

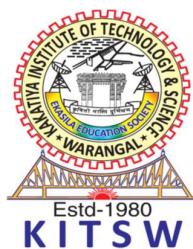
B.TECH. CURRICULUM

ACADEMIC YEAR: 2024-25

DEPARTMENT OF COMPUTER SCIENCE & 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)**



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

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History:

PROGRAM	DESCRIPTION	
	INTAKE	NBA ACCREDITATION
UG in B.Tech. COMPUTER SCIENCE & ENGINEERING	• Started with 60 seats in 1994 • Intake increased to 120 in 2002 • Intake increased to 180 in 2015	• First time accreditation: 2008 • Reaccreditation-1: 2014 • Reaccreditation-2: 2016 • Reaccreditation-2: 2018 • Reaccreditation-2: 2020 • Reaccreditation-2: 2022

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 COMPUTER SCIENCE AND ENGINEERING: VISION AND MISSION

VISION

Attaining center of excellence status in various fields of Computer Science and Engineering by offering worth full education, training and research to improve quality of software services for ever growing needs of the industry and society.

MISSION

M1:	Practice qualitative approach and standards to provide students better understanding and profound knowledge in the fundamentals and concepts of computer science with its allied disciplines
M2:	Motivate students in continuous learning to enhance their technical, communicational, and managerial skills to make them competent and cope with the latest trends, technologies, and improvements in computer science to have a successful career with professional ethics.
M3	Involve students to analyze, design and experiment with contemporary research problems in computer science to impact socio-economic, political and environmental aspects of the globe.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1:	Escalate the technical skills within and across disciplines of Computer Science Engineering for productive career by maintaining professional ethics
PEO2:	Develop and exercise their capabilities to demonstrate their creativity in engineering practice and team work with increasing responsibility and leadership
PEO3:	Refine their knowledge and skills to attain professional competence through lifelong learning such as higher education, advanced degrees and professional activities

PEO TO MISSION MAPPING

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

PEO Statements	Mission Statements	Mapping Level	Justification
PEO1	M1	3	A strong foundation in M1 principles is crucial for developing effective and transformational software solutions, which directly aligns with PEO1's objective of applying fundamental knowledge to real-world problems.
	M2	3	Technical expertise requires staying updated with new technologies and methodologies, aligning perfectly with PEO1's goal of leveraging updated knowledge for software development
	M3	2	While M3 is more focused on engaging students in contemporary research challenges and innovative solutions, it still supports the development of technical expertise by exposing students to real-world problems and interdisciplinary applications.
PEO2	M1	3	A Good understanding of core principles in Computer Science is mandatory for a successful career. Mastery of these principles ensures that graduates are well-prepared for various professional roles, higher education, or entrepreneurial endeavors.
	M2	2	Continuous learning and skill enhancement are vital for career success. M2's focus on fostering technical, communication, and managerial skills ensures that students are well-rounded and adaptable, which is crucial for thriving in a dynamic and evolving field.
	M3	3	To address contemporary research challenges and contributing to innovative solutions prepare students for high-impact careers. The ability to solve global issues using advanced technologies of computer science and engineering not only makes students highly employable but also positions them as leaders in their fields, directly supporting the objective of a successful career.
PEO3	M1	2	Understanding core principles also indirectly supports the development of professional ethics and effective communication. This foundational knowledge is essential for team work and problem-solving in professional settings.
	M2	2	The focus on professional ethics and embracing new technologies supports life-long learning and the development of soft skills nCSEssary for effective teamwork and social innovation.
	M3	3	Engaging students in real-world research challenges and encouraging them to address global issues inherently requires teamwork, effective communication, and ethical considerations. This mission strongly supports the development of soft skills and fosters a commitment to life-long learning.

PROGRAM SPECIFIC OBJECTIVES

PSO1: (Software Development and Quality assurance)	Transform various legacy or manual systems into computer automated systems using modern programming languages, integrated development environments and apply testing tools for efficient verification and validation of this software systems.
PSO2: (Immediate professional practice)	Work as software practitioner or continue higher education by adopting advanced technologies in various fields of Computer Science and Engineering.

PO/PSO TO PEO MAPPING

PO's		PEO1	PEO2	PEO3
PO1	Engineering Knowledge	3	2	3
PO2	Problem Analysis	3	3	3
PO3	Design/Development of solutions	3	3	3
PO4	Conduct investigations of complex problems	3	3	3
PO5	Modern tool usage	3	3	3
PO6	The engineer and the world	1	3	1
PO7	Ethics	2	3	3
PO8	Individual and Teamwork	3	3	2
PO9	Communication	2	3	3
PO10	Project management and finance	3	3	2
PO11	Lifelong Learning	3	3	3
PSO1	Transform various legacy or manual systems into computer automated systems using modern programming languages, integrated development environments and apply testing tools for efficient verification and validation of this software systems.	3	2	3
PSO2	Work as software practitioner or continue higher education by adopting advanced technologies in various fields of Computer Science and Engineering.	3	3	2

URR24: SYLLABI FOR I to VIII SEMESTERS
 of
 B.TECH COMPUTER SCIENCE & ENGINEERING
 w.e.f. A.Y. 2024-25

I SEMESTER, B.TECH CSE (W.E.F. A.Y. 2024-25)

Stream – I

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
-	IKSC	U24IK100	U24SK100 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	U24PY102C	Engineering Physics <i>(for CSE)</i>	2	1	2	5	10	4
3	PCC	U24CS103	Computer Organization & Architecture	2	1	-	4	7	3
4	ESC	U24CS104	Programming for Problem Solving with C	2	1	2	5	10	4
5	ESC	U24EE105C	Basic Electrical Engineering	2	1	2	5	10	4
6	VAC	U24CY106	Environmental Studies	2	-	-	3	5	-
7	AEC	U24AE107	IDEA Lab Makerspace	-	-	2	2	4	1
8	ELC	U24EL108	Practicum-1	-	-	-	4	4	1
9	VAC	U24VA109X XXXX	SEA - I/ SAA-1	-	-	-	2	2	1
10	AEC	U24AE110	Expert Talk Series-1	-	-	-	1	1	1
Total:				12	5	8	37	62	22
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)				-NiL-					

Pool – I (Physics)

S. No.	Course Code	Course Title
1.	U24PY102A	Engineering Physics <i>(for Civil Engineering)</i>
2.	U24PY102B	Engineering Physics <i>(for ECIE)</i>
3.	U24PY102C	Engineering Physics <i>(for CSE)</i>
4.	U24PY102D	Engineering Physics <i>(for EEE)</i>
5.	U24PY102E	Engineering Physics <i>(for ECE)</i>

Pool – II (Basic Electrical & Electronics Engineering)

S. No.	Course Code	Course Title
1.	U24EE105A	Basic Electrical and Electronics Engineering <i>(for Civil Engineering)</i>
2.	U24EE105B	Basic Electrical Engineering <i>(Common to ECE and ECI)</i>
3.	U24EE105C	Basic Electrical Engineering <i>(for CSE)</i>
4.	U24EE105D	Basic Electrical Engineering <i>(for EEE)</i>

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 Outcomes (COs): <i>After completion of this course, the students should be able to...</i> 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			
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): <i>Review of basic concepts of limit, continuity and differentiability [Reference 1: topic (3.1,3.2,3.5,4.1)]</i> <i>Alternating series [(Text 1: topic 9.12, Solved problems: 9.16,9.17, Practice problems: exercise 9.7(1, 7)]</i> <i>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))]</i> <i>Additional problems on Maclaurin’s series [(Text 1: topic 4.4, Solved problems: 4.20, Practice problems: exercise 4.5 (3, 5)]</i>			
UNIT-II		9 Hrs	
Partial differentiation and its applications: Functions of two or more variables, Partial derivatives, Total derivative, Change of variables, Jacobians, Functional relationship, Geometrical Interpretation-Tangent plane and Normal to a surface, Taylor’s theorem for function of two variables (without proof), Errors and approximations, Total differential, Maxima and minima of functions of two variables, Lagrange’s method of undetermined multipliers, Differentiation under the integral sign Self-Learning Topics (SLTs): <i>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)]</i> <i>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))].</i> <i>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))]</i>			

UNIT-III	9 Hrs
Differential equations of first order (DE): Reorientation of differential equation of first order and first degree (Formation a differential equation, variables separable method, homogeneous equations, Linear equations), Exact differential equations, Equations reducible to exact equations, Applications of differential equations of first order: Orthogonal trajectories - Orthogonal trajectories of the family of curves $f(x, y, c)=0$, Physical applications-Motion of a boat across a stream, Resisted motion, Velocity of escape from the earth, Simple electric circuits - RL series circuit, Newton's law of cooling, Rate of decay of Radio-active materials, Rate of growth of population Self-Learning Topics (SLTs): Review of DEs of first order (Text 1: topic 11.1, 11.2, 11.3, 11.4,11.5) Solutions of Non-exact DEs by Inspection Method [(Text 1: topic 11.12(1), Solved Problems: 11.30, Practice problems: exercise 11.8 (1,3)] Additional problems on Non-exact DEs [(Text 1: topic 11.12(2,3,4,5), Solved problems: 11.33,11.35,11.36, Practice problems: exercise 11.8 (9,15)] Orthogonal Trajectories of family of curves in polar coordinates [(Text 1: topic 12.3(3), Solved problems :12.7,12.8 , Practice problems: exercise 12.2(9,10)]	
UNIT-IV	9 Hrs
Linear differential equations: Linear differential equations with constant coefficients, Rules for finding complementary function, Inverse operator, Rules for finding the particular integral ($Q=e^{ax}$, $\sin(ax+b)$ or $\cos(ax+b)$, x^m and $e^{ax}V(x)$), Method of variation of parameters, Linear dependence of solutions Applications of linear differential equations: Simple harmonic motion, Simple pendulum, Oscillations of spring, Oscillatory electrical circuit-LCR circuit, Electro-mechanical analog Self-Learning Topics (SLTs): Finding the particular integral of $Q(X) = X^m V(X)$ [(Text 1: topic 13.7, Solved problems: 13.16,13.17,13.19, Practice problems: exercise 13.2 (21,22)]. Additional problems on method of variation of parameters [(Text 1: topic 13.8(1), Solved problems: 13.25, 13.26, Practice problems: exercise 13.3(1,5)] Cauchy's homogeneous linear differential equation [(Text 1: topic 13.9(1), Solved problems: 13.31,13.34, Practice problems: exercise 13.4(3,6,9)]	
Textbook(s): 1. Grewal, B.S., <i>Higher Engineering Mathematics</i>, Khanna Publishers, Delhi, 44th edition, 2017	
Reference Book(s): 1. Shanti Narayan, Dr. Mittal P.K, <i>Differential Calculus</i>, S. Chand & Co., New Delhi, 1st edition, Reprint 2014 2. Kreyszig E, <i>Advanced Engineering Mathematics</i>, Inc, U.K, John wiely & sons, 10th edition, 2020 3. S.S. Sastry, <i>Engineering Mathematics, Vol.II</i>, Prentice Hall of India, 3rd edition, 2014.	
Web and Video link(s): 1. https://youtu.be/4EYko9rdF7g?si=WUu12 NPTEL Video Lecture on Infinite series by Prof. S.K.Ray, Professor of Mathematics, IITK Kanpur. 2. https://youtu.be/0apMXhWG_W8?si=M-abw2Gq3buX5HLM NPTEL Video Lecture on Fundamental mean value theorems by Prof. Jithendra Kumar, Professor of Mathematics, IITK Kharagpur.	

3. <https://youtu.be/6r5jfT8xrXM?si=ryLXYVJr4-iUkdIV>; NPTEL Video Lecture on Exact Differential Equations, Prof. Jithendra 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. Jithendra 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	PS O1	PSO 2
CO1	U24MH101.1	2	2	1	1	-	-	-	1	1	-	1	1	-
CO2	U24MH101.2	2	2	1	1	-	-	-	1	1	-	1	1	-
CO3	U24MH101.3	2	2	1	1	-	-	-	1	1	-	1	1	-
CO4	U24MH101.4	2	2	1	1	-	-	-	1	1	-	1	1	-
U24MH101		2	2	1	1	-	-	-	1	1	-	1	1	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Examine the convergence of a series and interpret mean value theorems.	SDG4	Quality Education	Develops analytical thinking, mathematical reasoning, and problem-solving skills essential for quality technical education.
CO2	Apply partial differentiation to functions of several variables in solving various engineering problems.	SDG9	Industry, Innovation and Infrastructure	Supports engineering design, optimization, modelling, and innovation in industrial and technological applications.
CO3	Apply appropriate methods of differential equations of first order and first degree to solve real-life engineering problems.	SDG9	Industry, Innovation and Infrastructure	Differential equation models are widely used in transportation, environmental systems, population studies, and engineering infrastructure.
CO4	Analyze the solutions of higher order linear differential equations with constant coefficients.	SDG9	Industry, Innovation and Infrastructure	Helps in analyzing dynamic systems, control systems, electrical/mechanical engineering applications, and technological advancement.

ENGINEERING PHYSICS (for CSE)			
Class: B.Tech. I- Semester		Branch: CSE	
Course Code:	U24PY102C	Credits:	4
Hours/Week (L-T-P-O-E):	2-1-2-5-10	CIE :	60%
Total Number of Teaching Hours:	60 Hrs	ESE :	40%
Course Learning Outcomes (COs):			
After completion of this course, the students should be able to			
CO1: evaluate properties of lasers and optical fibre parameters			
CO2: calculate the electric field, electric potential, magnetic field and flux density; determine properties of magnetic and superconducting materials			
CO3: evaluate the energy values of a particle in an infinite potential well and apply the quantum principles in quantum computing			
CO4: analyze V-I characteristics of semiconductor diodes and suggest their applications; determine resistances of transistor biasing circuits			
CO5: measure diameter of wire and hollow tubes using Vernier callipers and screw gauge			
CO6: determine the width of a narrow slit and wavelength of laser using diffraction phenomenon and numerical aperture of an optical fiber			
CO7: calculate the dielectric constant of a material and plot the hysteresis curve of ferromagnetic material			
CO8: determine forward voltage and currents from V-I characteristics of semiconductor diodes; identify cut-off, saturation and active regions of NPN transistor			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Applied Optics and Lasers: Principles of interference, Diffraction phenomena and applications (qualitative), Difference between conventional light and laser, Basic principles and 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			
Fiber Optics: Introduction, Total internal reflection, Optical fiber construction, Numerical aperture and acceptance angle, Types of optical fibers - Step index and graded index, Single and multimode, V-number; Power losses in optical fibers - Attenuation, Dispersion, Bending; Fiber optic communication system, Applications of optical fibers – Endoscopy, Fiber optic sensors (temperature and displacement)			
<i>Self Learning Topics (SLTs): Concept of wave and basic concepts- amplitude, wavelength, frequency, phase, phase angle and general wave equation(Text1: topic 1.9), types of waves(Text1: topic 1.10), reflection laws(Text1: topic 1.11).</i>			
UNIT-II		9 Hrs	
Electrostatics and Magnetostatics: Electric charges, Coulomb’s law, Electric field, Electrostatic potential, Computation of electric field and electrostatic potential due to point and line charges; Magnetic field, Magnetic flux density, Biot-Savart’s law, Ampere’s law, Faraday’s law and Lenz’s law			
Magnetic and Superconducting materials: Introduction, Permeability, Magnetization, Susceptibility, Origin of magnetism, Bohr magneton, Ferro, Antiferro and ferri magnetic materials, Hysteresis, Soft and hard magnetic materials and their applications; superconductivity, Meissner effect, Transition temperature, Isotope effect, Type-I and type-II superconductors, High T _c superconductors, Applications of superconductors			
<i>Self Learning Topics (SLTs): magnetization, susceptibility & their relations (Text1: topic 41.2), London penetration depth (Text1: topics 42.4.7), Solved problems (Text1: Prob 42.9 to 42.14).</i>			

