operations – Lancing, nibbling, Perforating, Trimming, Shaving, Slitting and notching. (Text 1, chapter - 8)*

UNIT-IV	9 Hrs

Welding Processes: Classification; Gas welding - principle of oxy-acetylene welding, Types of flames; Electric Arc welding- Principle, Equipment; Types-AC and DC welding; TIG and MIG welding processes; Resistance welding- principle, Types- Butt welding, Spot welding and Seam welding; Solid state welding-principle, Types-Friction welding, Explosive welding; Brazing and Soldering; Electron Beam welding and laser beam welding, welding defects

Self-Learning Topics (SLTs): *Brazing and soldering, welding defects (Text 1, chapter - 9)*

LABORATORY COMPONENT

List of Experiments

1. Observation of microstructures of low, medium and high carbon steels
2. Observation of microstructure of cast irons – grey, nodular and white cast irons
3. Measurement of hardness of ferrous and non-ferrous metals
4. Conduction of liquid penetration test for weld joints
5. Preparation of the specimen using powder metallurgy process

6. Determination of Grain Fineness Number (GFN) of a given sample sand and Shatter Index (SI) of a moulding sand
7. Determination of moisture and clay contents of a given moulding sand
8. Design and development of a wooden pattern for aluminium casting
9. Preparation of a pipe joint using oxy-acetylene welding
10. Preparation of a lap joint using resistance spot welding and TIG welding
11. Conduction of a bend test on a single V butt joint prepared by DC Arc welding
12. Drawing of a shallow cup using hydraulic press

Textbook(s):

1. P. N. Rao, *Manufacturing Technology*, Volume-I, 5th ed., New Delhi: Tata McGraw-Hill, 2018.

Reference Book(s):

1. S. K. Hajra Chowdhury, A. K. Hajra Chowdhury and Nirjhar Roy, *Elements of Workshop Technology* Vol-1, 17th ed., Mumbai: Media Promoters and Publishers Pvt. Ltd., 2015.
2. P. C. Sharma, *A Textbook of Manufacturing (Technology-1),* 1st ed., S. Chand publishing, 2011.
3. Amitabha Ghosh and Asok Kumar Mallik, *Manufacturing Science*, 2nd ed., East-West Press Pvt. Ltd., 2010.
4. V.D. Kodgire, *Material Science & Metallurgy*, 42nd ed., Pune: Everest Publishing House, 2018.
5. E.C. Subba Rao, *Testing and Inspection of Engineering Materials*, New Delhi: Tata McGraw Hill, 1998.

Web and Video link(s):

https://www.youtube.com/watch?v=jdFrBtHeJbs&list=PLSGws_74K01-g9nnTMBssGURHawYYQfMQ *NPTEL Video Lecture on Fundamentals of Manufacturing Processes By Prof. D K Dwivedi, Professor of ME, IIT Roorkee.*

Laboratory Manual (for laboratory component):

Material Science & Manufacturing Processes Laboratory Manual & Record Book, Department of ME, KITSW.

Course Learning Outcomes (COs):

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

(based on cognitive skills acquired from theory component)

CO1: interpret various metal casting processes and design of gating/riser system for sound casting

CO2: compare and contrast various metal forming processes and calculate loads required for rolling & drawing processes

CO3: recommend suitable sheet metal operation for a given industrial application and design punch & die for punching and blanking operations

CO4: classify and illustrate various welding processes

(based on psychomotor skills acquired from laboratory component)

CO5: prepare specimen for metallography and observe microstructure of ferrous metals

CO6: conduct destructive and non-destructive testing on a given specimen

CO7: prepare the sand specimen and conduct standard tests to measure properties of moulding sand; design a given wooden pattern

CO8: prepare a given joint using various welding processes; perform shallow cup drawing operation

Course Articulation Matrix (CAM): U24ME303: MANUFACTURING TECHNOLOGY														
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	U24ME303.1	3	2	2	-	1	-	-	1	1	1	1	1	1
CO2	U24ME303.2	3	2	1	-	-	-	-	1	1	1	1	1	1
CO3	U24ME303.3	3	2	2	-	-	-	-	1	1	1	1	1	1
CO4	U24ME303.4	3	2	1	-	-	-	-	1	1	1	1	1	1
CO5	U24ME303.5	3	2	-	-	1	-	-	2	1	1	1	2	1
CO6	U24ME303.6	3	2	-	-	1	-	-	2	1	1	1	2	1
CO7	U24ME303.7	3	2	-	-	1	-	-	2	1	1	1	2	1
CO8	U24ME303.8	3	2	-	-	1	-	-	2	1	1	1	2	1
	U24ME303	**3**	**2**	**1.5**	**-**	**1**	**-**	**-**	**1.5**	**1**	**1**	**1**	**1.5**	**1**

HEAT POWER ENGINEERING			
Class: B. Tech. III -Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME304**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: properties of steam and vapour power cycles

LO2: steam generators and steam turbines

LO3: classification and testing of IC engines

LO4: fuel supply systems and advances in IC engines

UNIT-I	9 Hrs

Properties of Steam: Steam properties, Use of (steam) property tables, Mollier diagram

Vapor Power Cycles: Components of steam power cycle, Rankine cycle - representation on h-s and T-s diagrams, Rankine cycle with superheat, Reheat and Regeneration

Self-Learning Topics (SLTs): *Terminology of pure substances, (Text1: topics 3.4), Practice problems (Text1: Prob 3.1, 3.2, 3.3, 3.4,), Performance parameters of vapor power cycles (Text1: topics 12.2), Practice problems (Text1: Problem no.12.1, 12.2, 12.3, 12.4)*

UNIT-II	9 Hrs

Steam Generators: Classification; Criteria for selection of a boiler, Functions of boiler Mountings and Accessories, High pressure boilers-Babcock and Wilcox, Benson Boilers

Steam Nozzles: Classification, Applications

Steam Turbines: Classification; Impulse & Reaction turbines - velocity diagrams, Power output, Axial thrust, Maximum blade efficiency; Pressure and Velocity compounding; Comparison of impulse and Reaction turbines

Self-Learning Topics (SLTs): *Working principle of fire tube boilers (Text1: topics 22.2), Condition for maximum discharge through the nozzle (Text1: topics 21.2.3), Solved problems on Impulse & Reaction turbines (Text1: Problem no. 22.1, 22.2, 22.3, 22.13, 22.14, 22.15)*

UNIT-III	9 Hrs

IC Engines: Basic engine components and nomenclature; Classification of engines; Working principle of two and four stroke SI & CI engines; Valve and Port timing diagrams

Testing of IC Engines: Measurement of brake power, Friction power and Indicated power; Indicator diagram, Fuel and air consumption; Performance parameters–mean effective pressure, Specific fuel consumption, Air-fuel ratio, Mechanical, Volumetric and Thermal efficiencies; Heat balance sheet; Effect of clearance volume on volumetric efficiency

Self-Learning Topics (SLTs): *Classification of engines (Text 2: topic 1.5), Solved problems (Text 2: Problem no. 1.1, 1.2, 1.4, 1.5)*

UNIT-IV	9 Hrs

Fuel Supply Systems: SI Engines - carburetion, Mixture requirements; Calculation of air fuel ratio; Types of carburettors; CI Engines - functional requirements of an injection system, Injection pump and Injector nozzle

Supercharging & Scavenging: Effect of supercharging on thermal efficiency; Methods of supercharging and scavenging

Advances in IC engines: Working principles of EGR, MPFI, CRDI and HCCI engines

Self-Learning Topics (SLTs): *Carburetion and factors affecting Carburetion (Text2: topic 7.7), working of HCCI engines (Text 2: topic 20.7)*

Textbook(s):

1. Mahesh M. Rathore, *Thermal Engineering*, 1st ed., New Delhi: Tata Mc Graw-Hill publications, 2010.
2. V. Ganesan, *Internal Combustion Engines*, 4th ed., New Delhi: Tata McGraw-Hill, 2013.

Reference Book(s):

1. V. P. Vasandani and D. S. Kumar, *Heat Engineering*, 4th ed., Metropolitan Book Co. Pvt. Ltd., 2008.
2. R.K. Rajput, *Internal Combustion Engines*, New Delhi: Laxmi publication Pvt. Ltd., 2013.
3. B. Heywood, *Internal Combustion Engine Fundamentals*, revised ed., New Delhi: McGraw-Hill, 1988.