UNIT-III	9 Hrs
Elements of Quantum Mechanics: Wave-particle duality, de-Broglie wavelength, Physical significance of wave function, Schrodinger time-dependent wave equation, Schrodinger time-independent wave equation, Particle in an infinite potential well (one dimension) Introduction to Quantum Computing: Observables and operators, Expectation values, Expectation values in operator notation, Dirac Bra-Ket notation, Superposition principle, Concept of Quantum bits, Classical versus Quantum computing, Quantum parallelism and Quantum entanglement, Applications of quantum computing Self Learning Topics (SLTs): Heisenberg's uncertainty principle (Text1: topics 27.2), Observables and operators (Text1: topics 27.19), Solved problems (Text1: Prob 27.13, Prob 27.17).	
UNIT-IV	9 Hrs
Semiconductor Physics: Classification of solids based on energy band theory- Conductors, Semiconductors and insulators, Intrinsic semiconductor- carrier generation and recombination; Extrinsic semiconductors - n-type and p-type (qualitative) Semiconductor Diodes and Bipolar Junction Transistors (BJTs): Formation of a PN junction, Forward and reverse bias, PN junction diode, Diode current equation, Zener diode, Zener diode as voltage regulator and their V-I characteristics, Light emitting diode (LED), Transistor structure, Representation of NPN and PNP transistors, Transistor action, Transistor configurations- Common base(CB), Common emitter(CE) and Common collector(CC); Corresponding α, β, γ parameters and their relations and transistor as an amplifier Self Learning Topics (SLTs): drift & diffusion current (Text2: topic 4.9), diode current equation (Text2: topic 4.15), Solved problems (Text2: Prob 4.17 to 4.21).	
LABORATORY COMPONENT	
List of Experiments 1. Linear Measurements using Vernier callipers and screw gauge 2. Determination of slit width using He-Ne laser 3. Determination of wavelength of He-Ne laser using reflection and transmission diffraction grating 4. Determination of dielectric constant of materials using parallel plate capacitor 5. Magnetic hysteresis- B-H curve tracing using CRO 6. Numerical aperture and acceptance angle of an optical fiber 7. Study of V-I characteristics of PN junction diode 8. Study of V-I characteristics of LED 9. Study of common emitter characteristics of NPN transistor 10. Energy band gap of a semiconductor material 11. Determination of thickness of thin sheet using air-wedge method 12. Determination of Planck's constant	
Textbook(s): 1. M. Avadhanulu and Kshirsagar, TVS Arun Murthy, <i>A Text Book of Engineering Physics</i>, S. Chand & Company Ltd, 11th Edn., 2018 (Unit-I, II & III- Chapter 5, 6, 27, 41, 42, 44 & 47) 2. S Salivahanan, N Suresh Kumar, <i>Electronic devices and circuits</i>, Mc Graw Hill Edn., 2017 (Unit-IV-Chapter 4, 5 & 6) 3. Michael Nielsen and Isaac Chuang, <i>Quantum Computation and Quantum Information</i>, Cambridge University Press, 2010 (Unit-III-Chapter 1.1, 1.2 & 1.3)	

Reference Book(s):

1. Neil Gershenfeld, *Physics of Information Technology*, Cambridge University Press, 1st Edn., 2000
2. V. Rajendran, *Engineering Physics*, Mc Graw Hill Edn., 2013
3. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, The MIT Press Cambridge, Massachusetts London, England, 2011
4. R.K. Gaur and S.L.Gupta, *Engineering Physics*, Dhanpath Rai and Sons, 2013
5. David Halliday, Robert Resnick and S Krane, *Physics Volume I&II*, Wiley India Limited, 5th Edn., 2014

Web and Video link(s):

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

Laboratory Manual (for laboratory component):

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

Course Articulation Matrix (CAM):				U24PY102C- ENGINEERING PHYSICS (for CSE)										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2
CO1	U24PY102C.1	2	1	1	-	-	1	1	1	1	-	1	1	-
CO2	U24PY102C.2	2	1	-	-	-	1	1	1	1	-	1	1	-
CO4	U24PY102C.4	2	1	-	-	-	1	1	1	1	-	1	1	-
CO5	U24PY102C.5	2	1	-	-	-	1	1	1	1	1	1	1	-
CO6	U24PY102C.6	2	1	1	-	1	1	1	1	2	-	1	1	-
CO7	U24PY102C.7	2	1	-	-	1	1	1	1	2	-	1	1	-
CO8	U24PY102C.8	2	1	-	-	1	1	1	1	2	-	1	1	-
U24PY102C		2	1	1	1	1	1	1	1	1.5	1	1	1	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix			
CO	CO Statement The student should be able to...	Relevant SDG	Mapping Justification
CO1	evaluate properties of lasers and optical fibre parameters.	SDG 4	Understanding laser action and optical fibre parameters builds foundational photonics competency, strengthening rigorous, application-oriented engineering education as envisaged by SDG 4.
		SDG 9	Lasers and optical fibres are core technologies of modern communication, sensing and photonic infrastructure; evaluating their properties supports innovation in these industries.
CO2	calculate the electric field, electric potential, magnetic field and flux density; determine properties of magnetic and superconducting materials.	SDG 7	Superconducting and magnetic materials enable low-loss power transmission, efficient transformers and magnets, directly supporting affordable, energy-efficient technologies.
		SDG 9	Electromagnetic field computation and characterization of magnetic/superconducting materials underpin the design of electrical machines, sensors and next-generation infrastructure.
CO3	evaluate the energy values of a particle in an infinite potential well and apply the quantum principles in quantum computing.	SDG 4	Grounding students in quantum mechanics and its computational applications builds advanced, future-ready scientific literacy consistent with SDG 4's emphasis on quality STEM education.
		SDG 9	Quantum computing is an emerging frontier technology; exposure to its foundational principles fosters innovation capacity in next-generation computing infrastructure.
CO4	analyze V-I characteristics of semiconductor diodes and suggest their applications; determine resistances of transistor biasing circuits.	SDG 9	Diode and transistor circuit analysis is fundamental to electronic device design, supporting innovation in the semiconductor and electronics industry.
		SDG 7	Understanding diode and transistor biasing supports the design of energy-efficient electronic and power-conditioning circuits.

CO-SDG Alignment Matrix			
CO	CO Statement The student should be able to...	Relevant SDG	Mapping Justification
CO5	measure diameter of wire and hollow tubes using Vernier callipers and screw gauge.	SDG 4	Precision measurement using Vernier callipers and a screw gauge is a foundational laboratory skill. Hands-on experimentation with standard instruments builds scientific competency and promotes inquiry-based learning as envisioned by SDG 4.
CO6	determine the width of a narrow slit and wavelength of laser using diffraction phenomenon and numerical aperture of an optical fiber.	SDG 4	Laser diffraction and optical-fibre experiments build core photonics competency and experimental rigor, strengthening quality, inquiry-based STEM education.
		SDG 9	Slit-width and wavelength determination using lasers, together with numerical-aperture characterization of fibres, underpin precision metrology and fibre-optic communication technologies central to industrial infrastructure.
CO7	calculate the dielectric constant of a material and plot the hysteresis curve of ferromagnetic material.	SDG 9	Dielectric constant measurement supports the design of capacitors and insulating materials, while hysteresis characterization of ferromagnetic materials informs the design of transformers and motors, both central to industrial infrastructure.
		SDG 7	Characterizing magnetic losses via the hysteresis curve helps in selecting low-loss core materials for transformers and motors, contributing to energy-efficient electrical systems.
CO8	determine forward voltage and currents from V-I characteristics of semiconductor diodes; identify cut-off, saturation and active regions of NPN transistor.	SDG 9	PN junction diodes and NPN transistors are fundamental building blocks of electronic circuits; experimental characterization of their behaviour supports innovation in the electronics and semiconductor industry.
		SDG 7	Characterizing diode forward-voltage behaviour and transistor operating regions underpins the design of energy-efficient rectifier, switching and amplifier circuits.

COMPUTER ORGANIZATION AND ARCHITECTURE			
Class: B.Tech. I- Semester		Branch: CSE	
Course Code:	U24CS103	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-4-7	CIE :	60%
Total Number of Teaching Hours:	36 Hrs	ESE :	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i>			
CO1: examine the study of the basic structure and operation of a digital computer operations and performance, data representation methods, and digital logic circuit analysis.			
CO2: analyze instruction execution, addressing modes, hardware components, and control mechanisms in processors.			
CO3: apply ALU operations on positive and negative numbers and analyze the features of various types of memory.			
CO4: analyze I/O interfaces, bus systems, data transfer methods, and pipeline processing concepts.			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Digital Computers: Introduction to computers, Functional units, Basic operational concepts of a computer, Performance			
Data Representation: Binary number system, Octal and hexadecimal numbers, Decimal representation, Alphanumeric representation			
Digital Logic Circuits: Logic gates-symbols and truth tables, Map simplification, Flip flops, Registers			
Self Learning Topics (SLTs): <i>Computer types(Text1: topics 1.1), Historical perspective(Text1: topics 1.7), Universal logic gates(Text2: topics 2.3), Don't care conditions (Text2: topics 2.4),Practice problems (Text2:Prob 2.4,Prob 2.8,Prob 2.9)</i>			
UNIT-II			
Instruction Set Architecture: Memory locations and addresses, Memory operations, Instructions and instruction sequencing, Addressing modes			
Basic Processing Unit: Fundamental concepts, Instruction execution, Hardware components, Instruction fetch and execution steps, Control signals			
Self Learning Topics (SLTs): <i>Decimal representation(Text2: topics 4.1), Practice problems(Text2: Prob 4.5,Prob 4.7,Prob 4.10), Assembly language notation(Text1: topics 2.5.3), Solved problems(Text 1: Prob 2.1,Prob 2.2,Prob 2.3), Practice problems (Text1: Prob 2.1, Prob 2.2, Prob 2.3)</i>			
UNIT-III		9 Hrs	
Arithmetic: Addition and subtraction of signed numbers, Multiplication of numbers, Integer division			
The Memory System: Basic concepts, Semiconductor RAM memories- Internal organization of memory chips, Static memories, Dynamic RAMs; Read-only memories, Memory hierarchy, Cache memories, Direct memory access, Performance considerations			
Self Learning Topics (SLTs): <i>Addition/Subtraction logic unit(Text1:topics 9.1.1),Solved problems</i>			

(Text1: Prob 9.2, Prob 9.4), Practice problems (Text1: Prob 9.2, Prob 9.4, Prob 9.9), Solved problems (Text1: Prob 8.3, Prob 8.4, Prob 8.5), Practice problems (Text1: Prob 8.3, Prob 8.5)	
UNIT-IV	9 Hrs
Input-Output Organization: Input-output interface- I/O bus and interface modules, I/O versus memory bus, Isolated versus memory-mapped I/O, Asynchronous data transfer- Strobe control, Handshaking Pipeline Processing: Pipelining, Arithmetic pipeline, Instruction pipeline Self Learning Topics (SLTs): Asynchronous serial transfer (Text2: topics 12.3), Practice problems (Text2: Prob 12.1, Prob 12.8, Prob 12.10, Prob 12.29), Pipeline hazards (Text 2: topics: 10.4), Practice problems (Text2: Prob 10.3, Prob 10.9, Prob 10.11)	
Textbook(s): 1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", McGraw-Hill Education, 6th Edition, ISBN-9789355323729, 2023. (Chapter Nos. 1, 2, 5, 7, 8, 9) M. Morris Mano, "Computer System Architecture", Revised Third Edition, Pearson Education, ISBN: 978-93-325-8560-7, 2019. (Chapter Nos. 9, 10, 11, 12, 14)	
Reference Book(s): 1. B Ram, Sanjay Kumar, "Computer Fundamentals: Architecture and Organization", New Age International Publishers, 5th Edition, ISBN: 978-81-224-3610-5, 2018. 2. W. Stallings, "Computer Organization and Architecture - Designing for Performance", 7th Edition, Pearson Education, ISBN 978-81-7758-993-1, 2009.	
Web and Video link(s): 1. https://youtu.be/Kn5ipjXJvpQ?si=qs19paRizepEmRZ5; NPTEL Video Lecture on Fast Addition, Multiplication by Prof. Anshul Kumar, Professor of CSE, IIT Delhi 2. https://youtu.be/CSkN0wj0zZU?si=suwgssCvwwvTlytn; NPTEL Video Lecture on DMA transfer by Prof. Jatindra Kumar Deka, Professor of CSE, IIT Guwahati.	

Course Articulation Matrix (CAM):					U24CS103 COMPUTER ORGANIZATION AND ARCHITECTURE									
CO		PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PSO1	PS O2
CO1	U24CS103.1	2	2	2	1	-	1	-	-	-	-	1	1	2
CO2	U24CS103.2	2	2	2	1	-	1	-	-	-	-	1	1	2
CO3	U24CS103.3	2	2	2	1	-	1	-	-	-	-	1	1	2
CO 4	U24CS103.4	2	2	1	1	-	1	-	-	-	-	1	1	2
U24CS103		2	2	1.75	1	-	1	-	-	-	-	1	1	2

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	examine the study of the basic structure and operation of a digital computer operations and performance, data representation methods, and digital logic circuit analysis	SDG9	Industry, Innovation and Infrastructure	Fundamental knowledge of computer hardware organization, digital systems, and performance optimization, which are essential for developing innovative computing technologies, strengthening digital infrastructure, and advancing industrial automation and technological innovation
CO2	analyze instruction execution, addressing modes, hardware components, and control mechanisms in processors	SDG9	Industry, Innovation and Infrastructure	Enabling students to understand processor architecture and control mechanisms, which are fundamental for designing efficient computing systems, improving industrial technologies, and supporting innovation in digital infrastructure and advanced electronic systems
CO3	apply ALU operations on positive and negative numbers and analyze the features of various types of memory	SDG9	Industry, Innovation and Infrastructure	Arithmetic processing and memory system analysis, which are essential for designing high-performance computing systems, optimizing digital infrastructure, and fostering innovation in modern electronic and industrial applications
CO4	analyze I/O interfaces, bus systems, data transfer methods, and pipeline processing concepts	SDG9	Industry, Innovation and Infrastructure	Enabling students to understand efficient data communication and processing techniques, which are vital for developing reliable computing infrastructure, enhancing system performance, and supporting innovation in industrial and technological applications

PROGRAMMING FOR PROBLEM SOLVING WITH C			
Class: B. Tech. I – Semester		Branch: CSE	
Course Code:	U24CS104	Credits:	3
Hours/Week (L-T-P- E):	2-1-2-5-10	CIE:	40%
Total Number of Teaching Hours:	36 Hrs	ESE:	60%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> 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 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			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction to Programming: Components of a computer, concept of hardware and software, 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			
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, Dynamic arrays			
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, Nesting of functions Recursion, The scope, visibility and lifetime of variables (storage classes)			
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, Array of pointers

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

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

Reference Book(S):

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

Web and Video link(s):

<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.