Web and Video link(s):

1. https://archive.nptel.ac.in/courses/112/103/112103277/ *NPTEL Video Lecture on steam power engineering cycles by Prof. Vinayak N. Kulkarnu, Professor of ME, IIT Guwahati.*
2. https://archive.nptel.ac.in/courses/112/103/112103262/ *NPTEL Video Lecture on IC Engines and Gas Turbines by Prof. Pranab K. Mondal & Prof. Vinayak N. Kulkarnu, Professor of ME, IIT Guwahati.*

Course Learning Outcomes (COs):

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

CO1: evaluate properties of steam & efficiency of a Rankine cycle
CO2: categorize boilers & steam nozzles and evaluate performance parameters of steam turbines
CO3: determine performance parameters of IC engines
CO4: analyze fuel supply systems & advancements in IC engines

Course Articulation Matrix (CAM):		U24ME304 HEAT POWER 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	U24ME304.1	2	2	1	1	-	1	-	1	1	-	1	2	1
CO2	U24ME304.2	2	2	1	1	-	1	-	1	1	-	1	2	1
CO3	U24ME304.3	2	2	1	1	-	1	-	1	1	-	1	2	1
CO4	U24ME304.4	2	2	1	1	-	1	-	1	1	-	1	2	1
	U24ME304	2	2	1	1	-	1	-	1	1	-	1	2	1

PYTHON PROGRAMMING			
Class: B.Tech. III -Semester		**Branch:** Common to All	
Course Code:	**U24ME305**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: operators, control statements, functions and iterators of Python programming

LO2: namespaces, modules, collections, string handling methods and regular expressions

LO3: object-oriented programming, files and database connectivity

LO4: numpy, pandas and matplotlib libraries of Python

THEORY COMPONENT

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

Functions: Function definition, Function call, Variable scope and lifetime, the return statement, Advances in defining in functions, Recursive functions, Lambda functions, Iterators, Decorators, Generators

Self-Learning Topics (SLTs): *Installing Python, Testing and Debugging (Text1: Chapter 3 Anexure-1&2), Operator Precedence and Associativity (Text1: topic 3.12.10),* The else statement used with loops *(Text1: topic 4.8), Document Strings(Text1: topic 5.8)*

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, Comprehensions, High order functions

Self-Learning Topics (SLTs): Standard library modules *(Text1: topic 5.13), in & not in operator (Text1: topic 6.7), Variable-length Argument Tuples(Text1: topic 8.4.13), The zip() Function (Text1: topic 8.4.14), String formatting with Dictionaries (Text1: topic 8.6.10)*

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, Class methods, Static methods, Inheritance, Meat classes, Polymorphism, Operator overloading, Magic Methods

Error and Exception handling: Introduction to errors and exceptions, Handling exceptions, Multiple except blocks, Raising exception, Instantiating exceptions, Built-in and User-defined Exceptions, The finally Block, Re-raising exceptions, Assertions, *Multi threading*

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

Self-Learning Topics (SLTs): *Calling class method from another class method (Text1: topics 9.10), Built in class variables (Text1: topic 9.12), Garbage Collection (Text1: topic 9.13), Complex objects (Text1: topic 10.4), Multiple Exceptions in a Single Block (Text1: topic 12.4), Handling exceptions in Invoked Function(Text1: topic 12.9)*

UNIT-IV	9 Hrs

NumPy: The basics of NumPy arrays, Array indexing, Array slicing, Reshaping of array, Concatenation and splitting arrays, Aggregations, Universal Functions, Broad casting of Arrays
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, Vectorized String Operations, Working with Time Series
Visualization with Matplotlib: Importing Matplotlib, Saving figures to files, Simple line plots, Simple scatter plots, Histograms, Binnings, and density, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap

Self-Learning Topics (SLTs): *Sorting array, Structured array operations (Text2: Chapter 2 topics), Rearranging Multi-Indices, Pivoting table (Text2: Chapter 3 topics),* Visualizing errors, Density and Contour plots, Customizing color bars*(Text2: Chapter 4 topics)*

LABORATORY COMPONENT

List of Experiments

Experiment-I:

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. Develop a Python program to demonstrate importance of indentations. Purposefully raise indentation error and correct it
4. Develop a Python program to take input text as command line argument and display it on screen

Experiment-II

1. Develop a Python program that takes 2 numbers as command line arguments and print its sum
2. Develop a Python program to check whether the given number is even or odd
3. Develop a Python program to calculate GCD of 2 numbers
4. Develop a Python program to find Exponentiation (Power) of a number
5. Develop a Python program to find given year is leap year or not
6. Develop a Python program to develop a simple calculator

Experiment-III

1. Develop a Python program to find the Factorial of a given number
2. Develop a Python program to find the Armstrong for a given number
3. Develop a Python program to take a number as input, and print countdown from that number to zero (use while loop)
4. Develop a Python program to demonstrate Iterators
5. Develop a Python program to demonstrate Decorators
6. Develop a Python program to demonstrate Generators

Experiment-IV

1. Develop a Python program to implement a module using import statement (Use python source file as a Module and implement import statement another python source files)
2. Develop a Python program to implement from, import statement
3. Develop a Python program to implement dir() function
4. Develop a Python program to demonstrate packages in python

Experiment-V

1. Develop a Python python program on strings for the following
    a. To display substring in a string
    b. To update an existing string
    c. To implement string concatenation
    d. To demonstrate string formatting operator

2. Develop a Python program to demonstrate use of slicing in strings
3. Develop a Python program to compare two strings
4. Reverse string and call this function for performing the operation)
5. Develop a Python program to demonstrate regular expression functions
6. Develop a Python program to demonstrate regular expressions using Meta characters

Experiment-VI

1. Develop a Python program to demonstrate list and related functions
2. Develop a Python program to demonstrate tuple and related functions
3. Develop a Python program to demonstrate set and related functions
4. Develop a Python program to demonstrate dictionaries
5. Develop a Python program to demonstrate comprehensions
6. Develop a Python program to demonstrate high order functions

Experiment-VII

1. Develop a python program to demonstrate classes and objects
2. Develop a python program to demonstrate class method
3. Develop a python program to demonstrate static method
4. Develop a python program to demonstrate inheritance
5. Develop a python program to demonstrate polymorphism
6. Develop a python program to demonstrate magic methods.

Experiment-VIII

1. Develop a python program to demonstrate multiple exception handling
2. Develop a python program to demonstrate multiple exception rising
3. Develop a python program to demonstrate multiple finally block
4. Develop a python program to demonstrate Assertions
5. Develop a python program on file operations for the following
   a. To open and read data from a file
   b. To write data into a file
   c. To compute number of characters, words, lines in a file

Experiment-IX

1. Develop a python programs to implement database connectivity
   a. Install and verify SQLite Connector for Python
   b. To connect check SQLite Database connectivity
   c. To retrieve and display data from a table
   d. To insert data into a table
   e. To delete rows in a table

Experiment-X

1. Develop a Python program to demonstrate NumPy array
2. Develop a Python program to demonstrate Slice operation
3. Develop a Python program to demonstrate Reshaping of an array
4. Develop a Python program to demonstrate Ufunctions
5. Develop a Python program to demonstrate Broadcasting of numpy arrays
6. Develop a Python program to demonstrate Aggregate operations

Experiment-XI

1. Develop a Python pandas program to create a series from a ndarray
2. Develop a Python pandas program to create a series from input files
3. Develop a Python pandas program to demonstrate indexing and slicing data frames
4. Develop a Python pandas program to demonstrate handling missing values
5. Develop a Python pandas program to demonstrate vectorized string operations,
6. Develop a Python pandas program to demonstrate handling time series data

Experiment-XII

1. Develop a Python program to draw a simple line plot
2. Develop a Python program to draw a scatter plots
3. Develop a Python program to draw a histogram plot
4. Develop a Python program to draw a binning and density
5. Develop a Python program to demonstrate a three dimensional plotting
6. Develop a Python program to demonstrate a geographic basemap

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: O'Reilly Media, 2016 (*Chapter 2 to 4*)

Reference Book(s):

1. Dr. Charles R. Severance, *Python for Everybody-Exploring Data Using Python*, 1st ed. New Delhi: Shroff Publishers, 2016
2. David Beazley, *Python Cookbook*, 3rd ed. California: O'Reilly Media, Inc., 2013
3. Caleb Hattingh, *20 Python Libraries You Aren't Using*, 2nd ed. California: O'Reilly Media, 2016
4. Magnus Lie Hetland, *Beginning Python: from Novice to Professional*, 1st ed. New York: 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*
3. *By Prof. A Ramesh, IIT Roorkee.*
4. https://onlinecourses.nptel.ac.in/noc25_cs69/ *NPTEL Video Lecture on The Joy of Computing using Python By Prof. Sudarshan Iyengar , IIT Ropar*

Laboratory Manual (for laboratory component):

Python Programming Laboratory Manual and Record Book, Department of CSE, KITSW.

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 control statements, operators and functions

CO2: apply collections, namespaces, packages, strings and regular expressions in application development

CO3: apply object-oriented programming principles in real-time problem solving

CO4: develop visualization graphs with Matplotlib and apply Numpy and Pandas libraries for data analysis

(based on psychomotor skills acquired from laboratory component)

CO5: implement and test python programs using operators, control statements &functions

CO6: Implement and test python packages using string handling methods, regular expressions, and collections

CO7: implement and test object oriented paradigms and database operations in Python programming

CO8: build visualization graphs with Matplotlib and adapt packages like Numpy, Pandas for data analysis

Course Articulation Matrix (CAM):		U24ME305: PYTHON PROGRAMMING												
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	U24ME305.1	1	2	2	2	2	1	-	-	-	1	1	1	1
CO2	U24ME305.2	2	2	2	2	2	1	-	-	-	1	1	1	1
CO3	U24ME305.3	2	2	2	2	3	1	-	-	-	1	1	1	1
CO4	U24ME305.4	2	2	2	2	3	1	-	-	-	1	1	1	1
CO5	U24ME305.5	1	2	2	2	2	1	1	1	1	1	2	1	1
CO6	U24ME305.6	2	2	2	2	2	1	1	1	1	1	2	1	1
CO7	U24ME3405.7	2	2	2	2	3	1	1	1	1	1	2	1	1
CO8	U24ME305.8	2	2	2	2	3	1	1	1	1	1	2	1	1
	U24ME305	**1.75**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1.5**	**1**	**1**

SOFT AND INTERPERSONAL SKILLS LABORATORY			
Class: B.Tech. III -Semester		**Branch:** Common to all Branches	
Course Code:	**U24VA306B**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE:**	**100 %**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: analysing self and learning to overcome possible threats

LO2: group dynamics to demonstrate respect for the opinions and beliefs of group

LO3: effective presentations using visual aids and analyzing the videos

LO4: communicating professionally, making resume in line with industry expectations

LIST OF ACTIVITIES

Activity 1: Ice-breaking, Self-Awareness and Just a Minute (JAM)
Activity 2: Self-Introduction & Personal SWOT Analysis
Activity 3: Reading Comprehension & Critical Thinking
Activity 4: Active Listening & Non-Verbal Observation (Video + Peer Practice)
Activity 5: Group Discussion - 1
Activity 6: Resume Building & LinkedIn Profile Review
Activity 7: Group Discussion - 2
Activity 8: Presentation Skills with PPT / Storytelling
Activity 9: Group Discussion - 3
Activity 10: Mock Interviews: Technical & HR
Activity 11: Email Etiquette & Professional Communication
Activity 12: Workplace Etiquette & Conflict Resolution

Course Learning Outcomes (COs):

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

CO1: deliver concise & effective self-introduction and demonstrate confidence, spontaneous speaking skills within a limited time

CO2: conduct a personal SWOT analysis to identify areas for self-improvement and career development

CO3: demonstrate clear & respectful communication, leadership, positive attitude and improve interpersonal relationship by actively participating in group discussions, collaborative tasks & mock interviews

CO4: create a professional resume, develop a LinkedIn profile and demonstrate effective video communication by making effective videos on self-introduction, personal SWOT analysis & spontaneous speaking activity along with email & workplace etiquette

Textbook(s):

1. Krishna Mohan & Meera Benerji, *Developing Communications Skills*, 2nd ed., New Delhi: Mcmillan Publications, 2005

Course Articulation Matrix (CAM):		U24VS306B SOFT AND INTERPERSONAL SKILLS LABORATORY											
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	U24VA306B.1	-	-	-	-	-	-	-	2	3	-	1	-	-
CO2	U24VA306B.2	-	-	-	-	-	-	2	3	3	-	1	-	-
CO3	U24VA306B.3	-	-	-	-	-	-	-	2	3	-	1	-	-
CO4	U24VA306B.4	-	-	-	-	-	-	1	2	3	-	1	-	-
U24VA306B		-	-	-	-	-	-	1.5	2.25	3	-	1	-	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PRACTICUM-3			
Class: B. Tech. III -Semester	**Branch:** Common to all branches		
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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparing well-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

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**	**U24PS102**	**U24EC103**	**U24CS104**	**U24EE105**	**U24CH106**
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053
	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- 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 timetable 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 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 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 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

Course Articulation Matrix (CAM):		**U24EL308 PRACTICUM-3**											
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***

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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentation through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

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/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

(h) **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.

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

(j) **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.

(k) **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. 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/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(l) **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.

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

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, 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. ***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.

(n) ***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.

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 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

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 Articulation Matrix (CAM):		**U24VA309 (SE/SA)ZZZ- Courses listed under SEA/ SAA**											
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	**U24VA309.1**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO2	**U24VA309.2**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO3	**U24VA309.3**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO4	**U24VA309.4**	-	-	-	-	-	2	2	2	2	2	2	-	-
	U24VA409	-	-	-	-	-	2	2	2	2	2	2	**-**	**-**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course Code: **U24VA409 (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

EXPERT TALK SERIES-3			
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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice and applying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

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 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 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

Course Articulation Matrix (CAM):		**U24AE310 EXPERT TALK SERIES-3**												
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	U24AEX310.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AEX310.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AEX310.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AEX310.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE310		**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***

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	PCC	U24ME401	Heat Transfer	2	1	-	4	7	3
2	PCC	U24ME402	Machine Drawing	2	1	2	5	10	4
3	PCC	U24ME403	Fluid Mechanics and Hydraulic Machines	2	1	2	5	10	4
4	PCC	U24ME404	Design of Machine Elements	2	1	-	4	7	3
5	PCC	U24ME405	Machine Tools & Metrology	2	1	2	5	10	4
6	VAC	U24VA406A	Quantitative Aptitude & Logical Reasoning	2	-	-	2	4	2
7	SEC	U24SE407	PSD LAB -03	-	-	2	2	4	1
8	ELC	U24EL408	Practicum-4	-	-	-	4	4	1
9	VAC	U24VA409	SEA - 4 / SAA - 4	-	-	-	2	2	1
10	AEC	U24AE410	Expert Talk Series-4	-	-	-	1	1	1
11	VAC*	U24CY411*	Environmental Studies*	2*	-	-	2*	5*	-
Total:				**12**	**5**	**8**	**34**	**59**	**24**
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	-	05
Total credits for Honours/Minor students:				-	-	-	-	-	**28**
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*

@U24VA306 T & P Basket		
S. No.	**Course Code**	**Course Title**
1.	U24VA406A	Quantitative Aptitude and Logical Reasoning *(for Stream II)*
2.	U24VA406B	Soft and Interpersonal Skills Lab *(for Stream I)*

HEAT TRANSFER			
Class: B. Tech. IV -Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME401**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-4-7**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: modes of heat transfer and extended surfaces

LO2: transient heat conduction and forced convection

LO3: free convection, boiling, condensation and heat exchangers

LO4: thermal radiation and radiative heat exchange between two bodies

UNIT-I	9 Hrs

Basic modes of heat transfer: Fourier's law of heat conduction, Newton's law of cooling, Stefan-Boltzmann's law of thermal radiation; Thermal conductivity and thermal resistance

Conduction: General heat conduction equation in Cartesian, Cylindrical and spherical coordinate systems; Thermal diffusivity; Boundary and initial conditions; One-dimensional steady state heat conduction without heat generation in plane walls, Cylinders and spheres; Composite systems; Critical thickness of insulation; One-dimensional steady state heat conduction with internal heat generation in plane walls

Extended Surfaces: Types and applications; One-dimensional heat conduction equation for uniform cross-sectional area - infinitely long fin, Fin of finite length with insulated tip and tip with convective conditions; Efficiency and effectiveness

Self-Learning Topics (SLTs): *Conduction equation in cylindrical and spherical coordinate systems (Text1: chapter 2), Heat transfer through fin subjected to convective conditions and insulated tip (Text1: chapter 3)*

UNIT-II	9 Hrs

Transient Heat Conduction: Lumped body analysis; Governing equation for lumped system; Significance of Biot and Fourier number; Time constant

Convection: Mechanisms of free and forced convective heat transfer; Physical significance of dimensionless parameters - Reynolds, Prandtl, Nusselt, Stanton, Peclet, Grashof and Rayleigh's number; Dimensional analysis - Buckingham's π theorem for forced convection

Forced Convection: External flow & Internal flow - Hydrodynamic and thermal boundary layer theory; Use of empirical correlations for convective heat transfer - flat plate, Cylinders and horizontal pipe

Self-Learning Topics (SLTs): *Solved Problems- 7.6-7.10 (Text1: chapter 7)*

UNIT-III	9 Hrs

Free Convection: Dimensional analysis - Buckingham's π theorem for free convection, Development of hydrodynamic and thermal boundary layers along a vertical plate; Use of empirical correlations for convective heat transfer – vertical plate

Boiling and Condensation: Heat transfer accompanied by phase change; Regimes of pool boiling and flow boiling; Film and drop wise condensation

Heat Exchangers: Classification - parallel flow, Counter flow, Multi-pass and cross flow heat exchangers, Condensers and Evaporators; Logarithmic mean temperature difference; NTU-effectiveness method

Self-Learning Topics (SLTs): *Solved Problems- 8.2-8.10 (Text1: chapter 8); Derivation of heat transfer using LMTD for parallel flow Heat exchangers and Є-NTU method for counter flow Exchangers, Heat Transfer through multi-pass and cross flow heat exchangers (Text1: chapter 12);*

UNIT-IV	9 Hrs

Thermal Radiation: Radiation spectrum; Black and gray surfaces; Emissive power, Mono chromatic emissive power, Emissivity; Kirchhoff's law, Planck's distribution law, Wein's displacement law

Radiative Heat Exchange Between Two Bodies: configuration factor; Large parallel plates, Equal parallel and opposite squares, Rectangular plates perpendicular to each other; Heat exchange between large parallel plates of different emissivity; Gray body radiation – small bodies, Large parallel plates, concentric

cylinders and spheres, Small body in a large enclosure, Concept of shape and surface resistances, Re-radiating surfaces, Radiation shields

Self-Learning Topics (SLTs): *Planck's distribution law, Wein's displacement law, mono chromatic emissive power,* re-radiating surfaces *(Text1: chapter 9)*

Textbook(s):

1. R. C. Sachdeva, *Fundamentals of Engineering Heat and Mass Transfer,* 6th ed., New Delhi: New Age International Pvt. Ltd., 19th July, 2022. *(Chapters 1, 2, 3, 5, 6, 7, 8, 9, 10,11,12)*

Data Book:

1. C. P. Kothandaraman and S. Subramanian, *Heat and Mass Transfer Data Book*, 10th ed., New Delhi: New Age International Pvt. Ltd., 1st Jan, 2022

Reference Book(s):

1. J. P. Holman and Souvik Bhattacharyya, *Heat Transfer*, 10th ed., New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2017.
2. Frank P. Incropera, David P. Dewitt, Theodore L. Bergman and Adrienne S. Lavine, *Incropera's Principles of Heat and Mass Transfer*, New Delhi: Wiley India Pvt. Ltd., 1 Jan, 2018.
3. Yunus A Cengel and Afshin J Ghajar, *Heat and Mass Transfer-Fundamentals and Applications*, 6th ed., New Delhi: McGraw Hill, 5th August 2020.
4. P.K. Nag, *Heat and Mass Transfer,* 10th ed., New Delhi: Tata McGraw Hill Education Pvt. Ltd., 2017.
5. P.S. Ghoshdastidar, *Heat Transfer*, 2nd ed., New Delhi*:* Oxford University Press, 2012.