<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 Articulation Matrix (CAM): U24CS104: PROGRAMMING FOR PROBLEM SOLVING WITH C														
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS104.1	2	1	1	1	1	-	-	1	-	1	2	2	2
CO2	U24CS 104.2	2	2	2	1	1	-	-	1	-	1	2	2	2
CO3	U24CS 104.3	2	2	3	1	1	-	-	1	-	1	2	2	2
CO4	U24CS 104.4	2	2	3	2	1	-	-	1	-	1	2	2	2
CO5	U24CS104.5	2	1	1	1	1	-	1	1	-	1	2	2	2
CO6	U24CS 104.6	2	2	2	1	1	-	1	1	-	1	2	2	2
CO7	U24CS 104.7	2	2	3	1	1	-	1	1	-	1	2	2	2
CO8	U24CS 104.8	2	2	3	2	1	-	1	1	-	1	2	2	2
U24CS 104		2	1.75	2.25	1.25	1	-	1	1	-	1	2	2	2

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	enumerate programming development steps, design an algorithm and draw flow chart for a given application	SDG4	Quality Education	Writing a C program begins with understanding algorithms and flowcharts – these teach learners how to break any problem into logical, sequential steps before touching a keyboard. This systematic thinking is the essence of quality technical education. When a student declares a variable, assigns a data type, and uses printf() / scanf() for formatted I/O, they are learning how a computer receives, stores, and communicates information – skills directly applicable to any software career. Operators and expressions in C train students to translate real-world mathematical and logical problems into executable instructions. These concepts make C programming education a powerful vehicle for building digital literacy and technical competence, perfectly aligned with SDG 4's goal of ensuring inclusive, equitable, and quality education that equips youth with relevant skills for employment and life.
CO2	apply logical skills for problem solving using control structures and arrays	SDG9	Industry, Innovation and Infrastructure	In C programming, control structures like if-else and switch are the decision-making engines of every industrial software system – from automated assembly lines to embedded controllers in machines. for and while loops enable repetitive tasks such as reading data from sensors

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				in a loop, continuously monitoring a system state, or iterating over a production dataset. Arrays in C allow storage and manipulation of large datasets in contiguous memory – a technique central to writing efficient firmware for industrial microcontrollers. Linear search in C is a direct implementation of the most basic data retrieval algorithm used in low-level embedded systems where advanced libraries are unavailable. Writing these constructs in C – a language used in 70%+ of critical infrastructure software – directly develops the skills that power industrial innovation and technological infrastructure, the heart of SDG 9.
CO3	develop string operations and modular programming with functions	SDG3	Good Health & Well-Being	In C, character arrays and string functions like strlen(), strcpy(), strcmp(), and strcat() are the primary tools for handling text-based patient data – names, diagnoses, prescriptions – in medical device firmware written in C. User-defined functions in C promote modular programming, where each function handles one specific task (e.g., calculate_bmi(), check_heartrate()), making medical software reliable, testable, and maintainable – critical in life-saving devices. Recursion in C is used in algorithms like binary search for patient records and tree traversal in medical data structures. Storage classes (auto, static, extern, register) control memory efficiently in embedded health devices like ECG monitors, pulse oximeters, and insulin pumps – where every byte of memory matters. C remains the dominant language in medical device programming, making this unit directly relevant to SDG 3.
CO4	Analyse and implement structures, unions, pointers and files in C programming	SDG11	Sustainable Cities & Communities	Advanced programming concepts such as data structures, pointers, and file handling form the foundation for developing reliable software systems

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				and modern computing infrastructure In C, a struct groups related data under one name – for example, a struct citizen can hold name, ID, address, and utility usage together, exactly how urban management systems model real-world entities. Pointers in C enable dynamic and efficient memory access – critical in C programs that run on resource-constrained urban devices like smart meters, traffic signal controllers, and public transport embedded systems. Pointers to structures allow linked-list based data structures used in city-wide route management and network topology of infrastructure. File I/O in C using fopen(), fread(), fwrite(), and fclose() enables persistent data storage – logging power consumption, water usage, or traffic counts to files that city planners use for sustainable decision-making. union saves memory in embedded city devices by sharing memory across different data types. Together, these advanced C concepts are the building blocks of the embedded and systems software that makes smart, sustainable cities possible – directly supporting SDG 11.

BASIC ELECTRICAL ENGINEERING			
Class: B.Tech. I -Semester		Branch: CSE	
Course Code:	U24EE105 C	Credits	4
Hours/Week (L-T-P-O-E):	2-1-2-5-10	CIE	60 %
Total Number of Teaching Hours:	60 Hrs	ESE	40 %
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: determine voltage, current & power in electrical circuits using network reduction techniques, mesh & nodal analysis CO2: apply suitable network theorems to analyze DC circuits CO3: determine impedance, voltage, current, and power in 1- $\emptyset$ AC circuits & determine line and phase quantities in 3- $\emptyset$ AC circuits CO4 : select a suitable electrical machine for given applications and determine the energy consumed by a lighting load. CO5: validate mesh and nodal analysis CO6: validate network theorems CO7: determine the impedance of series RL & RC circuits at various operating frequencies CO8: determine the efficiency of a transformer by conducting a load test			
THEORY COMPONENT			
UNIT-I			9 Hrs
DC circuits: Network elements, Linear & non-linear elements, Active & passive elements, Unilateral & bilateral elements, Ohm's law, Power, Energy, Kirchhoff's laws, Resistances connected in series and parallel, Voltage divider rule & Current divider rule. DC Circuit analysis: Source transformation, Star-Delta conversion, Mesh analysis & Nodal analysis (T & π networks only). <i>Self-Learning Topics (SLTs):</i> 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
DC network theorems (Independent sources only): Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem (T & π networks only). <i>Self-Learning Topics (SLTs):</i> Condition for maximum power transfer (Text1: Topics3.9), Solved problems (Text1: Prob 3.15, 3.18, 3.23 & 3.25), Practice problems (Text1: Chap-3, Prob 9,10,13 & 14).			
UNIT-III			9 Hrs
1-$\emptyset$ 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,			

3- Ø AC circuits: Generation of 3- Ø voltages, Advantages, Disadvantages, Applications of a three-phase system, Voltage & current relationships of line and phase values for balanced star and delta connections. Self-Learning Topics (SLTs): Expression for RMS & Average value (Text1: Topic, 4.4 & 4.5) Solved problems (Text1: Prob 4.10, 4.12, 4.13 & 4.14), Practice problems (Text1: Chap-4, Prob 8,9,12&12).	
UNIT-IV	9 Hrs
Electrical Machines & Electrical Lighting (Qualitative treatment): Construction, Principle of operation, Characteristics & applications of 1- Ø transformer, 3- Ø induction motor, 1- Ø induction motor and DC motor and Types of DC motor. Electrical lighting sources and Energy calculations: Lighting sources-incandescent, Fluorescent, CFL & LED lamps, Elementary calculations for energy consumption. Self-Learning Topics (SLTs): EMF equation of a Transformer (Text1: Part-II Topic, 4.4.2) Solved problems (Text1: Part-II Prob 4.5, 4.6 & 4.7), Practice problems (Text1: Part-II Prob 5.2, 5.3 & 5.4), Practice problems (Text1: Part-II Prob 6, 7 & 8)	
LABORATORY COMPONENT	
List of Experiments	
1. Verification of voltage divider rule and current divider rule 2. Verification of Mesh Analysis 3. Verification of Nodal Analysis 4. Verification of Superposition Theorem 5. Verification of Thevenin's Theorem 6. Verification of Maximum power transfer Theorem 7. Determination of internal parameters of a choke coil 8. Impedance calculations and phasor representation of RL series circuit 9. Impedance calculations and phasor representation of RC series circuit 10. Load test on 1-phase transformer 11. Verification of Kirchoff's laws using PSPICE/MATLAB 12. Interfacing Sensors with Arduino using TINKER CAD i. LED blinking ii. IR Sensor iii. Ultrasonic Sensor iv. Voltage Sensor v. Current Sensor vi. Speed Sensor	
Textbook(s): 1. K. Uma Rao, <i>Basic Electrical Engineering</i> , Pearson Education, Edition, 2011	

Reference Book(s):

1. B.L.Thereja, A.K.Thereja, *Electrical Technology Vol. I & II*, S.Chand & Company Ltd, Edition, 2005.
2. Edward Hughes, *Electrical & Electronics Technology*, Pearson Education, 10th Edition., 2010.
3. D. P. Kothari and I. J. Nagrath, *Basic Electrical Engineering*, Tata McGraw Hill, Edition, 2010.
4. Chakravarthy A, Sudhipanath and Chandan Kumar, *Basic Electrical Engineering*, Tata McGraw Hill Ltd, Edition, 2009.

Web and Video link(s):

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

Laboratory Manual (for laboratory component):

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

Course Articulation Matrix (CAM):			U24EE105C : BASIC ELECTRICAL ENGINEERING											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	U24EE105C.1	2	1	-		-	-	1	1	1	1	1	1	1
CO2	U24EE105C.2	2	2	-	-	-	-	1	1	1	1	1	1	1
CO3	U24EE105C.3	3	3	1	1	1		1	1	1	1	1	1	1
CO4	U24EE105C.4	3	3	1	1	1	1	1	1	1	1	1	1	1
CO5	U24EE105C.5	2	1	-	-	-	-	1	1	1	1	1	1	1
CO6	U24EE105C.6	2	2	-	-	-	-	1	1	1	1	1	1	1
CO7	U24EE105C.7	3	3	1	1	1		1	1	1	1	1	1	1
CO8	U24EE105C.8	3	3	1	1	1	1	1	1	1	1	1	1	1
U24EE105C		2.5	2.25	1	1	1	1	1	1	1	1	1	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply network reduction, Kirchhoff's laws, nodal and mesh analysis to determine resistance, voltage, current & power in electrical circuits.	SDG 9	Industry, Innovation and Infrastructure	Mastering fundamental DC circuit analysis techniques (Ohm's law, KVL/KCL, mesh/nodal analysis) is essential for designing reliable and efficient power distribution networks. This foundational knowledge supports the development of resilient industrial infrastructure and fosters innovation in electrical systems.

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO2	Evaluate impedance, voltage, current, and power in 1- $\emptyset$ AC circuits & select suitable motor for given application.	SDG 7	Affordable and Clean Energy	SDG 7: Analysis of AC circuits (phasors, power factor, RLC analysis) is crucial for optimizing power transmission and distribution, which directly enables reliable and affordable clean energy access. SDG 9: Selecting the appropriate motor (1- $\emptyset$ IM, DC, Stepper, BLDC) for specific applications like pumps, EVs, and industrial drives improves overall energy efficiency and supports innovation in sustainable automation and infrastructure.
CO3	Evaluate the voltage and current characteristics of PN junction diode and Zener diode.	SDG 9	Industry, Innovation and Infrastructure	Understanding the V-I characteristics of PN junction and Zener diodes is fundamental to modern electronics. This knowledge is critical for designing power supplies, rectifiers, and protection circuits, which are key components in developing innovative industrial electronics and communication systems, thereby driving infrastructure modernization.
CO4	Evaluate the voltage and current characteristics of transistors and select suitable sensor for given application.	SDG 7	Affordable and Clean Energy	Evaluating BJT characteristics (CE, CB, CC configurations) is foundational for analog and digital electronics. Furthermore, the ability to select suitable sensors (Thermocouple, RTD, Hall Effect, LDR, Ultrasonic) is crucial for creating smart systems and IoT applications. This directly contributes to industrial innovation and the development of intelligent infrastructure.
CO5	validate mesh and nodal analysis along with voltage and current divider rules	SDG 4	Quality Education	Performing circuit analysis experiments builds foundational knowledge in electrical engineering, enhancing quality technical education and analytical skills.
CO6	determine the impedance of series RL and RC circuits and represent phasor diagrams	SDG 9	Industry, Innovation and Infrastructure	Impedance calculations and phasor analysis are essential for AC circuit design, power factor correction, and industrial electrical infrastructure development.

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO7	determine the efficiency of a single-phase transformer by load test and verify Kirchhoff's laws using PSPICE	SDG 7 & SDG 9	Affordable and Clean Energy; Industry, Innovation and Infrastructure	Transformer efficiency testing promotes energy conservation (SDG 7); simulation using PSPICE / MATLAB encourages digital innovation in engineering (SDG 9).
CO8	determine the input-output characteristics of BJT and parameters of a rectifier circuit including zener diode as voltage regulator	SDG 9	Industry, Innovation and Infrastructure	BJT characteristics and rectifier circuits form the backbone of power supplies, sensor interfaces, and reliable electronic infrastructure for industrial applications.

ENVIRONMENTAL STUDIES			
Class: B.Tech. I Semester		Branch: Common to CE, EEE, ECIE, ECE & CSE	
Course Code:	U24CY106	Credits:	0
Hours/Week (L-T-P-O-E):	2-0-0-5-7	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Outcomes (COs): After completion of this course, the students should be able to, CO1: identify the natural resources and practice their usage more equitably CO2: develop an action plan for sustainable alternatives and conserving biodiversity CO3: examine and perceive the solutions for the environmental pollution CO4: adapt issues involved in enforcement of environmental legislation and green methodology			
UNIT-I			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, <i>Text Book of Environmental Studies for Under Graduate Courses</i>, 2nd Edn., Universities Press (India) Pvt. Ltd, 2013	
Reference Book(s): 1. Y. Anjaneyulu, <i>Introduction to Environmental Science</i>, B.S. Publications, 2004. 2. Gilbert M. Masters, <i>Introduction to Environmental Engineering & Science</i>, 3rd Edn., Prentice Hall of India, 1991 3. Anubha Kaushik, C.P. Kaushik, <i>Environmental Studies</i>, 4th Edn., New Age International Publishers, 2014 4. R. Rajagopalan, <i>Environmental Studies from crisis to cure</i>, Oxford University Press, 2nd Edn., 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 Articulation Matrix (CAM):			U24CY106 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	U24CY106.1	2	1	2	1	-	2	1	1	1	-	-	-	-
CO2	U24CY106.2	-	-	2	-	-	1	1	1	1	1	-	-	-
CO3	U24CY106.3	1	2	1	-	-	1	1	1	1	1	1	-	-
CO4	U24CY106.4	-	-	1	-	-	1	1	1	1	-	1	-	-
U24CY106		1.50	1.50	1.50	1.00	-	1.25	1.00	1.00	1.00	1.00	1.00	-	-

IDEA Lab Makerspace			
Class: B.Tech. I & II -Semester		Branch: Common to all branches	
Course Code:	U24AE107	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-2-2-4	CIE :	100%
Total Number of Lab Hours:	36 Hrs	ESE :	-
Course Learning Outcomes (COs):			
After completion of this course, the students should be able to ...			
CO1: produce wooden joints and intricate articles using carpentry and CNC wood router respectively			
CO2: implement procedures to prepare the mould cavity for sand casting and arc welding joints			
CO3: produce innovative prototypes using laser engraving and 3D printing			
CO4: design and develop systems based on PCB and IoT for given applications			
LABORATORY COMPONENT			
S. No.	Creative Fabrication Technology	List of Experiments	
1.	Carpentry	Prepare a half lap dovetail joint	
2.	CNC Wood Router	Perform wood carving using CNC Wood Router	
3.	Foundry	Prepare a sand mould using single piece pattern	
4.	Welding	Prepare a single V-butt joint on mild steel plates using AC arc welding machine	
5.	Injection Moulding	Prepare a plastic product using Injection moulding machine	
6.	Laser Engraving	Perform key chain by using CO ₂ laser cutting machine	
7.	3D Printing	Prepare a key chain on 3D printer with the given dimensions	
8.		Prepare a Spur Gear on 3D printer with the given dimensions	
9.	Robotics	Perform basic pick-and-place operation using robot	
10.	Printed Circuit Board (PCB)	Design and fabricate a PCB for a given application	
11.	Internet of Things (IoT)	Measure the temperature and humidity by using DHT11 sensor and Arduino UNO	
12.		Create a smart plant watering system using IoT	
Course Project		- Students are required to create an affordable prototype as their course project, based on the knowledge and skills acquired during the course. - Students have to present and submit their prototypes to demonstrate their ability to apply classroom learning practically, showcasing their creativity and technical aptitude.	
Laboratory Manual:			
IDEA Lab Makerspace Laboratory Manual & Record Book (LMRB) prepared by the faculty of department of Mechanical Engineering, KITSW, Revised version 4, August-2024.			