Web and Video link(s):

1. https://www.youtube.com/playlist?list=PL5F4F46C1983C6785 *Heat and Mass Transfer by Prof. S. P. Sukhatme and Prof. U. N. Gaitonde, Department of Mechanical Engineering, IIT Bombay.*
2. https://archive.nptel.ac.in/courses/112/108/112108149/ *NPTEL Video Lecture on Heat Transfer by Prof. Prof. Pradip Dutta, IISC Bengaluru.*

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 critical radius of insulation & heat transfer through composite walls and fins
CO2: analyze transient heat conduction and forced convection heat transfer for various flows
CO3: solve free convection, boiling, condensation and design of heat exchangers problems
CO4: estimate radiation heat transfer between black and gray bodies

Course Articulation Matrix (CAM):		**U24ME401: HEAT TRANSFER**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24ME401.1**	2	2	1	1	-	1	-	1	1	-	1	2	1
CO2	**U24ME401.2**	2	2	1	1	-	1	-	1	1	-	1	2	1
CO3	**U24ME401.3**	2	2	1	1	-	1	-	1	1	-	1	2	1
CO4	**U24ME401.4**	2	2	1	1	-	1	-	1	1	-	1	2	1
U24ME401		**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**2**	**1**

MACHINE DRAWING			
Class: B. Tech. IV -Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME402**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: machine drawing fundamentals & concepts of geometric dimensioning and tolerances; fasteners

LO2: cotter joints, couplings, and bearings

LO3: part drawings of milling machine tailstock, revolving center, drill jig

LO4: assembly drawings of eccentric screw jack; prototype building

THEORY COMPONENT

UNIT-I — 9 Hrs

Fundamentals of Machine Drawing: Classification of machine drawing, Industrial standards: BIS, ASME, ISO; Conventional representation of standard machine elements, Limits, Fits, Tolerances and Surface roughness symbols

Fasteners: Screw fastening - screw thread nomenclature, Types of thread profiles; Bolted joints - hexagonal-headed bolt with nut and washer, Eye foundation bolt; Keys - representation of saddle key, Sunk keys

Self-Learning Topics (SLTs): *Conventional representation of standard machine elements (Textbook 1, Chapter 17, Section 17.3), Eye foundation bolt (Textbook 1, Chapter 12, Section 12.17), Sunk keys (Textbook 1, Chapter 13, Section 13.22)*

UNIT-II — 9 Hrs

Cotter joints – Cotter joints with sleeve, Cotter joint with a Gib, Knuckle joint

Couplings- Butt muff coupling, Universal coupling

Bearings- Solid journal bearing, Footstep bearing

Self-Learning Topics (SLTs): *Cotter joint with a gib (Textbook 1, Chapter 13, Section 13.3.3), universal coupling (Textbook 1, Chapter 14, Section 14.1.4), bearings (Textbook 1, Chapter 18, Section 18.1).*

UNIT-III — 9 Hrs

Part Drawings – Sectional Views and Part Drawings of Mechanical Components: Milling machine Tailstock, Revolving centre and Drill jig

Self-Learning Topics (SLTs): *Part drawing (Textbook 1, Chapter 23, Section 23.1), revolving center (Textbook 1, Chapter 23, Section 23.3.4)*

UNIT-IV — 9 Hrs

Assembly Drawings - Assembly drawings of eccentric and screw jack; Bill of Materials (BOM) preparation

Blueprint to Prototype & Industrial Standards - Conversion of 2D drawings into real-world models; Industrial case studies from Automotive, Aerospace and Manufacturing

Self-Learning Topics (SLTs): *Assembly drawing (Textbook 1, Chapter 22, Section 22.1); industrial case studies from automotive (Textbook 1, Chapter 21, Section 21.3)*

LABORATORY COMPONENT

List of Experiments

1. Introduction to CAD Software – Basic sketching, projection, and dimensioning
2. Draft standard threaded fasteners – hexagonal bolts, screws, and riveted joints
3. Create detailed drawings of keys, cotter joints, and knuckle joints
4. Create exploded and sectional views of a shaft coupling
5. Develop CAD models of thrust bearing and radial bearing
6. Construct and interpret a multi-component gearbox assembly drawing

7. Draft a sectional view of a piston and connecting rod, identifying internal features and understanding their mechanical relationships
8. Convert 2D engineering drawings into 3D CAD models, applying materials and rendering techniques for design visualization
9. Draft dimensional tolerances, Geometric Dimensioning & Tolerance (GD&T) symbols, and surface finish symbols in CAD
10. Create a simple mechanical assembly containing housing with a sliding fit; assign tolerances to each part
11. Fabricate a small-scale mechanical part using a 3D printer, testing the accuracy and viability of the CAD design in real-world conditions
12. Develop a complete machine drawing based on an actual industrial application, incorporating all drafting standards, annotations and detailing

Textbook(s):

1. Siddheswar, Kannaiah, and Sastry, *Machine Drawing*, 48th ed., New Delhi: McGraw-Hill Education, 2014. ISBN-13: 978-0074603376

Reference Book(s):

1. Narayana, Venkat Reddy, and Kannaiah, *Machine Drawing*, 3rd ed., New Delhi: New Age International, 2009. ISBN-13: 978- 8122419177.
2. N.D.Bhatt and V. M. Panchal, *Machine Drawing*, 46th ed., Anand: Charotar Publishing House, 2011. ISBN-13: 978- 93-80358-46-8.
3. Prof. Sham Tickoo, AutoCAD 2017 for Engineers and Designers, 23rd ed., New Delhi: Dreamtech Press, Wiley Publisher, 2016. ISBN-13: 978- 9351199472.

Web and Video link(s):

https://nptel.ac.in/courses/112104031; *NPTEL Video Lecture on Computer Aided Engineering Design by Dr. Anupam Saxsena, Professor of ME, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

Machine Drawing Laboratory Manual, Department of ME, KITSW.

Course Learning Outcomes (COs):

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

(based on cognitive skills acquired from theory component)

CO1: interpret industrial standards & drawing conventions and construct detailed drawings of threaded fasteners, foundation bolt & keys

CO2: create detailed drawings of mechanical joints, couplings, & bearings by applying conventional drafting practices

CO3: develop sectional & part drawings of mechanical components like milling machine tail stock, revolving centre & drill jig using standard conventions & orthographic projection techniques

CO4: design complete assembly drawings of eccentric & screw jack and convert 2D technical data into functional 3D models while evaluating manufacturability based on industrial drafting standards

(based on psychomotor skills acquired from laboratory component)

CO5: apply CAD software tools to create 2D sketches and develop 3D models of mechanical components, incorporating projection, dimensioning, and rendering techniques

CO6: design and detail standard machine elements such as fasteners, joints, bearings and couplings, including exploded and sectional views for technical documentation

CO7: interpret and construct multi-component assembly drawings with appropriate GD&T symbols, surface finish notations and dimensional tolerances

CO8: evaluate the manufacturability and functionality of CAD models through 3D printing, and produce complete machine drawings aligned with industrial drafting standards

Course Articulation Matrix (CAM):		U24ME402 MACHINE DRAWING											
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	U24ME402.1	2	1	1	-	-	-	-	1	1	1	1	1	1
CO2	U24ME402.2	2	1	1	-	-	-	-	1	1	1	1	1	1
CO3	U24ME402.3	2	1	1	-	-	-	-	1	1	1	1	1	1
CO4	U24ME402.4	2	1	1	-	-	-	-	1	1	1	1	1	1
CO5	U24ME402.5	2	2	-	-	2	-	-	1	1	1	1	1	2
CO6	U24ME402.6	2	2	-	-	2	-	-	1	1	1	1	1	2
CO7	U24ME402.7	2	2	-	-	2	-	-	1	1	1	1	1	2
CO8	U24ME402.8	2	2	-	-	2	-	-	1	1	1	1	1	2
U24ME402		**2**	**1.5**	**1**	-	**2**	-	-	**1**	**1**	**1**	**1**	**1**	**1.5**

FLUID MECHANICS AND HYDRAULIC MACHINES			
Class: B. Tech. IV -Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME403**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: properties of fluids and fluid statics
LO2: fluid dynamics & impulse and momentum equation
LO3: flow through pipes & hydraulic turbines
LO4: performance of reciprocating & centrifugal pump

THEORY COMPONENT

UNIT-I	9 Hrs

Fluid fundamentals: Classification of fluids, Fluid properties - density, Specific weight, Specific gravity, Specific volume, Viscosity, Capillarity, Vapour pressure, Compressibility, Surface tension, Cohesion and Adhesion

Fluid statics: Pascal's Law, hydrostatic Law, Measurement of pressure, manometers, Piezometer, U-tube differential manometer, Inverted differential manometer, Hydrostatic forces on submerged plane and curved surfaces, Buoyancy, meta center, Stability of floating and Submerged bodies

Self-Learning Topics (SLTs): Meta center, stability of floating and submerged bodies. *(Text1: Pg. No. 155-160, Prob. No. 4.1, to 4.8)*

UNIT-II	9 Hrs

Fluid dynamics: Classification of fluid flow, Continuity equation in one, Two, and Three-dimensional flow, Velocity potential and stream function, Forces causing motion, Control-volume analysis of mass, Momentum and energy, Fluid acceleration, Euler's equation of motion, Bernoulli's Equation, applications of Bernoulli's equation

Impulse and Momentum equation: Linear momentum equation, Application of linear momentum equation to forces on pipe bend, Venturi meter, Orifice meter, Pitot tube, Viscous flow of incompressible fluids, Basics of compressible fluid flow

Self-Learning Topics (SLTs): viscous flow of incompressible fluids, basics of compressible fluid flow. *(Text1: Page No. 938-946)*