Text/ Reference Book(s):

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

Course 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):				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	PS O1	PSO 2
CO1	U24AE107.1	2	2	1	1	2	1	1	2	2	-	1	1	-
CO2	U24AE107.2	2	2	1	1	2	1	1	2	2	-	1	1	-
CO3	U24AE107.3	2	2	1	1	2	1	1	2	2	-	1	1	-
CO4	U24AE107.4	2	2	1	1	2	1	1	2	2	-	1	1	-
U24AE107		2	2	1	1	2	1	1	2	2	-	1	1	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	develop technical skills such as 3D printing, Laser engraving, Wood carving and Robotics	SDG 4	Quality Education	Development of modern fabrication and automation skills enhances technical competency, creativity, innovation and employability of students through hands-on learning and skill-oriented education
CO2	apply the techniques and principles of welding, carpentry and foundry to produce required prototype/model	SDG 9	Industry, Innovation and Infrastructure	Practical exposure to manufacturing and prototyping techniques promotes industrial skills, innovation capability and infrastructure-oriented engineering practices required for sustainable industrial

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
				development
CO3	design and build a IoT based and PCB system for a given application	SDG 11	Sustainable Cities and Communities	IoT and embedded system development supports smart technologies, automation, efficient resource monitoring and sustainable solutions for modern industries & communities
CO4	engage in project-based learning which reinforces theoretical knowledge through practical application	SDG 8	Decent Work and Economic Growth	Project-based learning improves problem-solving, teamwork, innovation and practical engineering skills, preparing students for productive employment and entrepreneurship in emerging technologies

DEPARTMENT OF CSE, KITS, WARANGAL

URR24: B.TECH CSE SCHEME OF INSTRUCTION

Stream-I

Sl. No	Category	Course Code	Course Title	Lectures / week			Credits	
				L	T	P	E	C
1	BSC	U24MH201	Matrix Theory and Vector Calculus	2	1	-	3	3
2	BSC	U24CY202C	Engineering Chemistry (<i>for CSE</i>)	2	1	-	3	3
3	PCC	U24CS203	Operating Systems	2	1	-	3	3
4	ESC	U24CS204	Data Structures Through C	2	1	-	3	3
5	HSMC	U24MH205	English Communication and Report Writing	2	-	-	2	2
6	VAC	U24VA206	Sports & Yoga	-	-	2	2	1
7	ESC	U24ME207	Engineering Graphics Through CAD*	-	-	2	2	1
8	SEC	U24SE208	Programming Skill Development (PSD) Lab - 1	-	-	2	2	1
9	BSC	U24CY209CL	Engineering Chemistry Laboratory	-	-	2	2	1
10	PCC	U24CS210L	Data Structures Laboratory	-	-	2	2	1
Total:				10	4	10	24	19
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)				-NiL-				

* For CE and ME, it will be a three (03) credit (1-0-4) course on Engineering Graphics & Design (Pedagogy: Sessions with conventional drafter and CAD).

Pool - III (Chemistry)

S. No.	Course Code	Course Title
1.	U24CY202AR25	Engineering Chemistry (<i>for Civil Engineering</i>)
2.	U24CY202B R25	Engineering Chemistry (<i>for ECIE</i>)
3.	U24CY202C R25	Engineering Chemistry (<i>for CSE</i>)
4.	U24CY202D R25	Engineering Chemistry (<i>for EEE</i>)

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):	2-1-0-4-7	CIE:	60 %
Total Number of Teaching Hours:	36 Hrs	ESE:	40 %
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to...</i> 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			
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)]	
Textbook(s): 1. Grewal, B.S., <i>Higher Engineering Mathematics</i>, Khanna Publishers, Delhi, 44th edition, 2017(Chapters 2,7,8) 2. Kreyszig E, <i>Advanced Engineering Mathematics</i>, Inc, U.K, John Wiley & sons, 10th edition, 2020 (Chapter 8(8.2))	
Reference Book(s): 1. Spiegel M, <i>Vector Analysis</i> -Schaum's Series, McGraw Hill, 2nd edition, 2017 2. S.S. Sastry, <i>Engineering Mathematics, Vol.II</i>, Prentice Hall of India, 3rd edition, 2014. 3. Gilbert Strang, <i>Introduction to Linear Algebra</i>, Wellesley-Cambridge Press, 5th edition	
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=CNNA58OluszubPiX : NPTEL Video Lecture on Integral and Vector Calculus./Prof.Hari Shankar Mahato /IIT Kharagpur	

Course Articulation Matrix (CAM):				U24MH201 R25 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	PSO1	PSO 2
CO1	U24MH201.1	2	2	1	1	-	-	-	1	1		1	-	-
CO2	U24MH201.2	2	2	1	1	-	-	-	1	1		1	-	-
CO3	U24MH201.3	2	2	1	1	-	-	-	1	1		1	-	-
CO4	U24MH201.4	2	2	1	1	-	-	-	1	1		1	-	-
U24MH201R25		2	2	1	1	-	-	-	1	1		1	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	analyze eigen value problems using matrix theory	SDG4	Quality Education	If the work focuses on mathematical learning, computational methods, or improving higher education and research in mathematics and engineering.
CO2	apply basic concepts of multiple integrals in evaluating physical quantities of real-life engineering problems	SDG9	Industry, Innovation and Infrastructure	Multiple integrals are applied in engineering fields such as fluid mechanics, thermodynamics, and structural analysis to evaluate physical quantities in real-world systems. In Computer Science and Engineering (CSE) and AI & ML, they are used in image processing, computer graphics, data modeling, probability distributions, and optimization techniques.
CO3	apply differential operators on vector and scalar point functions	SDG9	Industry, Innovation and Infrastructure	Applying differential operators on scalar and vector point functions is essential in fluid dynamics, electromagnetism, engineering analysis, and computational modeling. These mathematical tools are widely used in scientific research, technological development, and modern engineering applications.
CO4	solve line, surface, volume integrals and correlate these with applications of Green, Stoke and Gauss divergence theorems	SDG9	Industry, Innovation and Infrastructure	Line, surface, and volume integrals along with Green's, Stoke's, and Gauss divergence theorems are widely used in engineering, fluid mechanics, electromagnetics, and computational science. In Computer Science and Engineering, these concepts are applied in computer graphics, image processing, simulation techniques, artificial intelligence, and data visualization.

ENGINEERING CHEMISTRY (for CSE)			
Class: B.Tech. II-Semester		Branch: CSE	
Course Code:	U24CY202C	Credits:	4
Hours/Week (L-T-P-O-E):	2-1-1-5-10	CIE:	60%
Total Number of Teaching Hours:	60 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: apply the concepts of electrochemical energy systems for batteries and fuel cells			
CO2: interpret suitable techniques of water analysis and corrosion treatment of solid materials			
CO3: engineering materials and spectroscopic techniques of chemical analysis			
CO4: polymers, principles of green chemistry and their applications			
CO5: determine water quality parameters-alkalinity, hardness			
CO6: make use of analytical instruments for chemical analysis			
CO7: determine metals present in their ores			
CO8: design the synthesis of nanomaterial and polymer			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Electrochemical Technology and Engineering: Introduction, Specific conductance, Equivalent conductance, Effect of dilution; Conductometric titrations-Acid base titrations-Strong acid vs strong base, Strong acid vs weak base, Weak acid vs strong base, Weak acid vs weak base, Advantages of conductometric titrations; Galvanic cell, Electrode potential, Electrochemical series, Nernst equation; Potentiometric titrations-Acid base titrations and advantages of potentiometric titrations			
Batteries: Classification, Lead-acid battery, Li-ion battery			
Fuel cells: Hydrogen-oxygen fuel cell			
Self Learning Topics (SLTs): Types of conductors (Text 1: Jain &Jain: chapter 5 topic 1), Ohms law (Text 1: Jain & Jain: chapter 5 topic 5)			
UNIT-II		9 Hrs	
Water Technology: Introduction, Hardness of water, Estimation of hardness of water by complexometry, Alkalinity, Determination of alkalinity, Numerical problems. Determination of dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Softening methods-Ion exchange method, Desalination processes, Reverse osmosis; Quality parameters of potable water (BIS and WHO)			
Corrosion: Introduction, Dry corrosion, Pilling-Bedworth rule, Wet corrosion; Factors effecting corrosion-Purity of the metal, Relative areas of anodic and cathodic parts, Nature of surface film, Humidity, pH and Temperature; Prevention methods of corrosion-Cathodic protection-Impressed current cathodic protection, Sacrificial anodic protection			
Self Learning Topics (SLTs): Units of hardness (Text 1: Jain &Jain chapter 1 topic 5), Introduction to corrosion (Text 1: Jain & Jain: chapter 7 topic 1)			
UNIT-III		9 Hrs	
Engineering Materials: Nanomaterials-Introduction, Synthesis of nanomaterials- Top down and bottom-up approaches, Synthesis by sol-gel method; Nanoscale materials-Fullerenes, Carbon nanotubes and Graphene, Properties and applications, Biosensors			
Spectroscopy: Introduction to spectroscopy, Microwave spectroscopy-Principle, Selection rules, Applications; Infra-red spectroscopy-Principle, Selection rules, Applications; UV Spectroscopy-Lambert-Beer's law and its applications			
Self Learning Topics (SLTs): Introduction to nanotechnology (Text 1: Jain & Jain: chapter 37 topic 1), Electromagnetic spectrum (Text 1: Jain & Jain; chapter 35 topic 1)			

UNIT-IV	9 Hrs
Polymers: Introduction, Monomer, Polymer, Types of polymerization reactions- Addition and condensation; Preparation, Properties and Applications-Polythene, Polyvinyl cyanide, Polyvinyl chloride, Bakelite, Nylon 6:6; Thermosetting resins and thermoplastic resins; Conducting polymers and their applications Green Chemistry: Principles of green chemistry, Synthesis of adipic acid by traditional pathway and green pathway; Green methods in electronic production, Impact of electronic waste on environment and public health Self Learning Topics (SLTs): Mechanism of addition polymerization (Text 1: Jain & Jain: chapter 3, topic 6); Alternative solvents for green synthesis ((Text 2: Jain & Jain: chapter 36, topic 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 & bi carbonate in ground water 3. Estimation of alkalinity of water sample containing (i) bicarbonate; (ii) carbonate & hydroxide in potable water 4. Determination of hardness of water by complexometric method 5. Determination of dissolved oxygen in a sample of water 6. Standardization of sodium hydroxide (NaOH) by conductometry using standard hydrochloric acid (HCl) 7. Standardization of acetic acid (CH₃COOH) by conductometry using standard sodium hydroxide (NaOH) 8. Standardization of strong acid hydrochloric acid (HCl) by potentiometry using standard sodium hydroxide (NaOH) 9. Colorimetric analysis-verification of Lambert-Beer's law 10. Estimation of ferrous (Fe²⁺) ion in the given solution using potassium permanganate 11. Preparation of nanoparticles of cadmium sulphide (CdS) 12. Synthesis of polymer (phenol-formaldehyde)	
Text Book(s): 1. Jain and Jain, <i>Engineering Chemistry</i>, Dhanpat Rai Publishing Company, 17th Edn., 2019	
Reference Book(s): 1. J. C. Kuriacose and J. Rajaram, <i>Chemistry in Engineering and Technology</i> (vol. I & vol. II), Tata Mc. Graw-Hills Education Pvt. Ltd., 2010 2. Shashi Chawla, <i>Text book of Engineering Chemistry</i>, Dhanpat Rai Publishers, 3rd Edn., 2003 3. S. S. Dara, S. S. Umare, <i>A Text book of Engineering Chemistry</i>, S. Chand & Company Ltd., 12th Edn., 2010	
Web and Video link(s): 1. 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): 1. <i>Engineering Chemistry laboratory manual</i>, Department of PS, KITSW	

Course Articulation Matrix		U24CY202C : ENGINEERING CHEMISTRY <i>(for CSE)</i>												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CY202C.1	2	-	-	-	1	1	1	-	1	-	1	-	-
CO2	U24CY202C.2	2	-	-	-	1	1	1	-	1	-	1	-	-
CO3	U24CY202C.3	2	-	-	-	1	1	1	-	1	-	1	-	-
CO4	U24CY202C.4	2	-	-	-	1	2	1	-	1	-	1	-	-
CO5	U24CY202C.1	2	1	-	-	-	1	1	-	1	-	1	-	-
CO6	U24CY202C.2	2	1	-	-	2	1	1	-	1	-	1	-	-
CO7	U24CY202C.3	2	1	-	-	-	1	1	-	1	-	1	-	-
CO8	U24CY202C.4	2	1	-	-	-	1	1	-	1	-	1	-	-
UU24CY202C		2	1	-	-	1.1 2		1	-	1	-	1	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the concepts of electrochemical energy systems for batteries and fuel cells	SDG7	Affordable and Clean Energy	Electrochemical energy systems such as batteries and fuel cells provide clean, reliable, and efficient energy storage and reduce dependence on fossil fuels, promote renewable energy utilization.
CO2	interpret suitable techniques of water analysis and corrosion treatment of solid materials	SDG3	Good Health and well-being	Water analysis techniques help identify contaminants and ensure safe drinking water, thereby protecting human health and preventing water-borne diseases. Corrosion treatment of solid materials improves the safety and durability of pipelines, storage systems, and medical equipment.
CO3	appraise manufacturing of engineering materials and spectroscopic techniques of chemical analysis	SDG9	Industry, Innovation and Infrastructure	Engineering materials enhancing knowledge of manufacturing processes for engineering materials and Spectroscopic techniques develops knowledge of modern spectroscopic techniques used in chemical analysis. These concepts promote industrial innovation, quality improvement, and advanced material development for

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				sustainable industries.
CO4	apprise the synthesis, materials and principles of green chemistry applications of engineering	SDG9	Industry, Innovation and Infrastructure	Engineering materials, and principles of green chemistry promotes sustainable industrial development through the design of eco-friendly materials and processes. It encourages innovation in engineering applications by reducing waste, energy consumption, and environmental impact in manufacturing industries.
CO5	Make use of analytical instruments for chemical analysis	SDG9	Industry, Innovation and Infrastructure	Analytical instruments such as electrochemical analyzers help in accurate chemical analysis and research. These techniques improve industrial quality control, product development, and technological innovation.
CO6	Determine water quality parameters-alkalinity, hardness	SDG6	Clean water and sanitation	Determination of alkalinity and hardness is essential for assessing the suitability of water for drinking and industrial purposes. Monitoring these parameters helps in maintaining water quality and preventing health and environmental issues.
CO7	determine metals present in their ores	SDG9	Industry, Innovation and Infrastructure	Determining metals present in ores forms the basis for metallurgical and material industries. It supports technological advancement and efficient industrial processing of mineral resources.
CO8	design the synthesis of nanomaterial and polymer	SDG9	Industry, Innovation and Infrastructure	Synthesis of nanomaterials and polymers promotes technological innovation and the development of advanced engineering materials. These materials are widely used in electronics, healthcare, energy storage, construction, and manufacturing industries, supporting sustainable industrial growth and modern infrastructure development.

OPERATING SYSTEMS			
Class: B.Tech. II -Semester		Branch: CSE	
Course Code:	U24CS203	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-4-7	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: build the operating system services and system calls CO2: analyze CPU scheduling and synchronization algorithms CO3: assess the deadlock related problems and memory management issues CO4: develop the file, disk and system protection techniques			
UNIT-I			9 Hrs
Introduction: What operating systems do, Operating-system operations, Process management, Computing environments System Structures: Operating-system services, System calls, Types of system calls, System programs, Operating-system structure, System boot Process Concept: Process concept, Interprocess communication Self Learning Topics (SLTs): <i>Dual mode and multi mode operation (Text1: topics 1.5.1), Mobile computing and distributed systems (Text1: topics 1.11.2,1.11. 3), File management and device management (Text1: topics 2.4.2,2.4.3), Hybrid systems (Text1: topics 2.7.5), Threads (Text1: topics 3.1.4), Message-passing systems (Text1: topic 3.4.2)</i>			
UNIT-II			9 Hrs
Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms – first- come first serve, Shortest-job-first, Priority, Round-robin Synchronization: Background, The critical-section problem, Peterson’s solution, Synchronization hardware, Mutex locks, Semaphores, Monitors Self Learning Topics (SLTs): <i>Practice problems (Text1: Prob 6.3, 6.16, 6.17), Deadlocks and starvation and priority inversion (Text1: topics 5.6.3, 5.6.4), Implementing a monitor using semaphores (Text1: topic 5.8.3)</i>			
UNIT-III			9 Hrs
Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock Memory Management: Background, Swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table-hierarchical paging, Hashed page tables, Inverted pagetables Virtual-Memory Management: Background, Demand paging, Page replacement, Allocation of frames, Thrashing. Self Learning Topics (SLTs): <i>No preemption and circular wait (Text1: topics 7.4.3, 7.4.4), Detection-algorithm usage (Text1: topics 7.6.3), Resource preemption (Text1: topics 7.7.2), Dynamic loading and dynamic linking and shared libraries (Text1: topics 8.1.4, 8.1.5), Practice problems (Text1: Prob 7.3, 7.8, 7.9, 7.22, 7.23), Practice problems (Text1: Prob 9.8, 9.21, 9.30).</i>			
UNIT-IV			9 Hrs
File System: File concept, Access methods, Directory structure, Implementing file systems - Allocation methods, Free space management. Mass Storage Structure: Overview of mass storage structure, Disk structure, Disk scheduling, Disk management, Swap-space management. System Protection: Goals of protection, Principles of protection, Domain of protection.			

Self Learning Topics (SLTs): Solid state disks and magnetic tapes (Text1: topics 10.1.2, 10.1.3), File types and file structure (Text1: topics 11.1.3, 11.1.4), Practice problems (Text1: Prob 10.11), An Example: UNIX, An example: MULTICS (Text1: topics 14.3.2, 14.3.3)

Textbook(s):

1. Abraham Silberschatz , Peter B Galvin, Gerg Gagne, “Operating System Concepts”, Wiley , 10th Edition, ISBN-978-1-119-32091-3, 2018.

Reference Book(s):

1. Ekta Walia, “Operating System Concepts”, Khanna Publishers, Delhi, 2nd Edition, ISBN-10: 9789380016658, ISBN-13: 978-9380016658, 2019.
2. Dhananjay M. Dhamdhare, “Operating Systems A Concept-Based Approach”, McGraw Hill Education, ISBN-10: 0072957697 ISBN-13: 978-0072957693, 2008
3. William Stalling, "Operating Systems", Maxwell, McMillan International Editions, ISBN 81-203-1187- 6, 1992.

Web and Video link(s):

1. <https://www.youtube.com/watch?v=jciGlvn7UfM&list=PLyqSpQzTE6M9SYI5RqwFYtFYab94gIpWk>; NPTEL Video Lecture on Introduction to Operating Systems By Prof. Chester Rebeiro, IIT Madras.

Course Articulation Matrix (CAM):			U24CS203 OPERATING SYSTEMS											
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2
CO1	U24CS203.1	2	1	2	1	-	-	-	1	-	-	2	2	2
CO2	U24CS203.2	3	2	2	2	-	-	-	-	-	-	2	2	2
CO3	U24CS203.3	3	2	2	2	2	-	-	-	-	1	2	2	2
CO4	U24CS203.4	2	2	2	1	2	1	-	1	-	1	1	2	2
U24CS203R25		2.5	1.75	2	1.5	2	1	-	1	-	1	1.75	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	build the operating system services and system calls	SDG9	Industry, Innovation and Infrastructure	If the work focuses on mathematical learning, computational methods, or improving higher education and research in mathematics and engineering. Developing operating system services and implementing system calls strengthens the foundational software infrastructure required for reliable, efficient, and innovative computing systems, supporting sustainable industrial and technological development
CO2	analyze CPU scheduling and synchronization algorithms	SDG9	Industry, Innovation and Infrastructure	Analyzing CPU scheduling and synchronization algorithms improves system performance, efficient resource utilization, and reliable process coordination, contributing to the development of robust and efficient computing infrastructure
CO3	assess the deadlock related problems and memory	SDG9	Industry, Innovation and Infrastructure	Assessing deadlock and memory management issues enhances system reliability, resource

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	management issues		Infrastructure	efficiency, and overall operating system performance, supporting resilient computing infrastructure and technological innovation
CO4	develop the file, disk and system protection techniques	SDG9	Industry, Innovation and Infrastructure	Developing file, disk, and system protection techniques ensures secure, reliable, and efficient computing infrastructure, promoting resilient digital systems and technological innovation

DATA STRUCTURES THROUGH C			
Class: B.Tech. II –Semester		Branch: CSE	
Course Code:	U24CS204	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-1-5-10	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Outcomes:			
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 using dynamic memory allocation and evaluate their time and space complexities.			
CO2: Analyze and implement stack and queue data structures using array representations, and evaluate their applications and operational complexities.			
CO3: Analyze and implement singly, doubly, and circular linked lists using dynamic memory allocation, and evaluate their operational complexities.			
CO4: Develop and compare sorting algorithms and hashing techniques by analyzing their time complexities, collision resolution methods, and application efficiency.			
Based on psychomotor skills acquired from the laboratory component			
CO5: Develop, test, and evaluate programs implementing array operations and dynamic memory allocation techniques.			
CO6: Implement stack and queue data structures using arrays and linked lists, and perform various operations based on LIFO and FIFO principles.			
CO7: Develop programs using singly, doubly, and circular linked lists to perform insertion, deletion, searching, and traversal operations efficiently.			
CO8: Implement and evaluate sorting algorithms and hashing techniques with appropriate collision resolution methods for efficient data storage and retrieval.			
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 Program to implement hash table.
<u>Textbook(s):</u> 1. Debasis Samanta, <i>Classic Data Structures</i>, Prentice Hall India, 2nd edition, 2009
<u>Reference Book(s):</u> 1. Reema Thareja, <i>Data Structures Using C</i>, Oxford University Press, 2nd edition, 2014 2. Balagurusamy E, <i>Data Structure Using C</i>, McGraw Hill Education, 1st edition, 2017 3. Richard F. Gilberg and Behrouz A. Forouzan, <i>Data Structures: A Pseudocode Approach with C</i>, Cengage Learning, 2nd Edition, 2007
<u>Web and Video link(s):</u> https://nptel.ac.in/courses/106106130; NPTEL Video Lecture on Programming and Data Structures Dr. N. S. Narayana Swamy, CSE, IIT Madras.
<u>Laboratory Manual (for laboratory component):</u> <i>Data Structures through C Laboratory Manual and Record Book</i>, Department of CSE, KITSW.

Course Articulation Matrix (CAM):					U24CS204 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	U24CS204.1	2	2	2	1	-	-	1	-	1	-	1	2	1
CO2	U24CS204.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24CS204.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24CS204.4	2	2	2	2	-	-	1	-	1	-	2	2	2
U24CS204R25		2	2	2	1.75	-	-	1	-	1	-	1.75	2	1.75

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities	SDG 4	Quality education	Unit I introduces foundational thinking skills – algorithmic analysis, complexity trade-offs, and memory management – that are core to inclusive, quality technical education (SDG 4). Teaching students <i>how to reason about efficiency</i> equips them with problem-solving competencies that transcend programming languages and support lifelong learning in computing.
CO2	analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities	SDG 9	Industry, Innovation and Infrastructure	Stacks and queues are the structural backbone of real-world software infrastructure – OS process scheduling, compiler design (infix→postfix parsing), undo/redo systems, and network packet buffering. Recursion and the Tower of Hanoi build the algorithmic innovation skills that drive SDG 9's goal of fostering resilient, modern industrial systems through technology.
CO3	analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities	SDG 4	Quality education	Linked lists require students to reason about pointer manipulation, memory deallocation, and abstract data representation – demanding higher-order thinking that reflects SDG 4's emphasis on deep, quality learning. The progression from arrays to dynamic structures builds adaptable knowledge, and topics like skip lists and merging extend learners toward self-directed

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				inquiry beyond the classroom.
CO4	develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies	SDG 9	Industry, Innovation and Infrastructure	Sorting and hashing are workhorses of industry-grade systems – database indexing, search engines, cryptographic hashing, and load balancing all rely on these techniques. Collision resolution directly models the design challenges engineers face building scalable, fault-tolerant infrastructure. This unit's focus on performance trade-offs and real-world applicability aligns strongly with SDG 9's innovation and infrastructure mandate.

ENGLISH COMMUNICATION AND REPORT WRITING			
Class: B.Tech. I & II –Semesters		Branch: Common to all branches	
Course Code:	U24MH205	Credits:	2
Hours/Week (L-T-P-O-E):	2-0-0-3-5	CIE:	60 %
Total Number of Teaching Hours:	36 Hrs	ESE:	40 %
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> 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.			
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): <i>Articles-(Text 2,Unit-II), English Vocabulary (Text 2,Unit-I, Unit-II, Unit-III)</i> <i>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)</i>			

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 <i>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)</i>	

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 <i>Self Learning Topics (SLTs):</i> <i>Parts of Speech (Text book 1, Unit-I), Tenses (Reference book 1, Topics- 16,17,18,19) Phrasal Verbs</i> <i>(Reference book 3)</i>	
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 <i>Self-Learning Topics (SLTs):</i> Tenses (Reference book 2, Topics: 152-157))	
<u>Textbook(s):</u> - Sanjay Kumar & Pushp Lata, “ <i>English Language and Communication Skills for Engineers</i>” As per the latest AICTE syllabus, Oxford University Press, 1st edition 2018 “<i>Language and Life: A Skill’s Approach</i>” Based on the latest AICTE model curriculum Orient Blackswan Private Limited 2nd Edition 2019.	
<u>Reference Book(s):</u> - Thomson A.J. , Martinet A.V., “ <i>A Practical English Grammar</i>”, Oxford University Press 3rd Edition 1997 - Thomson A.J. , Martinet A.V., “ <i>A Practical English Grammar</i>” Exercise 2 , Oxford University Press 3rd Edition 1997 - Standard Allen W. , “<i>Living English Structure</i>”, Pearson India Education Pvt Ltd. 5th Edition 2009	
<u>Web and Video link(s):</u> 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 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	U24MH205.1	-	-	-	-	-	1	2	2	2	-	2	-	-
CO2	U24MH205.2	-	-	-	-	-	1	2	2	2	-	2	-	-
CO3	U24MH205.3	-	-	-	-	-	1	2	2	2	-	2	-	-
CO4	U24MH205.4	-	-	-	-	-	1	2	2	2	-	2	-	-
U24MH205R25		-	-	-	-	-	1	2	2	2	-	2	-	-
1-LOW 3 - HIGH, 2 - MEDIUM,														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply basic grammar principles in speech and writing, read fast, form new words, make coherent paragraphs and adapt the real value of life	SDG-3 SDG-5 SDG-4	Good health and well-being Gender equality Quality education	This aligns with SDG-3 as it partially contributes to the negative impact of mental imbalance on health through the irrational fears of Johnsy who is certain of her death when the last leaf falls down This also aligns with SDG-5 as it highlights women accomplishments on par with men by exposing Johnsy and Sue as painters who come out of their home town to stay in another place and work along with men for societal exposure This aligns with SDG-4 as its primary focus is on enhancing the quality of language in speech and writing by strengthening grammar, vocabulary and writing skills.
CO2	create effective letters, e-mails, reply to Memos and do the given tasks with confidence	SDG-4 SDG-8	Quality education Decent work and economic growth	This aligns with SDG-4 as its aim is to enhance reading and writing skills by helping students write letters and resumes effectively applying grammar rules and using relevant vocabulary This aligns with SDG-8 as it indirectly contributes to economic growth and helps students become aware of the inevitability of strengthening their resume by improving their skills

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO3	analyze the given texts and write clear and unambiguous reports	SDG-4	Quality education	This aligns with SDG-4 as it focuses on enhancing the speaking, reading and writing skills of students to prove their abilities and the best communicators in society and work place by exhibiting professionalism in the usage of language
CO4	deduct the superfluous information from lengthy text, prepare SoP (Statement of Purpose) effectively and solve critical problems in life with emotional balance	SDG-4 SDG-16	Quality education Peace, justice and strong institutions	This aligns with SDG-4 as it orientates the students towards reading and writing, and improves critical and critical thinking Though not completely, it aligns with SDG-16 as it emphasizes the need to give up anger which is the most potential enemy of man to enjoy peace and become morally strong

SPORTS/YOGA			
Class: B.Tech. II-Semester		Branch: All UG Branches	
Course Code:	U24VA206	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 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.			
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			
<u>Textbook(s):</u> 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,53 rd Edition,Pblished 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, Author E .Prasad Rao, Published by D.V.S New Delhi-110019.			

ReferenceBook(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>

		Grade-P (50%) 11sec above	Grade-D (60%) 10-11 sec	Grade-C (70%) 9-10 sec	Grade-B (80%) 8-9 sec	Grade-A (90%) 7-8 sec	Grade-S (100%) 7 sec below
50 mts / 30 mts (Sprint)	Women	5	6	7	8	9	10
	Men	5	6	7	8	9	10
Jump (Standing Broad Jump)	Women	0.90 – 1 mts	1.00 – 1.25 mts	1.25 – 1.50 mts	1.5 – 1.75 mts	1.75 – 2 mts	2 mts above
	Men	1.50 – 1.7 mts	1.7 – 1.9 mts	1.90 – 2.1 mts	2.30 – 2.1 mts	2.5 – 2.7 mts	2.70 mts above
Throw (Shot- put)	Women	3.5-4.0mts	4.0-4.5mts	4.5-5.0mts	5.0-5.5mts	5.5-6.0mts	6.0-6.5mts
	Men	4.0-5.0mts	5.0-6.0mts	6.0-7.0mts	7.0-8.0mts	8.0-9.0mts	9mts above
Yoga Aasanas (Surya Namaskaras)	Women	2 repetition (12min)	3 repetition (18min)	4 repetition (24min)	5 repetition (30min)	6 repetition (36min)	7 repetition (42min)
	Men	2 repetition (12min)	3 repetition (18min)	4 repetition (24min)	5 repetition (30min)	6 repetition (36min)	7 repetition (42min)
Attendance %		40-50%	50-60%	60-70%	70-80%	80-90%	90-100%
Marks		10	12	14	16	18	20

Performance in Regular Participation in classes :

15

Performance in Selected Event : 25

Course Articulation Matrix (CAM):			U24VA206 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	PS O1	PS O 2	
CO1	U24VA206	-	-	-	-	-	-	-	-	-	-	1	-	-	
CO2	U24VA206	-	-	-	-	-	-	-	1	-	-	-	-	-	
CO3	U24VA206	-	-	-	-	-	-	2	-	-	-	-	-	-	
CO4	U24VA206	-	-	-	-	-	-	-	-	1	-	1	-	-	
3 – HIGH, 2 – MEDIUM, 1 – LOW															

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Demonstrate Physical Fitness by performing Yoga Asanas	SDG13, SDG5	Climate Action, Gender Equality	Promoting eco-friendly sports practices, minimal resource usage, outdoor yoga, and sustainable lifestyle habits. Promoting teamwork, leadership, inclusiveness, equal participation, and collaboration in sports and group yoga sessions.
CO2	Demonstrate Physical Fitness through various games & Sports	SDG3	Good Health & Well-being	Designing personalized fitness routines, yoga modules, and wellness programs to meet individual health needs.
CO3	Demonstrate Sportsman spirit and ethics	SDG16	Peace, Justice & Strong Institutions	Encouraging discipline, fairness, inclusivity, respect, mental balance, and ethical conduct through sportsmanship and yogic values.
CO4	Demonstrate Physical, Psychological, Social and Emotional balance	SDG3, SDG11	Good Health & Well-being, Sustainable Cities & Communities	Understanding the role of physical fitness and yoga in improving societal health, work-life balance, and community well-being.