UNIT-III	9 Hrs

Flow through pipes: Loss of head in pipes, Expression for head loss due to major and minor losses in pipes, HGL and TEL lines, pipes in series and parallel, equivalent pipe

Concept of impact jets: Classification, Force extracted by fixed inclined, Curved, and Moving blades, Head losses, Condition for maximum efficiency, Various efficiencies

Hydraulic turbines: Concept of impact jets, Classification, head, Losses and Various efficiencies, Pelton turbines, Components, Velocity triangles, Power and efficiencies, Reaction turbines, Francis and Kaplan turbines, Efficiencies and Characteristics, Unit quantities, Specific speed, Draft tube theory

Self-Learning Topics (SLTs): draft tube theory *(Text1: P. No. 1040-1041), (Text1: Prob 21.2, 21.23)*

UNIT-IV	9 Hrs

Reciprocating pumps: Working of single and double-acting pumps, Work done and efficiencies, Slip, Negative slip, Performance characteristics of pumps, Air vessel

Centrifugal pumps: Principle, Components, Work done and efficiency, Pumps in series and in parallel, Multi-stage pumps, Characteristics, Cavitation, and Priming

Self-Learning Topics (SLTs): *Cavitation and Priming (Text1: Chap. 24, Page. No. 1208)*

LABORATORY COMPONENT

List of Experiments

1. Assembly and Disassembly of an IC engine
2. Performance test and heat balance test on conventional single-cylinder four-stroke, Compression Ignition Engine with Brake Drum Dynamometer
3. Performance test and heat balance test on conventional twin-cylinder, four-stroke, Compression Ignition engine with hydraulic dynamometer
4. Valve Timing Diagram of a single-cylinder four-stroke, Compression Ignition Engine
5. Performance test on single-cylinder, four-stroke Compression Ignition engine with Variable Compression Ratio
6. Performance test and heat balance test on computer-aided single-cylinder four-stroke, Compression Ignition Engine with eddy current Dynamometer
7. Determination of coefficient of head losses in pipes due to major and minor losses (sudden enlargement, sudden contraction and bend)
8. Determination of coefficient of discharge for given orifice meter and Venturi meter
9. Determination of coefficient of impact for a jet on given vane
10. Determination of performance characteristics of a Pelton Wheel
11. Determination of performance characteristics of a Francis Turbine
12. Determination of performance characteristics of a Centrifugal Pump

Textbook:

1 P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, 21st ed., Standard Book House, Rajsons Publications Private Limited, 2017.

Reference Book(s):

1 R. K. Bansal, *Fluid Mechanics and Hydraulic Machines*, Periodicals Private Ltd., 2018
2 Victor Streeter and E. Benjamin, Wylie, *Fluid Mechanics*, 9th ed., Singapore: McGraw Hill, 2017.
3 Frank M. White, *Fluid Mechanics*, Special Indian ed., New Delhi: Tata McGraw Hill, 2011.
4 A.K. Jain, *Fluid Mechanics Including Hydraulic Machines*, 12th ed., New Delhi: Khanna Publications, 2018.

Web and Video link(s):

1. **https://www.youtube.com/playlist?list=PLwdnzlV3ogoV-ATGY2ptuLS9mwLFOJoDw** *NPTEL Video Lecture on* ***Fluid Mechanics*** *By Prof. Subashisa Dutta IIT Guwahati*
2. https://www.youtube.com/@fluidmachines5626/playlists *NPTEL Video Lecture on* ***Fluid Machines*** *By Prof. Suman Chakraborty IIT Kharagpur*

Laboratory Manual (for laboratory component):

Fluid mechanics and hydraulic machines Laboratory Manual and Record Book, Department of ME, KITSW.

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 fluid properties using fundamental laws of fluid statics
CO2: analyze continuity, Euler's, Bernoulli's, impulse and momentum equation
CO3: estimate losses in pipes, force developed by different vanes & performance parameters of turbines
CO4: determine performance characteristics of reciprocating & centrifugal pumps

(based on psychomotor skills acquired from laboratory component)

CO5: identify various components of an IC engine
CO6: analyze performance characteristics of an IC engine with constant and variable compression ratio
CO7: determine coefficient of discharge through venturimeter & orificemeter and estimate losses through pipes
CO8: compare performance of hydraulic turbines

Course Articulation Matrix (CAM):		U24ME403: FLUID MECHANICS AND HYDRAULIC MACHINES												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24ME403.1	2	2	1	1	-	1	-	-	1	-	1	2	1
CO2	U24ME403.2	2	2	1	1	-	1	-	-	1	-	1	2	1
CO3	U24ME403.3	2	2	1	1	-	1	-	-	1	-	1	2	1
CO4	U24ME403.4	2	2	1	1	-	1	-	-	1	-	1	2	1
CO5	U24ME403.5	2	2	1	1	-	1	-	1	1	-	1	2	1
CO6	U24ME403.6	2	2	1	1	-	1	-	1	1	-	1	2	1
CO7	U24ME403.7	2	2	1	1	-	1	-	1	1	-	1	2	1
CO8	U24ME403.8	2	2	1	1	-	1	-	1	1	-	1	2	1
	U24ME403	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**2**	**1**

DESIGN OF MACHINE ELEMENTS			
Class: B. Tech. IV-Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME404**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: design principles, Mohr's Circle and failure theories for analyzing static strength

LO2: fatigue failure, endurance limits, and stress concentration and design principles for shafts under combined loading

LO3: design and analysis of keys, couplings, cotter joints, knuckle joints and bolted joints under various loading conditions

LO4: design, failure modes and analysis of riveted & welded joints under static and eccentric loads

UNIT-I	9 Hrs

Introduction: Engineering design, Basic design procedure, Basic requirements of machine elements, Selection of materials for engineering applications; Design criterion

Design for Static Strength: Analysis of biaxial state of stress at a point, Principal stresses, Mohr's Circle representation of stresses; Theories of failure—maximum principal stress theory, Maximum shear stress theory, Maximum principal strain theory, Maximum total strain energy theory, Distortion energy theory and their applications

Self-Learning Topics (SLTs)*: Basic design procedure, Basic requirements of machine elements, selection of materials for engineering applications; Design criterion (Textbook 1, Sections 1.1 & 1.2); importance of failure theories in design (Textbook 1, Section 4.19)*

UNIT-II	9 Hrs

Design for Fatigue Strength: Types of fatigue loads, Phenomenon of fatigue failure, Endurance limit, Stress concentration factor and its importance in design, Notch sensitivity; Gerber's parabola, Goodman line, Soderberg equation and fatigue design under combined loading

Design of Shafts: Introduction, Materials and design stresses; Design criterion for shafts, Design of solid and hollow shafts under combined loads

Self-Learning Topics (SLTs): *Types of fatigue loads (Textbook 1, Section 5.0); importance of stress concentration factor in design (Textbook 1, Section 5.1); purpose and types of shaft design (Textbook 1, Sections 9.0 & 9.1)*

UNIT-III	9 Hrs

Design of Keys and Couplings: Types of keys, Design of sunk keys, and effect of keyways in sunk keys; Functions of couplings, Rigid and flexible couplings; Design of flange coupling and bush-pin type coupling

Cotter Joints: Design of socket and spigot type cotter joints; Design of knuckle joints

Bolted Joints: Stresses in screw fastenings—initial stresses, Stresses due to external forces and stresses due to combined load; Bolts of uniform strength; Eccentrically loaded bolted joints. stresses in screw fastenings—initial stresses, stresses due to external forces and stresses due to combined load; Bolts of uniform strength; eccentrically loaded bolted joints

Self-Learning Topics (SLTs): *Types of keys (Textbook 1, Section 9.9); Effect of keyways in sunk keys (Textbook 1, Section 9.11); Functions of couplings (Textbook 1, Section 9.17); Difference between rigid and flexible couplings (Textbook 1, Section 9.17); bolt of uniform strength (Textbook 1, Section 7.5)*

UNIT-IV	**9 Hrs**

Riveted joints: Terminology, Different types of riveted joints, Failure modes, Design procedure; Boiler joints—longitudinal butt joint and circumferential lap joint; Structural joints—lozenge joint; Eccentrically loaded riveted joints

Welded joints: Conventional representation of welded joints; Butt and fillet welds under static and varying loads; Welded joints under eccentric loading

Self-Learning Topics (SLTs): *Types of riveted joints; Terminology of riveted joints (Textbook 1, Section 8.20); conventional representation of welded joints (Textbook 1, Section 8.17)*

Course Learning Outcomes (COs):

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

CO1: apply engineering design principles to ensure static strength using Mohr's Circle & failure theories for stress analysis

CO2: analyze fatigue strength and apply failure criteria to design solid & hollow shafts

CO3: design and analyze keys, couplings, cotter joints, knuckle joints and bolted joints under various loading conditions

CO4: design and analyze riveted & welded joints for static, varying and eccentric loads

Textbook(s):

1. Bhandari, V. B., *Design of Machine Elements*, 4th ed., New Delhi: Tata McGraw-Hill Book Company, 2016.

Reference Book(s):

1. Richard Budynas and Keith Nisbett, *Shigley's Mechanical Engineering Design*, 10th ed., New Delhi: Tata McGraw-Hill Book Company, 2015.
2. R.S.Khurmi and J. K. Gupta, *A Textbook of Machine Design*, 15th ed., New Delhi: S. Chand & Co., 2005.
3. Robert L. Norton, *Machine Design: An Integrated Approach*, 5th ed., New Delhi: Pearson Publishing, 2014.
4. N.C.Pandya and C. S. Shah, *Elements of Machine Design*, 20th ed., Anand: Charotar Publishing House, 2015.