ENGINEERING GRAPHICS THROUGH CAD			
Class: B. Tech. II –Semester		Branch: Common to all (except CE & ME)	
Course Code:	U24ME207	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-2-2-4	CIE :	100 %
Total Number of Teaching Hours:	36 Hrs	ESE :	-
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: draw projections of points and straight lines inclined to one plane with Auto CAD. CO2: develop the projections of planes using Auto CAD CO3: construct the projections of solids and sections of solids using Auto CAD CO4: create orthographic and isometric projections and develop the simple electrical and electronic circuit using Auto CAD			
LABORATORY COMPONENT			
List of Experiments 1. Importance of Engineering Drawing, principles of engineering drawing, dimensioning; introduction to AutoCAD software-GUI, settings, standard toolbar, toolbars - draw, modify, dimension, properties, design centre and tool palettes 2. Introduction to orthographic projections-Vertical Plane, Horizontal plane; Views-Front view, Top view, and Side view and draw the Projection of points in different quadrants. 3. Draw the Projection of straight lines 4. Draw the Projection of planes 5. Draw the Projection of solids- Simple position(Axis perpendicular to HP or VP) 6. Draw the projections of solids inclined to both the planes 7. Draw the Sections of solids 8. Draw the Orthographic projections of given objects 9. Conversion of isometric view to orthographic projections 10. Draw the Isometric view from the given orthographic views 11. Draw the pictorial view (3D) from the given Isometric view 12. AutoCAD application in Electrical and Electronics circuits			
Textbook(s): 1. Bhatt N.D., <i>Elementary Engineering Drawing</i> , Charotar Publishing House, Anand, India, 2017. 2. Kulkarni D. M., Rastogi A. P., and Sarkar A., <i>Engineering Graphics with AutoCAD</i> , PHI publisher, revised edition, July 2010.			
Reference Book(s): 1. Dhananjay A Jolhe, <i>Engineering Drawing</i> , Tata Mc Graw- Hill, 2008. 2. Venugopal K. <i>Engineering Graphics with Auto CAD</i> , New Age International Publishers Ltd., Hyderabad, 2012. 3. Luzadder W.J and Duff J.M, <i>Fundamentals of Engineering Drawing</i> , Prentice-Hall of India, 1995.			
Web and Video link(s): ps://onlinecourses.nptel.ac.in/noc20_me79/preview NPTEL video link for <i>Engineering drawing and computer graphics</i> By Prof. Rajaram Lakkaraju, IIT Kharagpur.			
Laboratory Manual (for laboratory component): 1. <i>Engineering Graphics through CAD Laboratory Manual & Record Book</i> , Dept. of ME, KITSW.			

Course Articulation Matrix (CAM): U24ME207R25 ENGINEERING GRAPHICS THROUGH CAD														
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24ME207.1	2	1	1	-	2	-	1	-	2	-	1	-	-
CO2	U24ME207.2	2	1	1	-	2	-	1	-	2	-	1	-	-
CO3	U24ME207.3	2	1	1	-	2	-	1	-	2	-	1	-	-
CO4	U24ME207.4	2	1	1	-	2	-	1	-	2	-	1	-	-
U24ME207R25		2	1	1	-	2	-	1		2	-	1	-	-

CO	CO Statement – The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	Draw projections of points and straight lines.	SDG 4	Quality Education	Develops fundamental engineering graphics knowledge, spatial visualization skills, and technical competencies required for quality engineering education.
CO2	Develop the projections of planes using CAD.	SDG 4	Quality Education	Enhances students' proficiency in CAD-based drafting and graphical communication, promoting modern technology-enabled learning.
		SDG 9	Industry, Innovation and Infrastructure	Introduces the use of CAD tools employed in industrial design and infrastructure-related engineering applications.
CO3	Construct the projections of solids and sections of solids using CAD.	SDG 4	Quality Education	Strengthens analytical thinking, visualization, and engineering drawing skills through practical CAD applications.
		SDG 9	Industry, Innovation and Infrastructure	Supports engineering design and manufacturing practices by enabling the creation and interpretation of complex engineering models.
CO4	Create orthographic and isometric projections; develop simple electrical, electronic circuits and 3D models using CAD.	SDG 4	Quality Education	Promotes advanced technical skills, creativity, and lifelong learning through modern engineering software and design practices.
		SDG 9	Industry, Innovation and Infrastructure	Facilitates innovation and industrial development by equipping learners with CAD-based design, modeling, and visualization skills used in engineering industries.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the concepts of electrochemical energy systems for batteries and fuel cells	SDG7	Affordable and Clean Energy	Electrochemical energy systems such as batteries and fuel cells provide clean, and efficient energy storage and reduce dependence on fossil fuels, promote renewable energy utilization.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO2	interpret suitable techniques of water analysis and corrosion treatment of solid materials	SDG3	Good Health and well being	Water analysis techniques help identify contaminants and ensure safe drinking water, thereby protecting human health and preventing water-borne diseases. Corrosion treatment of solid materials improves the safety and durability of pipelines, storage systems, and medical equipment.
CO3	apprise manufacturing of engineering materials and spectroscopic techniques of chemical analysis	SDG9	Industry, Innovation and Infrastructure	Engineering materials enhancing knowledge of manufacturing processes for engineering materials and Spectroscopic technique develops knowledge of modern spectroscopic techniques used in chemical analysis. These concepts promote industrial innovation, quality improvement, and advanced material development for sustainable industries.
CO4	apprise the synthesis, materials and principles of green chemistry applications of engineering	SDG9	Industry, Innovation and Infrastructure	Engineering materials, and principles of green chemistry promote sustainable industrial development through the design of eco-friendly materials and processes. It encourages innovation in engineering applications by reducing waste, energy consumption, and environmental impact in manufacturing industries.

Bridge Courses for exit after B.Tech I Year

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 CSE)

(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 CSE : Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24CS211X	Java Programming	2	-	2	-	4	3
2	PCC	U24CS212X	Database Management	2	-	2	-	4	3
3	PCC	U24CS213X	Fundamental of Python Programming	2	-	2	-	4	3
4	PCC	U24CS214X	Computer Aided Software Engineering	2	-	2	-	4	3
5	PCC	U24CS215X	Web Designing	2	-	2	-	4	3
6	PCC	U24CS216X	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 CSE : Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE211X	Advanced Excel (NSIC Course)	-	-	6	-	6	3
2	SEC	U24SE212X	Web Development (NSIC course)	-	-	6	-	6	3
3	SEC	U24SE213X	Linux (NSIC course)	-	-	6	-	6	3
4	SEC	U24SE214X	Oracle SQL/PLSQL Programming (NSIC course)	-	-	6	-	6	3
5	SEC	U24SE215X	CCNA: Computer Networks Essentials	-	-	6	-	6	3
6	SEC	U24SE216X	Power BI (NASSCOM futureskills course)	-	-	6	-	6	3
7	SEC	U24SE217X	Foundational Course in Cyber Security (NASSCOM futureskills course)	-	-	6	-	6	3
8	SEC	U24SE218X	Any other skill-based course approved by BoS Chair and Dean AA	-	-	6	-	6	3

JAVA PROGRAMMING			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS211X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: apply java object-oriented concepts in problem solving			
CO2: develop java methods, constructors, and strings			
CO3: apply reusability concepts like inheritance, dynamic method dispatch, and interfaces			
CO4: develop packages, apply streams (I/O) and exception handling			
CO5 : implement java object-oriented concepts			
CO6 : implement java methods, constructors, and strings			
CO7 : apply reusability concepts like inheritance, dynamic method dispatch, and Interfaces			
CO8 : implement packages, apply streams (I/O) and exception handling			
THEORY COMPONENT			
UNIT-I			4 Hrs
Java Basics: History and evolution of java, An overview of java, Data types, Variables and arrays, Operators, Control statements.			
Introducing Classes: Class fundamentals, Objects, Methods, Object reference variables			
UNIT-II			4 Hrs
Classes and Methods: Overloading methods, <i>this</i> keyword, Passing and returning objects, Recursion, Variable length arguments, Constructors, Overloading constructors, Garbage collection, <i>static</i> variables, <i>static</i> blocks and <i>static</i> methods, Nested and inner classes, Command line arguments, Wrapper classes.			
Strings: Exploring String, StringBuffer, StringBuilder, and StringTokenizer classes.			
UNIT-III			4 Hrs
Inheritance: Inheritance basics, Types of inheritance, <i>super</i> keyword, Method overriding, Order of constructors calling, Dynamic method dispatch, Abstract classes, <i>final</i> with inheritance, Object class.			
Interfaces: Defining an interface, Implementing interfaces, Nested interfaces, Interfaces can be extended.			
UNIT-IV			4 Hrs
Packages: Packages, Access protection, Importing packages.			
Using I/O: I/O basics, Reading, Writing and copying files using byte and character streams. Exception Handling: Fundamentals, Exception types, Uncaught exceptions, Using <i>try</i> and <i>catch</i> , Multiple catch clauses, Nested <i>try</i> statements, <i>throw</i> , <i>throws</i> , <i>finally</i> .			
LABORATORY COMPONENT			
List of Experiments			
1. Write programs to demonstrate different operators, control structures , switch			

statement, one dimensional and two-dimensional arrays in java.
2. Develop programs to demonstrate class and object concepts, inner classes, garbage collection and static keyword.
3. Write programs on command line arguments and wrapper classes
4. Write programs on String, StringBuffer and StringTokenizer classes
5. Develop programs on different types of inheritances
6. Develop programs on abstract classes
7. Write programs to implement interfaces
8. Write programs to implement packages
9. Develop programs on Exception handling
10. Develop programs on files
<u>Textbook(s):</u>
1. Herbert Schildt, <i>Java The Complete Reference</i> , McGraw-Hill Education India Pvt. Ltd, 9 th edition, 2014
<u>Reference Book(S):</u>
1. Kathy Sierra, Bert Bates, <i>Head First Java</i> , O'Reilly Publications, 2 nd Edition, 2013
2. Uttam Roy K., <i>Advanced JAVA Programming</i> , Oxford Publications; 1 st edition, 2013
<u>Laboratory Manual (for laboratory component):</u>
1. <i>Object Oriented Programming through Java laboratory manual and Record Book</i> Department of CSE

Course Articulation Matrix (CAM):								U18CS211X Java Programming					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
U18CS211X.1	1	1	1	1	-	-	-	-	1	-	-	1	1
U18CS211X.2	2	2	2	1	-	-	-	-	1	-	2	2	1
U18CS211X.3	2	2	2	1	-	-	-	-	1	-	2	2	1
U18CS211X.4	2	2	2	1	-	-	-	-	1	-	2	2	1
U18CS211X.5	2	2	2	1	-	-	-	-	1	-	-	2	2
U18CS211X.6	2	2	2	1	-	-	-	-	1	-	2	2	2
U18CS211X.7	2	2	2	1	-	-	-	-	1	-	2	2	2
U18CS211X.8	2	2	2	1	-	-	-	-	1	-	2	2	2
U18CS211X	1.87	1.87	1.87	1	-	-	-	-	1	-	2	1.87	1.62
3 - HIGH, 2 - MEDIUM, 1 - LOW													

DATABASE MANAGEMENT			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS212X	Credits:	4
Hours/Week (L-T-P-O-E):	3-0-0-0-3	CIE:	60%
Total Number of Teaching Hours:	32 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: design the database management system effectively CO2: design the databases, which includes Enhanced Entity Relationship model. CO3: optimize the database by using normalization and query optimization techniques to avoid redundancy and maintain the performance of database. CO4: manage multi-level security, correctness of data and control over access on database. (based on pragmatic skills acquired from laboratory component) CO5: execute SQL queries using DDL/DML/TCL/DCL commands to create and manipulate data in database by enforcing constraints CO6: implement various database objects using SQL queries CO7: implement block structured programming with cursors to enable traversal over the records of the database CO8: implement pre-compiled stored programs, run-time errors checking, database objects collection in PL/SQL packages and high-level security using triggers			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Databases and Database Users: Introduction, Characteristics of the database approach, Actors on the scene, Workers behind the scene, Advantages of using a DBMS, when not to use a DBMS. Basic SQL: SQL Data Definition and Data Types, Specifying constraints in SQL, Basic retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL			
UNIT-II		4 Hrs	
Data modelling using the Entity-Relationship Model: Using high-level conceptual data models for database design, Entity types, Entity sets, Attributes and Keys, Relationships, Types, Relationship sets, Roles and structural constraints, Weak entity types, ER diagrams. Relational Database Design by ER-and EER-to-Relational Mapping: Relational database design using ER-to-Relational mapping, Mapping EER model constructs to relations.			
UNIT-III		4 Hrs	
Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Boyce-Codd normal form, Algorithms for relational database schema design, Multivalued dependency and fourth normal form, Join dependencies and fifth normal form. Query Processing and Optimization: Translating SQL queries into relational algebra, Using heuristics in query optimization.			
UNIT-IV		4 Hrs	
Introduction to Transaction Processing Concepts and Theory: Introduction to transaction processing, Transaction and system concepts, Desirable properties of transactions, Characterizing Schedules Based, Characterizing Schedules Based on Serializability.			

Concurrency Control Techniques: Two-Phase Locking techniques for concurrency control, Concurrency control based on Timestamp Ordering.

LABORATORY COMPONENT

List of Experiments

11. Queries using DDL, DML, TCL and DCL commands.
12. Queries on column level and table level constraints.
13. Queries using built-in functions of NUMBER, CHARACTER, DATE Datatypes.
14. Queries on Data type conversion functions, single row functions and operators.
15. Queries on aggregate functions.
16. Queries on joins and nested queries.
17. Write sample PL/SQL programs using conditional, iterative statements and cursors.
18. Write PL/SQL programs to handle exceptions.
19. Write PL/SQL programs using stored procedures and functions.
20. Write PL/SQL programs for creating packages and triggers.

Textbook(s):

1. Ramez Elmasri and Shamkanth B. Navathe, "Fundamentals of Database Systems", Pearson Education, 6th Edition, ISBN-13: 978-0-136-08620-8, 2010.

Reference Book(S):

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems ", McGraw-Hill Education, 3rd Edition, ISBN-13: 978-0072465631, 2002.
2. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw-Hill Education, 3rd Edition, ISBN: 0-07-114810-8, 1997.
3. Thomas Connolly and Carolyn Begg, "Database Systems", Pearson Education, 3rd Edition, ISBN: 81-7808-861-4, 2003.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_cs91/preview; NPTEL Video Lecture on Database Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay | IIT Kharagpur

Laboratory Manual (for laboratory component):

1. Database Management Systems Laboratory Manual, Prepared by the faculty of Department of CSE.

Course Articulation Matrix (CAM):				U24CS212 DATABASE MANAGEMENT										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O 1	PSO2
CO1	U24CS212X.1	2	2	2	2	1	-	-	-	1	-	2	2	2
CO2	U24CS212X.2	2	2	2	2	1	-	-	-	1	-	3	3	3
CO3	U24CS212X.3	2	2	2	2	1	-	-	-	1	-	2	2	2
CO4	U24CS212X.4	2	2	2	2	1	-	-	-	1	-	3	2	2
CO5	U24CS212X.5	2	2	2	2	2	-	-	1	1		2	1	2
CO6	U24CS212X.6	2	2	2	2	2	-	-	1	1		2	1	2
CO7	U24CS212X.7	2	2	2	2	2	-	-	1	1		2	1	3
CO8	U24CS212X.8	2	2	2	2	2	-	-	1	1		2	1	3
U24CS212		2	2	2	2	1.5	-	-	0.5	1	-	2.2	2.6	2.35
3 - HIGH, 2 - MEDIUM, 1 - LOW														

FUNDAMENTALS OF PYTHON PROGRAMMING			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS213X	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 Outcomes (COs) After completion of this course, the students should be able to, CO1: apply python control statements, operators and functions for problem solving CO2: develop programs using collections, namespaces, packages & strings CO3: analyse object-oriented programming principles, files & databases CO4: apply packages like Numpy or Pandas for statistical analysis& data handling CO5: develop python programs using operators, control statements & functions CO6: implement packages, string handling methods and collections CO7: build new classes, create objects, perform operations on files and databases CO8: develop statistical & data handling applications using packages Numpy and Pandas			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Python Preliminaries: Literal constants, Variables and identifiers, Data types, Input operation, Comments, Reserved words, Indentation, Operators, Expressions in Python, Type conversion Decision Control Statements: Selection/Conditional branching statements, Loop structures/ iterative statements, Nested loop, The continue statement, The pass statement, The else statement used with loops Functions: Function definition, Function call, Variable scope and lifetime, The return statement, Advances in defining in functions, Lambda functions, Recursive functions			
UNIT-II		4 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			
UNIT-III		4 Hrs	
Data Structures: Sequences, Lists, Tuple, Sets, Dictionaries Files: Opening and closing files, Reading and writing files, File positions, Renaming and deleting files, Directory methods Database Connectivity: Database browser for SQLite, creating a database table, Insert and retrieve data from database			

UNIT-IV	4 Hrs
NumPy: The basics of NumPy arrays, Array indexing, Array slicing, Reshaping of array, Concatenation and splitting arrays, Introducing UFuncs Data Manipulation with Pandas: Installing and using Pandas, Introducing Pandas objects, data indexing and selection, Handling missing data, Combining datasets, Merge and join, Aggregation and grouping	