Web and Video link(s):

1. https://youtube.com/playlist?list=PL3D4EECEFAA99D9BE&si=CWLAYbTZ_v8DJGB3: *Prof. B Maiti, Prof. G. Chakraborty, Department of Mechanical Engineering, IIT Kharagpur. Lecture Series on Design of Machine Elements – I*

Course Articulation Matrix (CAM):		**U24ME404 DESIGN OF MACHINE ELEMENTS**												
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	**U24ME404.1**	2	2	2	2	-	-	-	1	1	1	1	2	1
CO2	**U24ME404.2**	2	2	2	2	-	-	-	1	1	1	1	2	1
CO3	**U24ME403.3**	2	2	2	2	-	-	-	1	1	1	1	2	2
CO4	**U24ME404.4**	2	2	2	2	-	-	-	1	1	1	1	2	2
	U24ME404	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

MACHINE TOOLS AND METROLOGY

Class: B. Tech. IV –Semester		**Branch:** Mechanical Engineering	
Course Code:	**U24ME405**	**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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: lathe, drilling, boring, shaper and planer machines
LO2: milling machines, grinding machines and finishing operations
LO3: types of standards, tolerance analysis and comparators
LO4: surface finish and screw thread metrology, lasers in metrology and computer aided metrology

THEORY COMPONENT

UNIT-I	**9 Hrs**

Machine Tools: Classification and applications
Lathe Machines: Working principle, Types, Constructional features, Specifications, Operations, attachments; Capstan and Turret lathe, Single spindle and multi-spindle automatic lathes
Drilling and Boring Machines – Working principles, Types, Constructional features, Specifications, Operations, Drilling time calculations, Twist drill; Types of boring machines and Applications
Shaper and Planer machines – Working principles, Types, Constructional features and Operations

Self-Learning Topics (SLTs): *Twist drill and boring machines (Text 1, chapter – 5 & 6)*

UNIT-II	**9 Hrs**

Milling Machines – Working principles, Types, Constructional features, Operations, Geometry of milling cutters, Methods of indexing
Grinding Machines – Working principles, Types, Constructional features and Operations; Types of abrasives, Types of bonds, Selection of a grinding wheel
Finishing Operations - Working principles, Lapping, Honing and Super finishing operations; Constructional features

Self-Learning Topics (SLTs): *Geometry of milling cutters, Selection of a grinding wheel (Text 1, chapter – 11 & 10)*

UNIT-III	**9 Hrs**

Line and end standards: Linear measurement – Vernier caliper, Micrometer and slip gauges; Angular measurement - sine bar and Angle gauges
Limits, fits and tolerances: Terminology, Types of fits, Hole and Shaft basis systems, Design of gauges, Taylor's principle for limit gauges; Limit gauges -plug, Ring and Snap gauges; Alignment tests for lathe
Comparators: Classification; Mechanical comparators - Johanson Mikrokater and Sigma comparator; Optical comparator- autocollimator; Interferometry - profile projector

Self-Learning Topics (SLTs): *Optical comparator – autocollimator (Text 3, chapter - 5)*

UNIT-IV	**9 Hrs**

Metrology of surface roughness: Terminology; Methods of measurement of surface roughness; Principle and operation of Tomlinson surface meter and Taylor-Hobson Talysurf
Metrology of screw threads: Measurement of effective diameter using 2-wire and 3-wire method
Lasers in metrology - Advantages of lasers, Laser scan micrometers; Laser interferometers-Applications
Computer Aided Metrology - Basic concept of CMM, Types, Constructional features, Probes – accessories, Software, Applications, Three dimensional measuring machine**,** Machine vision

Self-Learning Topics (SLTs): *Three dimensional measuring machine (Text 3, chapter - 17)*

LABORATORY COMPONENT

List of Experiments

1. Perform step, taper and thread cutting on lathe machine
2. Perform eccentric turning on lathe machine
3. Perform a key way slot on rectangular block using slotter machine
4. Perform V-groove on cylindrical bar using shaper machine
5. Perform a contour cut on rectangular block using milling machine
6. Perform drilling and tapping on MS rod using drilling machine
7. Measurement of external taper angle of a component using bevel protractor and sine bar
8. Measurement of bore diameter, taperness and ovality using bore gauge
9. Measurement of screw thread characteristics using profile projector
10. Measurement of screw thread effective diameter using screw thread micrometer and 3-wire set
11. Measurement of surface roughness of a given component using digital surface roughness tester
12. Alignment tests for machine tools-Roundness of head stock spindle and flatness of lathe bed

Textbook(s):

1. S.K. Hajra Chowdary, S. K. Bose and A.K. Hajra Chowdary, *Elements of Workshop Technology,* Vol. II, 15th ed., New Delhi: Media Promoter and Publishers Pvt. Ltd., India, 2019. (*Chapters 3,5,7,8.10,11 and 14*).
2. R. K. Jain, *Engineering Metrology*, 25th ed., New Delhi: Khanna publishers, 2005 (*Chapters 2 to 8, 10, 11, 14, 16, and 17).*

Reference Book(s):

1. I. C. Gupta, *A Textbook of Engineering Metrology*, 7th ed., New Delhi: Dhanpat Rai and Sons, 2018.
2. Henrich Gerling, *All about Machine Tools*, revised ed., New Delhi: New Age International, 2007.
3. Kalpakjian, S. and Steven R. Schmid, *Manufacturing, Engineering & Technology*, 4th ed., New Delhi: Pearson, 2001.
4. M. Mahajan, *A textbook of Metrology*, New Delhi: Dhanpat Rai & Co., 2016.
5. N. V. Raghavendra and L. Krishnamurthy, *Engineering Metrology and Measurements*, 1st ed., New Delhi: Oxford University Press, 2013.

Web and Video link(s):

1. https://archive.nptel.ac.in/courses/112/106/112106179/ *NPTEL Video Lecture on Metrology by Prof. Kanakuppi Sadhasivappa,Professor of ME, Bapuji Engineering and technology Devangiree.*
2. http://digimat.in/nptel/courses/video/112105233/L01.html *NPTEL Video Lecture on Metal cutting & Machine Tool by Prf. Asimava Roy Choudhury, Professor of ME, IIT, Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Machine Tools and Metrology Laboratory Manual & Record Book,* Department of ME, KITSW.

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 machine tools, interpret working principles and identify operations & applications of lathe, drilling, boring, shaper & planner machines

CO2: interpret working principles and identify operations & applications of milling machines, grinding machines and finishing operations

CO3: measure linear & angular dimensions using various instruments, design limit gauges using Taylor's principle and recommend suitable comparator for a given application

CO4: measure surface finish of a component & effective diameter of screw thread and make use of lasers & computers in measurement of dimensions & alignment testing

(based on psychomotor skills acquired from laboratory component)

CO5: perform suitable machining operation on lathe, slotter & shaper machines for a given component

CO6: perform suitable machining operation on drilling & milling machines for a given component

CO7: determine thread characteristics & taper angles using 3-wire method and angular instruments respectively

CO8: carry out surface roughness measurement and alignment tests

Course Articulation Matrix (CAM): U24ME405 MACHINE TOOLS AND METROLOGY														
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	**U24ME405.1**	2	2	1	-	-	-	-	-	1	-	1	1	2
CO2	**U24ME405.2**	2	2	1	-	-	-	-	-	1	-	1	1	2
CO3	**U24ME405.3**	2	2	1	-	-	-	-	-	1	-	1	1	2
CO4	**U24ME405.4**	2	2	-	-	2	-	-	-	1	-	1	1	2
CO5	**U24ME405.5**	2	2	-	-	1	-	-	2	1	-	1	2	1
CO6	**U24ME405.6**	2	2	-	-	1	-	-	2	1	-	1	2	1
CO7	**U24ME405.7**	2	2	-	-	1	-	-	2	1	-	1	2	1
CO8	**U24ME405.8**	2	2	-	-	1	-	-	2	1	-	1	2	1
U24ME405		**2**	**2**	**1**	**-**	**1.2**	**-**	**-**	**2**	**1**	**-**	**1**	**1.5**	**1.5**

QUANTITATIVE APTITUDE AND LOGICAL REASONING			
Class: B.Tech. IV -Semester		**Branch:** Common to all Branches	
Course Code:	**U24VA406A**	**Credits:**	**2**
Hours/Week (L-T-P-O-E):	**2-0-0-2-4**	**CIE**	**60 %**
Total Number of Teaching Hours:	**24 Hrs**	**ESE**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: quantitative aptitude & problem-solving skills
LO2: computation of abstract quantitative information
LO3: application of basic mathematics skills & critical thinking to draw conclusions
LO4: evaluation of validity & possible biases in arguments presented in authentic contexts

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

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

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*, 1st 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														

PRACTICUM-4			
Class: B. Tech. IV -Semester	**Branch:** Common to all branches		
Course Code:	**U24EL408**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-4-4**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparing well-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

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**	**U24PS102**	**U24EC103**	**U24CS104**	**U24EE105**	**U24CH106**
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053
	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- 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 timetable 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 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 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 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

Course Articulation Matrix (CAM):		**U24EL408 PRACTICUM-4**											
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	**U24EL408.1**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	**U24EL408.2**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	**U24EL408.3**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	**U24EL408.4**	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL408		**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. IV-Semesters	**Branch:** Common to all branches		
Course Code:	**U24VA409 (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 Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentation through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

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/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

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

(r) **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. 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/presentation and report in which they demonstrate a link between

their experiences during fieldwork and the underlying theoretical concepts and ideas.

(s) **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.

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

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, 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. ***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.

(u) ***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.