LABORATORY COMPONENT
List of Experiments 1. Python installation, path verification and running python script on command prompt 2. Python programs on control statements and iterative statements 3. Python programs on functions, variable arguments and lambda functions 4. Python programs on implementing modules and namespaces 5. Python programs on collections: Strings and Regular expressions 6. Python programs on collections: List, Tuples, Sets and Dictionaries 7. Python programs on implementing object-oriented programming 8. Python programs on File operations and exception handling 9. Python programs to implement database connectivity 10. Python programs to demonstrate Numpy Package and related operations
<u>Textbook(s):</u> 1. Reema Thareja, <i>Python Programming using problem solving approach</i>, New Delhi: Oxford University Press, 2017. 2. Jake VanderPlas, <i>Python Data Science Handbook- Essential Tools for Working with Data</i>, California: O'Reilly Media Inc., 2016. (Chapter 2 to 4)
<u>Reference Book(S):</u> 1. Dr. Charles R. Severance, <i>Python for Everybody-Exploring Data Using Python</i>, open book, 2016. 2. David Beazley, <i>Python Cookbook</i>, 3rd ed. California: O'Reilly Media, Inc., 2013. 3. Caleb Hattingh, <i>20 Python Libraries You Aren't Using (But Should)</i>, 2nd ed. California: O'Reilly Media, Inc., 2016. 4. Magnus Lie Hetland, <i>Beginning: From Novice to Professional</i>, New York City: Apress, 2005
<u>Web and Video link(s):</u> https://onlinecourses.nptel.ac.in/noc24_cs113/preview; NPTEL Video Lecture on The Joy of Computing using Python by Prof. Sudarshan Iyengar, Professor of CSE, IIT Ropar.
<u>Laboratory Manual (for laboratory component):</u> 1. <i>Python Programming laboratory manual</i>, Department of CSE, KITSW

Course Articulation Matrix (CAM):														
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	U24CS213X.1	2	2	1	1	2	1	-	-	1	-	-	2	1
CO2	U24CS213X.2	2	2	2	1	2	1	-	-	1	-	-	2	1
CO3	U24CS213X.3	2	2	2	2	2	1	-	-	1	-	2	3	2
CO4	U24CS213X.4	2	2	2	2	3	1	-	1	1	-	2	2	2
CO5	U24CS213X.5	2	2	2	2	2	-	-	1	1	-	-	2	2
CO6	U24CS213X.6	2	2	2	2	2	-	-	1	1	-	-	2	2
CO7	U24CS213X.7	2	2	2	2	2	-	-	2	1	-	1	3	3
CO8	U24CS213X.8	3	2	2	2	3	-	-	2	1	-	2	2	3
U24CS213X		2..1	2	1.8	1.75	2.25	0.5	-	0.87 5	1	-	0.87	2.25	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

COMPUTER AIDED SOFTWARE ENGINEERING			
Class: B.Tech. I-Yr (Exit Course)		Branch: CSE	
Course Code:	U24CS214X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: design the appropriate software model for a given application			
CO2: develop different types of software designs & patterns			
CO3: apply an appropriate testing method for a software application			
CO4: asses the quality of software and analyze the risk management in project scheduling			
CO5: create schedule, cost estimation of the software project using Microsoft project management tool, and construct analysis model using unified modelling approach			
CO6: design a software system using unified modelling approach			
CO7: test with Selenium tool to improve the quality of the project/product being developed			
CO8: apply Test director and Test Link testing tools for traceability and test management			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Software Engineering Concepts: The changing nature of software, Software application domains, Legacy software, Software myths, Software engineering layered technology, A process framework, The capability maturity model integration (CMMI), Agile software			
Process Models -Prescriptive process models, RAD model, Specialized process models, Unified process model, Personal and team process models			
Agile Development: Agility and the cost of change, Agile process, Extreme programming, Other agile process models			
Software Engineering Practices: Communication principles, Planning principles, Modeling principles, Construction principles, Deployment principles			
UNIT-II		4 Hrs	
Requirements Engineering Tasks: Requirements analysis and modeling strategies, User requirement, System requirement, Software requirementsdocument			
Design Engineering: Design within the context of software engineering, Design process, Design concepts, The design model			
Architectural Design: Creating an architectural design - Software architecture, Architectural genres, Architectural styles, Architectural design, Assessing alternative architectural designs.			
UNIT-III		4 Hrs	
User Interface Design: The golden rules, User interface analysis and design, Interface analysis, Interface design steps, WebApp and mobile interface design			
Testing Strategies: Software testing fundamentals, Test strategies for conventional software, Test strategies for object-oriented software, Validation testing, System testing, The art of Debugging, White box testing, Basis path testing, Control structure testing, Black box testing			
Testing Web Applications: Testing concepts, The testing process, Content testing, User interface testing, Component-level testing, Navigation testing, Configuration testing, Security testing,Performance testing			

UNIT-IV	4 Hrs
Product Metrics: Measures, Metrics and indicators, Metrics for the requirements model, Metrics for the design model, Metrics for source code, Metrics for testing, Metrics for maintenance Process and Project Metrics: Metrics in the process and project domains, Software measurement, Metrics for software quality, Integrating metrics within the software process, The W5HH principle Risk Management: Reactive versus Proactive risk strategies, Software risks, Risk identification, Risk projection, Risk refinement, RMMM plan	
LABORATORY COMPONENT	
List of Experiments	
Experiment-I - Project scheduling using Microsoft project management tool - Project estimation using Microsoft project management tool Experiment-II Construct Use case and Class diagrams for the following - Online shopping - Banking system - Cab dispatching system Experiment-III Construct Collaboration and Sequence diagrams for the following - Librarian issues books to student - Mobile phone Experiment-IV Construct Activity and State chart diagrams for the following. - ATM transaction - Ticket machine - Credit card processing Experiment-V - Case study: Develop class diagram of Unified library application and model it in different views i.e. logic view, component view, deployment view, database design and perform forward & reverse Engineering Experiment-VI - Manual testing: Take any system (e.g. ATM system) and study its system specifications and report the various bugs Experiment-VII - Introduction to Selenium Testing Tool - Exploring Features of Selenium Experiment-VIII - Test a web application using Selenium in NetBeans IDE Experiment-VIII - Test a web application using Selenium in Net Experiment-IX - Working with Selenium Integrated Environment-Execution of IDE Commands - Selenium IDE locating strategies (validation of GUI components) Experiment-X - Selenium IDE test case execution - Implement GUI tests (a web application's User Interface) using Selenium IDE	
<u>Textbook(s):</u> Roger S.Pressman and Bruce R.Maxim, "Software Engineering: A Practitioner's Approach" , 9th ed., NewDelhi: McGraw Hill, 2020	
<u>Reference Book(S):</u> Ian Sommerville, "Software Engineering", 10th ed., Delhi:Pearson Education, 2020	

2. Deepak Jain, "Software Engineering: Principles and Practices", 3rd ed., Delhi: Oxford University Press, 2008
3. Pankaj Jalote, "Software Engineering: A Precise Approach", New Delhi: Wiley India, 2010
4. Waman S. Jawadekar, "Software Engineering: A Primer", New Delhi: Tata McGraw Hill, 2008

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc24_cs119/announcements?force=true; NPTEL Video Lecture on Software Engineering by Prof. Rajib Mall is Professor, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur

Laboratory Manual (for laboratory component):

1. CASE Tools Laboratory Manual, Department of CSE, KITSW

Course Articulation Matrix (CAM):						U24CS214X SOFTWARE ENGINEERING								
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS214X.1	1	1	1	1	-	-	-	1	1	2	1	2	1
CO2	U24CS214X.2	1	1	1	1	-	-	-	1	1	2	1	1	1
CO3	U24CS214X.3	2	2	1	1	-	1	-	1	1	2	1	2	1
CO4	U24CS214X.4	2	2	2	2	-	1	-	1	1	2	1	2	1
CO5	U24CS214X.5	2	2	2	2	-	-	1	1	1	1	1	2	1
CO6	U24CS214X.6	2	2	2	2	2	-	1	1	1	1	1	2	2
CO7	U24CS214X.7	2	1	2	2	2	-	1	1	1	1	1	2	1
CO8	U24CS214X.8	1	2	2	2	2	-	1	1	1	1	1	2	2
U24CS214X		1.6	1.6	1.6	1.6	2.0	1.0	1.0	1.0	1.0	1.5	1.0	1.9	1.3
3 - HIGH, 2 - MEDIUM, 1 - LOW														

WEB DESIGNING			
Class: B.Tech. I Yr (Exit Course)		Branch: CSE	
Course Code:	U24CS215X	Credits:	3
Hours/Week (L-T-P-O-E):	2-0-2-0-4	CIE Marks (%):	50
Total Number of Teaching Hours:	32 Hrs	ESE Marks (%):	50
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: design a static web pages using HTML Tags and CSS properties			
CO2: design a dynamic web pages using JavaScript.			
CO3: develop web server side applications using PHP concepts			
CO4: develop enterprise databases for web-based applications using PHP and MySQL			
CO5 : implementing HTML Tags and CSS for creating static web pages			
CO6: design dynamic web page for web applications using JavaScript			
CO7: design a web base application in PHP.			
CO8 : creating different web applications using PHP and MySql			
THEORY COMPONENT			
UNIT-I			4 Hrs
HTML: Document structure, Basic tags, Creating headings, Working with links, Creating paragraph, Working with images, Tables, Frames. Introduction to forms and controls: Creating HTML form, Specifying action URL and method to send the form, Using HTML controls.			
CSS: CSS (Cascading style sheet) rules and properties, Types: Inline, External and internal style sheets, Style classes, Multiple styles.			
UNIT-II			4 Hrs
JAVASCRIPT: JavaScript syntax, Embedding JavaScript in HTML page. Usage of variables, Working with operators, Control-flow statements, Functions and array, Creating objects, Handling events.			
UNIT-III			4 Hrs
Introduction to PHP: Overview of PHP, Advantages of PHP over scripting languages, Creating and running a PHP script, handling errors. Working with variables and constants: Variables, Data types and operators. Controlling program flow: Conditional statements, Looping statements, Break, Continue and exit statements. Working with functions, Arrays.			
UNIT-IV			4 Hrs
Database using PHP: Exploring relational database model, records and primary keys. Working with sql statements. Using PHP and MySql: Checking configuration, connecting to database, Selecting a database, Adding and altering a table in a database, Inserting and modifying data in a Table, Retrieving data from a table.			
Working with Forms: Web forms and form elements, processing a web form, validating a web form.			
LABORATORY COMPONENT			
List of Experiments			
Design the following static web pages with the following attributes:			
a. BasicTags., b. HeadingTags., c.List (Ordered andUn-Ordered).,d. Textbox,Buttons.			

Design the following static web pages required for an online book store web site.
 HOMEPAGE, LOGINPAGE
 The catalogue page should contain the details of all the books available in the web site in a table. The details should contain the following:
 Snap shot of Cover Page. B. Author Name and Publisher.
 Design a registration form and validate its field by using JavaScript.
 To design the scientific calculator and make event for each button using JavaScript.
 JavaScript program to validate username and password
 Write a HTML file to create a simple form with 5 input fields (Name, Password, Email, Pin code, Phone No. and a Submit button) and demonstrate required field validations to validate that all input fields are required and display error messages if the above validations do not hold.
 Design a server side script with functions and arrays in PHP
 Design a PHP program to elicit different ways to connect to MySQL
 Create a Create, Read, Update, Delete operations for PHP Page using MySQL

Textbook(s):

Kogent, "Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML", 1st Edition, Dreamtech Press (Black Book), ISBN-13: 9789351192510, 2013.

Reference Book(S):

Ivan Bayross, "Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP", 4th Edition, BPB Publications, ISBN-13: 978-8183330084, 2009,
 Uttam K. Roy, "Web Technologies", 7th Edition, Oxford Higher Education, ISBN-10: 0-19-806622-8, ISBN-13: 978-0-19-806622-4, 2010
 Luke Welling, Laura Thomson, "PHP and MySQL Web Development", 3rd Edition, Sams Publications, ISBN: 0-672-32672-8, 2005

Web and Video link(s):

Laboratory Manual (for laboratory component):

Web Designing laboratory manual, Department of CSE, KITSW

Course Articulation Matrix (CAM):					U24CS215X Web Designing									
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	PSO2
CO1	U24CS215X.1	2	2	2	1	2	1	1	2	1	2	1	2	2
CO2	U24CS215X.2	2	2	2	1	2	1	1	2	1	2	1	2	2
CO3	U24CS215X.3	2	2	2	1	2	1	1	2	1	2	1	2	2
CO4	U24CS215X.4	2	2	2	1	2	1	1	2	1	2	1	2	2
CO5	U24CS215X.5	2	2	2	1	2	1	1	2	1	2	1	2	2

CO6	U24CS215X.6	2	2	2	1	2	1	1	2	1	2	1	2	2
CO7	U24CS215X.7	2	2	2	1	2	1	1	2	1	2	1	2	2
CO8	U24CS215X.8	2	2	2	1	2	1	1	2	1	2	1	2	2
U24CS215X		2	2	2	1	2	1	1	2	1	2	1	2	2

URR24: SYLLABI FOR III & IV SEMESTERS
 of
 B.TECH COMPUTER SCIENCE & ENGINEERING
 w.e.f.
 A.Y. 2024-25

III SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	
1	BSC	U24CS301	Software Engineering	2	1	-	6	9	3
2	PCC	U24CS302	Theory of Computation	2	1	-	4	7	3
3	PCC	U24CS303	Advanced Data Structures	2	1	2	5	10	4
4	PCC	U24CS304	Computer Networks	2	1	-	4	7	3
5	PCC	U24CS305	Object Oriented Programming through JAVA	2	1	2	5	10	4
6	VAC	U24VA306A	Quantitative Aptitude and Logical Reasoning	2		-	2	4	2
7	SEC	U24SE307	Programming Skill Development Lab - 2	-	-	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	6	35	58	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)				Data Structures through C* (Supports Lateral Entry students in Advance data structures & DAA course)					1*

**For Lateral Entry Students Only*

Training & Placement Basket

S.No	Course Code	Course Title
1	U24VA306A	Quantitative Aptitude and Logical Reasoning
2	U24VA306B	Soft and Interpersonal Skills

SOFTWARE ENGINEERING			
Class: B. Tech. III – Semester		Branch: CSE	
Course Code:	U24CS301	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-4-7	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : analyze various SDLC models with respect to development time, cost, and flexibility to adapt to changing requirements			
CO2 : apply structured and object-oriented design principles to develop software solutions for real-world applications			
CO3 : apply appropriate software testing techniques to ensure software quality and reliability			
CO4 : assess software quality using standard metrics like lines of code, function points, cohesion, coupling, and defect density			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction to Software and Software Engineering: The nature of software, Defining the discipline, The software process, Software engineering practice			
Software Process (SDLC) Models: A generic process model, Defining a framework activity, Prescriptive process models, Product and process			
Agility and Process: What is agility, Agility and the cost of change, Agility principles, Scrum, The XP framework, DevOps			
UNIT-II			9 Hrs
Understanding Requirements: Requirements engineering, Establishing the groundwork, Requirements gathering, Developing the use cases, Building the analysis model			
Requirements Modeling: Requirements analysis, Scenario-based modeling, Class-based modelling, Functional modelling, Behavioral modeling			
Software Design Concepts: The design process, The design model, UML design diagrams- Use case diagram, Activity diagram, Sequence diagram, State machine diagram, Class diagram, Component diagram, Deployment diagram; Architectural design- Software architecture, Architectural styles			
UNIT-III			9 Hrs
Software Quality: Quality concepts- Quality factors, Quality assessment, software quality dilemma, Achieving software quality, Software quality assurance- Elements, SQA processes and product characteristics, SQA tasks, goals and metrics, Software reliability, The ISO 9000 quality standards			
Software Testing- Component level: A strategic approach to software testing, Test-case design, White-box testing, Black-box testing, Object-oriented testing.			