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 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

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 Articulation Matrix (CAM):		**U24VA409 (SE/SA)ZZZ- Courses listed under SEA/ SAA**											
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	**U24VA409.1**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO2	**U24VA409.2**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO3	**U24VA409.3**	-	-	-	-	-	2	2	2	2	2	2	-	-
CO4	**U24VA409.4**	-	-	-	-	-	2	2	2	2	2	2	-	-
	U24VA409	-	-	-	-	-	2	2	2	2	2	2	**-**	**-**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course Code: **U24VA409 (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

EXPERT TALK SERIES-4			
Class: B. Tech. IV -Semester	**Branch:** Common to all branches		
Course Code:	**U24AE410**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-1-1**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice and applying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

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 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 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

Course Articulation Matrix (CAM):		**U24AE410 EXPERT TALK SERIES-4**												
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	U24AEX410.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AEX410.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AEX410.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AEX410.4	1	1	1	1	1	1	2	1	2	1	2	1	1
	U24AE410	**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***

ENVIRONMENTAL STUDIES			
Class: B. Tech. IV Semester		**Branch:** Common to all branches	
Course Code:	**U24CY411**	**Credits:**	**-**
Hours/Week (L-T-P-O-E):	**2-0-0-3-5**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: natural resources and their usage more equitably
LO2: ecosystem and the importance of biodiversity conservation
LO3: environmental pollution and it's control measures
LO4: environmental legislation and green methodology

UNIT-I	6 Hrs

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and importance
Natural Resources: Forest Resources-Use and over exploitation 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	6 Hrs

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	6 Hrs

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	6 Hrs

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
The Sustainable Development Goals (SDGs): United Nations Sustainable Development Goals

Self-Learning Topics (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)*

Textbook(s):

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

Reference Book(s):

1. Y. Anjaneyulu, *Introduction to Environmental Science*, B.S. Publications, 2004.
2. Gilbert M. Masters, *Introduction to Environmental Engineering & Science*, 3rd ed., Prentice Hall of India,1991
3. Anubha Kaushik, C.P. Kaushik, *Environmental Studies*, 4th ed., New Age International Publishers,2014
4. R. Rajagopalan, *Environmental Studies from crisis to cure*, 2nd ed., Oxford University Press, 2011

Web and Video link(s):

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ch27/ *video lecture on renewable energy resources by Prof. Vaibhav. V. Goud and Dr. R. Anandalakshmi, Dept. Of Chemical Engineering, Guwahati.*
2. https://sdgs.un.org/goals; *UN's webpage on 17 sustainable Development Goals*
3. https://onlinecourses.nptel.ac.in/noc23_hs57/preview; *United nations Sustainable Development Goals*

Course Learning Outcomes (COs):

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

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

Course Articulation Matrix (CAM):		**U24CY411-- 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	**U24CY411.1**	2	1	2	1	-	2	1	1	1	-	-	-	-
CO2	**U24CY411.2**	-	-	2	-	-	1	1	1	1	1	-	-	-
CO3	**U24CY411.3**	1	2	1	-	-	1	1	1	1	1	1	-	-
CO4	**U24CY411.4**	-	-	1	-	-	1	1	1	1	-	1	-	-
U24CY411		**1.5**	**1.5**	**1.5**	**1**	**-**	**1.25**	**1**	**1**	**1**	**1**	**1**	**-**	**-**

REFRIGERATION SYSTEMS			
Class: B. Tech. IV –Semester (Exit)		**Branch:** Mechanical Engineering	
Course Code:	**U24ME414X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: methods of refrigeration and refrigerants
LO2: components of refrigeration systems and refrigeration cycles
LO3: vapor absorption refrigeration systems and equipment control
LO4: refrigeration system applications

THEORY COMPONENT

UNIT-I	4 Hrs

Refrigeration: Definition and importance of refrigeration; Applications in domestic, Commercial and Industrial fields; Historical development of refrigeration, Units of refrigeration

Methods of Refrigeration: Air refrigeration- open and dense air refrigeration systems; Bell-Coleman cycle

Refrigerants: Classification -Primary and secondary refrigerants; Desirable properties of refrigerants; Eco-friendly refrigerants - R134a, R600a, CO_2, NH_3, C_5H_{10}; Ozone depletion and global warming potential (ODP & GWP); Refrigerant handling and safety

UNIT-II	4 Hrs

Components of Refrigeration Systems: Basic components – compressor, Condenser, Expansion Devices and Evaporator

Refrigeration Cycles: Carnot refrigeration cycle; Vapor Compression Refrigeration Cycle (VCRC) - representation on h-s and T-s diagrams

UNIT-III	4 Hrs

Vapor Absorption Refrigeration System (VARS): Determination of COP; Types - aqua-ammonia; Lithium bromide – water, Electrolux; Comparison of vapor compression and vapor absorption

Refrigeration Equipment and Controls: Accumulators, Receivers, Driers, Oil separators Pressure and temperature control devices; Safety devices - HP/LP cut-outs, Thermostats, solenoid valves

UNIT-IV	4 Hrs

Refrigeration System Applications: Domestic refrigeration - Refrigerator, Deep freezer; Commercial refrigeration - Water coolers, Bottle coolers, Ice plants; Cold Storage - Design considerations; Transport Refrigeration

LABORATORY COMPONENT

List of Experiments

1. To determine the Coefficient of Performance of a vapor compression refrigeration system.
2. To evaluate the Coefficient of Performance of a vapor absorption refrigeration system
3. To analyze the components of an air conditioning tutor
4. To evaluate Coefficient of Performance of an air conditioning tutor
5. To study and analyze the properties of moist air using air-conditioning tutor
6. To determine the Coefficient of Performance of a window air-conditioning tutor
7. To evaluate the properties of air using window air-conditioning system
8. To determine performance of Vortex tube refrigeration system

Textbook:

1. Arora S.C. and S. Domkundwar, *A course in Refrigeration and Air Conditioning*, 3rd ed., New Delhi: Dhanpat Rai & Sons., Reprint-2018.

Data Book(s):

1. Mathur, M. L., and Mehta, F. S., *Refrigerant and Psychrometric Properties (Tables & Charts) SI Units*, Jain Brothers publishers, New Delhi, 2010.
2. Khurmi, R. S., and Gupta, J. K., *Refrigeration Tables with chart*, S. Chand publishers, New Delhi, 2008.

Reference Book(s):

1. Arora C.P., *Refrigeration and Air Conditioning*, 3rd ed., New Delhi: Tata McGraw-Hill, 2009
2. Wilbert F. Stoecker, Jerold W. Jones, *Refrigeration and Air Conditioning*, New Delhi: McGraw-Hill, 1982.
3. Roy J. Dossat, *Principles of Refrigeration*, 3rd ed., New Delhi: Prentice Hall International Paperback Editions, 1991.
4. *ASHRAE Hand Book*, McGraw-Hill, New York, 2009.

Web and Video link(s):

https://archive.nptel.ac.in/courses/112/105/112105129/; *NPTEL Video Lecture on Refrigeration and Air Conditioning, Prof. Ravi Kumar, Professor of ME, IIT Roorkee*

Laboratory Manual (for laboratory component):

Refrigeration Systems laboratory manual, Department of ME, KITSW

Course Learning Outcomes (COs)

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

(based on cognitive skills acquired from theory component)

CO1: explain the methods of refrigeration and properties of refrigerants
CO2: evaluate performance parameters of vapor compression refrigeration systems
CO3: analyze vapor absorption refrigeration system
CO4: recommend refrigeration system for a given application

(based on knowledge acquired from laboratory component)

CO5: draw the p-h diagram of a vapour compression of refrigeration system
CO6: evaluate the performance parameters of VARS system
CO7: interpret the coefficient of performance of a widow type air-conditioning system
CO8: analyse coefficient of performance of an air-conditioner tutor

Course Articulation Matrix (CAM): U24ME414X REFRIGERATION 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	U24ME414X.1	2	2	1	1	-	1	-	-	1	-	1	2	1
CO2	U24ME414X.2	2	2	1	1	-	1	-	-	1	-	1	2	1
CO3	U24ME414X.3	2	2	1	1	-	1	-	-	1	-	1	2	1
CO4	U24ME414X.4	2	2	1	1	-	1	-	-	1	-	1	2	1
CO5	U24ME414X.5	2	2	1	1	-	1	-	1	1	-	1	2	1
CO6	U24ME414X.6	2	2	1	1	-	1	-	1	1	-	1	2	1
CO7	U24ME414X.7	2	2	1	1	-	1	-	1	1	-	1	2	1
CO8	U24ME414X.8	2	2	1	1	-	1	-	1	1	-	1	2	1
	U24ME414X	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**2**	**1**

THEORY OF MACHINES			
Class: B. Tech. IV-Semester (Exit)		**Branch:** Mechanical Engineering	
Course Code:	**U24ME412X**	**Credits:**	**03**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: basic concepts of links, kinematic pairs, kinematic chains, mechanisms, velocity and acceleration analysis, and instantaneous centers of rotation
LO2: inversions of kinematic chains and principles of gear trains
LO3: types of cams and followers, role of governors, and function of flywheels in mechanical systems
LO4: static and dynamic balancing, gyroscopic motion in two-wheelers

THEORY COMPONENT

UNIT-I	4 Hrs

Basic Concepts: Definition of statics, Kinetics, Kinematics and dynamics; Rigid body and Resistant body concepts; Links, Kinematic pairs and their classifications; Degree of freedom in mechanical systems; Types of kinematic chains and constrained motion; Classification of mechanisms
Velocity and acceleration analysis of slider crank mechanism using graphical method, Instantaneous centres of rotation and Kennedy's theorem

UNIT-II	4 Hrs

Inversions of Kinematic Chains: Four-bar chain—locomotive coupler, Beam engine, Pantograph; Single slider crank chain—pendulum pump, Rotary I.C. engine mechanism, Oscillating cylinder engine; Whitworth quick return mechanism, Quick return mechanism of shaper; Double slider crank chain—Scotch Yoke mechanism, Elliptical trammel, Oldham's coupling
Gear terminology and classifications; Fundamental law of gearing Types of gear trains—simple, Compound, Epicyclic

UNIT-III	4 Hrs

Introduction to Cams and Followers: Cam and follower terminology; Classification of cams and followers; Types of follower motions and displacement diagrams—uniform velocity, Simple harmonic motion, Uniform acceleration and retardation; Classification and working principles of governors; Sensitivity and stability analysis of governors; Function of flywheel for energy storage

UNIT-IV	4 Hrs

Balancing: Need for balancing in mechanical systems; Types of balancing—static and dynamic balancing; Balancing of rotating and reciprocating masses; Principles of gyroscopic motion and its application in two-wheelers

LABORATORY COMPONENT

List of Experiments

1. Study of Kinematic Links, Pairs, Chains, and Mechanisms
2. Analysis of Different Types of Kinematic Chains
3. Inversions of the Slider-Crank Mechanism
4. Construction of Displacement Diagram for a Cam-Follower Mechanism
5. Static and Dynamic Balancing of Rotary Masses
6. Controlling Force Diagram of Hartnell Governor
7. Verification of Gyroscopic Effect
8. Determination of Natural Frequency of a Spring-Mass System

Textbook(s):

1. S.S Rattan, *Theory of Machines*, 4th ed., New Delhi: McGraw-Hill, 2014.

Reference Book(s):

1. R.L.Norton, *Design of Machinery-An Introduction to the Synthesis and Analysis of Mechanisms and Machines*, 4th ed., New York: McGraw-Hill, 2008.
2. Ambekar, *Theory of Mechanisms and Machines*, New Delhi: Prentice Hall of India, 2007.
3. J.S.Rao and R.V. Dukkipati, *Theory of Mechanisms and Machine Theory*, 2nd ed., New Delhi: New Age International, 2006.
4. R.S.Kurmi and J.K.Guptha, *Theory of Machines*, 14th ed., New Delhi: S. Chand & Co., 2014

Web and Video link(s):

https://archive.nptel.ac.in/courses/112/106/112106270/ *NPTEL Video Lecture on* ***Kinematics of Machines, Prof. Ashok K Mallik,*** *IIT Kanpur*

Laboratory Manual (for laboratory component): *Theory of Machines Manual,* Department of Mechanical Engineering, KITSW.

Course Learning Outcomes (COs): 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 fundamental concepts of links, kinematic pairs, kinematic chains, mechanisms, velocity and acceleration analysis, and instantaneous centers of rotation

CO2: describe inversions of kinematic chains and principles of gear trains with their applications

CO3: explain different types of cams and followers, role of governors, and function of flywheels in mechanical systems

CO4: illustrate principles of static and dynamic balancing, including gyroscopic motion in two-wheelers

(based on skills acquired from laboratory component)

CO5: analyze motion & behavior of kinematic systems, including links, pairs, chains and mechanisms

CO6: interpret and design mechanical systems such as kinematic chains, slider-crank mechanisms and cam-follower mechanisms

CO7: apply techniques to balance rotary masses and assess the effects of gyroscopic forces

CO8: determine natural frequency of spring-mass systems and apply this knowledge to practical engineering problems

Course Articulation Matrix (CAM):		**U24ME412X Theory of Machines**											
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	**U24ME214X.1**	1	1	-	-	-	-	-	1	1	1	1	1	1
CO2	**U24ME214X.2**	1	1	-	-	-	-	-	1	1	1	1	1	1
CO3	**U24ME214X.3**	1	1	1	1	-	-	-	1	1	1	1	1	1
CO4	**U24ME214X.4**	1	1	1	1	-	-	-	1	1	1	1	1	1
CO5	**U24ME214X.5**	1	1	1	-	-	-	-	1	1	1	1	1	1
CO6	**U24ME214X.6**	1	1	1	-	-	-	-	1	1	1	1	1	1
CO7	**U24ME214X.7**	1	1	1	1	-	-	-	1	1	1	1	1	1
CO8	**U24ME214X.8**	1	1	1	1	-	-	-	1	1	1	1	1	1
	U24ME214X	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

WORKSHOP TECHNOLOGY			
Class: B. Tech. IV –Semester (Exit)		**Branch:** Mechanical Engineering	
Course Code:	**U24ME413X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: workshop layouts, safety norms and carpentry shop

LO2: fitting and smithy shop

LO3: metals joining technique and foundry shop

LO4: sheet metal operations and machine tools

THEORY COMPONENT

UNIT-I	4 Hrs

Introduction: Introduction to various shops/sections and workshop layouts, Safety practices, Causes of accidents, General safety rules, Safety signs and symbols

Carpentry Shop: Carpentry tools & operations, Types of woods and its applications, Carpentry joints, Carpentry operations - marking, Sawing, Planning, Chiselling, Grooving, Boring, Joining, Wood turning

UNIT-II	4 Hrs

Fitting Shop: Fitting hand tools bench vice, Hammers, Chisels, Files, Hacksaw, Surface plate, Punch, V block, Angle plate, Try square, Marking block, Steel rule, Twist drills, Reamers, Tap set, Die set; Fitting operations

Smithy Shop: Tin Smithy - hammers, Stakes, Scissors & operations, Hearing, bending, Joining, Types of sheet metal joints and applications; Black smithy-introduction of forging tools and its operations

UNIT-III	4 Hrs

Foundry Shop: Hand moulding tools, Types of moulding boxes, Pattern materials - wood, Cast iron, Aluminium, Brass, Plastics, their uses and advantages, Types of moulding sands

Metal Joining Shop: Types of welding joint, Arc welding - Welding electrode, Filler rod, Fluxes, and Solders, Gas welding hand tools- welding torch, Welding tip, Pressure regulator, Oxygen and acetylene cylinders, Spark lighter

UNIT-IV	4 Hrs

Sheet metal: Hand tools snip, Shears sheet gauge, Straight edge, L square, scriber, Divider, Trammel, Punches, Pliers, Stakes, Groovers and Limit set

Machine Shop: Introduction to machine tools and operations, Basic machine tools - Lathe, Shaper, Drilling, Milling machine and CNC with basic operations and uses

LABORATORY COMPONENT

List of Experiments

1. Prepare mortise and tenon joint
2. Prepare a half round fit
3. Prepare a sand mould using two-piece pattern-dumbbell
4. Prepare a single V – Butt Joint using Arc welding
5. Prepare a pipe joint using Oxy-Acetylene gas welding
6. Perform step, taper and thread cutting operation on Lathe machine
7. Perform a V-groove on cylindrical bar using Shaper machine
8. Perform drilling and taping on MS rod using Drilling machine

Textbook(s):

1. H S Bawa, *Workshop Practice*, 2nd ed., Uttar Pradesh: McGraw Hill Education (India) Private Limited, 2017.
2. A K Sarathe, *Engineering Workshop Practice*, 1st ed., New Delhi: Khanna Book Publishing Company Pvt. Ltd., 2023.

Reference Book(s):

1. S A Hajra Choudhury, A K Hajra Choudhury and Nirjhar Roy, *Elements of Workshop Technology*, Vol-I (Manufacturing Processes), 9th ed., Mumbai: Media Promoters and Publishers 2010.
2. S A Hajra Choudhury, A K Hajra Choudhury and Nirjhar Roy, *Elements of Workshop Technology,* Vol-II (Machine Tools), 15th ed., Calcutta: Indian Book Distributing Co., 2010.
3. Rajender Singh, *Introduction to Basic Manufacturing Process & Workshop Technology*, 2nd ed., New Age International Pvt. Ltd. Publishers, 2010.
4. P. N. Rao, *Manufacturing Technology*, Volume-I, 5th ed., New Delhi: Tata McGraw-Hill, 2018.

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 safety practices, symbols and procedures to prevent accidents and perform various operations

CO2: apply different fitting tools to perform basic fitting operations and make use of tin smithy and black smithy operations

CO3: classify moulding sands and apply welding tools & consumables to perform arc and gas welding operations

CO4: demonstrate proper use of sheet metal tools in performing various operations and perform basic machining operations

(based on skills acquired from laboratory component)

CO5: apply suitable tools to prepare a mortise and tenon joint and a half round fit

CO6: apply basic gating system and produce a mould cavity for double piece pattern

CO7: select suitable welding process and build joints in welding trade

CO8: perform various machining operations on lathe, shaper and drilling machine

Course Articulation Matrix (CAM): U24ME413X WORKSHOP TECHNOLOGY														
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	**U24ME413X.1**	2	1	1	1	-	-	-	1	-	1	1	1	1
CO2	**U24ME413X.2**	1	2	1	1	-	-	-	1	-	1	1	1	1
CO3	**U24ME413X.3**	2	1	1	1	-	-	-	1	-	1	1	1	1
CO4	**U24ME413X.4**	1	2	1	1	-	-	-	1	-	1	1	1	1
CO5	**U24ME413X.5**	1	1	1	1	-	-	-	1	-	1	1	1	1
CO6	**U24ME413X.6**	1	2	1	1	-	-	-	1	-	1	1	1	1
CO7	**U24ME413X.7**	1	1	1	1	-	-	-	1	-	1	1	1	1
CO8	**U24ME413X.8**	1	2	1	1	-	-	-	1	-	1	1	1	1
U24ME413X		**1.25**	**1.5**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**1**