Software Testing-Integration level: Integration testing, Artificial intelligence and Regression testing, Validation testing, Testing patterns.	
UNIT-IV	9 Hrs
Software Configuration Management: The SCM scenario, Elements, Software configuration items, The SCM repository, Version control systems, The change management process Software Metrics and Analytics: Software measurement, Product metrics, Metrics for testing, Metrics for maintenance, Metrics for software quality Project Management Concepts: The management spectrum, People, Product, Process, Project, The W⁵HHH principle Risk Management: Reactive versus Proactive risk strategies, Software risks, Risk identification, Risk Mitigation, monitoring and management, The RMMM plan	
Textbook(s): 1. Roger S. Pressman and Bruce R. Maxim, <i>Software Engineering- A Practitioner's Approach</i>, McGraw Hill Education, 9th edition, 2023, Chennai	
Reference Book(s): 1. Ian Sommerville, <i>Software Engineering</i>, Pearson Education, 10th edition, 2017, Noida 2. Deepak Jain, <i>Software Engineering: Principles and Practices</i>, Oxford University Press, 3rd edition, 2017, Noida 3. Pankaj Jalote, <i>Software Engineering: A Precise Approach</i>, Wiley India, 1st edition, 2012, New Delhi 4. Rajib Mall, <i>Fundamentals of Software Engineering</i>, PHI Learning, 5th edition, 2018, New Delhi	
Web and Video link(s): ps://nptel.ac.in/courses/106105182 NPTEL course on Software Engineering by Prof. Rajib Mall, Department of CSE, IIT Kharagpur.	

Course Articulation Matrix (CAM):						U24CS301 SOFTWARE ENGINEERING								
CO		PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS301.1	3	2	2	2	1	1	1	1	1	-	1	2	2
CO2	U24CS301.2	3	3	3	2	1	1	1	1	1	-	1	2	2
CO3	U24CS301.3	3	3	2	3	2	1	1	1	1	-	1	2	2
CO4	U24CS301.4	3	2	2	2	2	1	1	1	1	-	1	2	2
U24CS301		3	2.5	2.25	2.25	1.5	1	1	1	1	-	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	analyze various SDLC models with respect to development time, cost, and flexibility to adapt to changing requirements	SDG9	Industry, Innovation and Infrastructure	Understanding SDLC models helps in developing efficient, scalable, and cost-effective software systems, supporting robust digital infrastructure and innovation in industry.
CO2	apply structured and object-oriented design principles to develop software solutions for real-world applications	SDG9	Industry, Innovation and Infrastructure	Software design principles enable development of reliable and maintainable systems used in industrial, enterprise, and societal applications, contributing to technological advancement.
CO3	apply appropriate software testing techniques to ensure software quality and reliability	SDG16	Peace, Justice and Strong Institutions	Software quality and reliability are critical in systems such as governance, finance, and public services, ensuring transparency, trust, and secure digital operations.
CO4	assess software quality using standard metrics like lines of code, function points, cohesion, coupling, and defect density	SDG12	Responsible Consumption and Production	Software metrics promote efficient resource utilization, reduce rework, and improve maintainability, supporting sustainable and responsible software development practices.

THEORY OF COMPUTATION			
Class: B.Tech. III -Semester		Branch: Computer Science & Engineering	
Course Code:	U24CS302	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-4-7	CIE :	60%
Total Number of Teaching Hours:	36 Hrs	ESE :	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 :	apply the concepts of formal languages, alphabets, strings, and grammars to construct and analyze different types of languages used in computation		
CO2 :	identify and apply the working principles of finite automata and regular expressions to design models for recognizing regular languages		
CO3 :	apply the concepts of context-free grammars and pushdown automata to model and analyze context-free languages and their properties		
CO4 :	analyze the computational power of Turing machines and apply them to solve problems, and classify problems based on decidability and computability concepts		
THEORY COMPONENT			
UNIT-I			9 Hrs
Automata Theory: Introduction to finite automata, Structural representations and the central concepts of automata theory			
Finite Automata: Deterministic finite automata, Non-deterministic finite automata, Finite automata with epsilon-transitions, Finite automata with output			
Regular Expressions and Languages: Regular expressions, Finite automata and regular expressions, Applications of regular expressions, Optimization of deterministic finite automata based pattern matchers			
UNIT-II			9 Hrs
Properties of Regular Languages: Proving languages not to be regular, Closure properties of regular languages, Equivalence and minimization of automata			
Context-free Grammars and Languages: Chomsky classification of languages, Writing grammars, Context free grammars, Parse trees, Construction of syntax trees, Applications of context-free grammars, Ambiguity in grammars and languages, Using ambiguity grammars, Simplification of context-free grammars.			
UNIT-III			9 Hrs
Properties of Context-free Languages: Normal forms for context-free grammars, Pumping lemma for context-free languages, Closure properties of context-free languages, Decision properties of context-free languages			
Pushdown Automata: Definition of the pushdown automaton, Deterministic pushdown automata, Languages of pushdown automata, Equivalence of pushdown automata and context- free grammar			
UNIT-IV			9 Hrs
Introduction to Turing Machines: Turing machine, Programming techniques for Turing machines, Extensions to the basic Turing machine			
Undecidability: A language that is not recursively enumerable, An undecidable problem that is recursively enumerable, Undecidable problems about Turing machines, Post's correspondence			

problem
Textbook(s):
1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd ed. Hong Kong: Pearson Education Asia, 2014.
Reference Book(s):
1. Mishra K. L. P, Chandrasekaran N, Theory of Computer Science: Automata, Languages and Computation, 3rd ed. New Delhi: PHI, 2012.
2. Harry R. Lewis, Christos H. Papadimitriou, Elements of the Theory of Computation, 2nd ed. Hong Kong: Pearson Education Asia, 1998.
3. Michael Sipser, Introduction to the Theory of Computation, 3rd ed. Boston: Cengage Learning, 2012.
4. John Martin, Introduction to Languages and the Theory of Computation, 3rd ed. New York: McGraw-Hill, 2007.
Web and Video link(s):
1. https://www.youtube.com/watch?v=77nkSUsQqJk&list=PL3-wYxht4yCgBHUpwXDTL0s3JStccGIax ; NPTEL Video Lecture on Theory of Computation By Prof. Raghunath Tewari, IIT Kanpur.

Course Articulation Matrix (CAM):				U24CS302 THEORY OF COMPUTATION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS302.1	2	2	2	2	2	1	1	2	1	1	2	2	1
CO2	U24CS302.2	2	2	2	2	2	-	1	2	1	1	2	2	1
CO3	U24CS302.3	2	2	3	3	2	-	1	2	1	1	3	3	1
CO4	U24CS302.4	2	2	3	3	2	1	1	2	1	1	3	3	1
U24CS302		2	2	2.5	2.5	2	1	1	2	1	1	2.5	2.5	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Build formal notation for languages, finite automata and regular expressions	SDG4	Quality Education	Formal languages and automata form the theoretical foundation of computer science, enhancing logical thinking and problem-solving skills, which are essential for quality technical education.
CO2	Develop context-free grammars and prove the language is not regular	SDG9	Industry, Innovation and Infrastructure	Context-free grammars are widely used in compiler design and programming languages, enabling innovation in software development and strengthening digital infrastructure.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO3	Construct pushdown automata and convert CFG to CNF or GNF	SDG9	Industry, Innovation and Infrastructure	Pushdown automata and grammar transformations are critical in parsing and language processing systems, supporting advancements in compilers, interpreters, and intelligent systems.
CO4	Design Turing machine and verify the given Post's Correspondence Problem has a solution	SDG4	Quality Education	Turing machines and undecidability concepts build deep computational understanding, improving analytical reasoning and preparing students for advanced research and innovation in computing.

ADVANCED DATA STRUCTURES			
Class: B.Tech. III-Semester		Branch: CSE	
Course Code:	U24CS303	Credits:	4
Hours/Week (L-T-P-O-E):	2-1-2-5-10	CIE :	60 %
Total Number of Teaching Hours:	60 Hrs	ESE :	40 %
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: apply binary trees and binary search trees to organise and retrieve the data CO2: design AVL tree, red black tree and heap trees to optimize database queries CO3: analyze the time complexities of different sorting and searching techniques CO4: organize and retrieve the data using Graphs, spanning trees and string-matching algorithms <i>(based on psychomotor skills acquired from laboratory component)</i> CO5: implement programs using binary trees and binary search trees to organise data efficiently CO6: implement programs using AVL tree, Red black tree to optimise data storage CO7: develop programs using sorting techniques on unsorted data and searching techniques for retrieve the data very effectively CO8: implement Graphs and string manipulation algorithms to organize and retrieve the data			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Trees: Basic terminologies, Definitions and concepts, Representations of binary tree, Operations on a binary tree Types of Binary Trees: Expression tree, Binary search tree- Searching a binary search tree, Inserting a node into a binary search tree, Deleting a node from a binary search tree Heap Trees: Representation of a heap tree, Operations on a heap tree- Insertion, Deletion Threaded binary trees: Representation of threaded binary trees <i>Self Learning Topics (SLTs): Formation of binary tree from its traversals (Text1: topic 7.4.3.2), Determining the Height of a Binary Search Tree(Reference1: topic 10.2.4), Practice problems (Text1: Prob 7.5, Reference1: Prob 9.11, Prob 9.12, Prob 9.13)</i>			
UNIT-II		9 Hrs	
Height Balanced Binary Tree: Definition, Adelson-Velsky and Landis (AVL) rotations, Insertion operation Red-Black Tree: Definition of a red-black tree, Operation on a red-black tree-Insertion Splay Tree: Definition. Operations on splay tree, Splaying operation B Trees: B tree indexing, Operations on a B tree- Inserting, Deleting B+ Tree Indexing: Searching, Inserting, B tree vs. B+ tree <i>Self Learning Topics (SLTs): Huffman's trees (Refernce1: 9.5), AVL tree deletion (Text1: 7.5.5), Practice problem (Text1: 7.17)</i>			

UNIT-III	9 Hrs
Interval Tree: Construction of interval trees Trie Tree Indexing: Trie structure, Operations on trie, Applications of tree indexing Sorting: Heap sort, Quick sort, Merge sort, Bitonic generator sort Searching: Fibonacci search, Interpolation search <i>Self Learning Topics (SLTs):</i> Linked representation of binomial heap(Reference1: 12.2.1), operations of binomial heap(Reference1: 12.2.2), Jump search (Reference1: 14.3), Hashtree (http://originstamp.com/blog/what-is-a-hash-tree-or-merkle-tree/)	
UNIT-IV	9 Hrs
Graphs: Introduction, Graph terminology, Representation of graphs Application of Graph Structures: Topological sorting, Minimum spanning trees- Prim's algorithm, Kruskal's algorithm; Graphs traversal methods- Breadth first search, Depth first search; Kosaraju's algorithm String Matching Algorithms: Brute force method, Rabin-karp string matching algorithm, Knuth morris pratt(KMP) algorithm, Boyer-moore algorithm <i>Self-Learning Topics (SLTs):</i> Directed graphs(Reference1: 13.3.1), practice problems (Reference1: 13.18) String compression -Run Length Encoding (https://www.naukri.com/code360/library/run-length-encoding)	
LABORATORY COMPONENT	
List of Experiments - Program to perform following binary tree operations - creation - insertion of a node - traversal using recursion - Program to perform following binary search tree traversal operations without recursion - inorder - preorder - postorder - Spiral order - Program to perform following binary search tree operations. - creation - insertion of a node - deletion of a node - Program to implement AVL tree construction - Program to implement search and insert operations on Trie - Program to implement the following sorting techniques. - Heap sort - Quick sort - Program to implement the following sorting techniques. - Merge sort - Bitonic generator sort - Program to implement the following search algorithms. - Fibonacci search - Interpolation search - Program to implement the following - Graph Representations - Topological sort - Program to implement the following graph traversal techniques. - Depth first search - Breadth first search - Program to implement following shortest path algorithms.	

i) Kruskal's Algorithm ii) Prim's Algorithm 12. Program to implement the following string matching algorithms. i) Knuth morris pratt algorithm ii) Boyer Moore algorithm iii) Rabin Karp algorithm
Text Book: 1. Debasis Samanta, <i>Classic Data Structures</i> , 2nd ed., Prentice Hall India, New Delhi, 2009 (Chapters 7 to 11)
Reference Book(s): 1. Reema Thareja, <i>Data Structures Using C</i> , 2nd ed., New Delhi: Oxford University Press, 2014 2. Narasimha Karumanchi, <i>Data Structures and Algorithms Made Easy</i> , 5th ed., CareerMonk, 2017
Web and Video link(s): https://nptel.ac.in/courses/106102064 ; NPTEL Video Lecture on Data Structures and Algorithms Prof. Naveen Garg, IIT Delhi 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. <i>Advanced Data Structures Laboratory Manual and Record Book</i> , Department of CSE, KITSW

Course Articulation Matrix (CAM):				U24CS303 ADVANCED DATA STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS303.1	2	2	2	1	1	-	1	1	-	1	1	2	2
CO2	U24CS303.2	2	2	2	1	1	-	1	1	-	1	1	2	2
CO3	U24CS303.3	2	2	2	2	1	-	1	1	-	1	1	2	2
CO4	U24CS303.4	2	2	2	2	1	-	1	1	-	1	1	2	2
CO5	U24CS303.5	1	1	3	2	1	-	1	1	-	1	1	1	1
CO6	U24CS303.6	1	1	3	2	1	-	1	1	-	1	1	1	1
CO7	U24CS303.7	1	1	3	2	1	-	1	1	-	1	1	1	1
CO8	U24CS303.8	1	1	3	2	1	-	1	1	-	1	1	1	1
U24CS303		1.5	1.5	2.50	1.75	1	-	1	1	-	1	1	1.5	1.5

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply binary trees and binary search trees to organise and retrieve the data	SDG 4	Quality Education	It focuses on building strong foundational knowledge in Data base systems. Enhances students' technical and analytical skills in the binary trees and binary search trees. This aligns with skill-based and outcome-based education principles. The knowledge gained improves students' readiness for real-world binary trees and binary

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				search trees challenges. It contributes to employability in fields like Database management system.
CO2	design AVL tree, red black tree and heap trees to optimize database queries.	SDG 9	Industry, Innovation and Infrastructure	Focuses on developing skills to design AVL tree, red black tree and heap trees, which are essential for strengthening Data base management systems. Data structures such as AVL tree, red black tree and heap trees help in Data bases.
CO3	analyze the time complexities of different sorting and searching techniques	SDG 9	Industry, Innovation and Infrastructure Justification	Focuses on developing skills to design different sorting and searching techniques, which are essential for strengthening Data base management systems.
CO4	organize and retrieve the data using Graphs, spanning trees and string matching algorithms	SDG 9	Industry, Innovation and Infrastructure	Focuses on developing skills to organize and retrieve Graphs, spanning trees and string matching algorithms, which are essential for strengthening Data base management systems.

COMPUTER NETWORKS			
Class: B.Tech. III –Semester		Branch: CSE	
Course Code:	U24CS304	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : evaluate OSI and TCP/IP reference models with respect to operational framework and switching infrastructure. CO2 : analyze data link layer mechanisms and medium access control protocols for efficient communication. CO3 : apply routing and congestion control algorithms to optimize network performance. CO4 : analyze services provided by transport and application layer protocols in network communication			
UNIT-I			9 Hrs
Introduction: Uses of computer networks, Types of Computer Networks, Network Technology from Local to Global , Network Protocols Reference Models: OSI reference model, TCP /IP reference model, Comparison of OSI and TCP/IP reference model Physical Layer: Transmission media - Guided transmission media, Wireless transmission, Using the Spectrum for transmission, Digital modulation and multiplexing Switching: Circuit and Packet switching			
UNIT-II			9 Hrs
Data Link Layer: Data link layer design issues, Error detection and correction, Elementary data link protocols, Sliding window protocols Medium Access Control Sub Layer: Channel allocation problem, ALOHA, Carriers sense multiple access, Collision free protocols, Limited contention protocol, Wireless LAN Protocols, Ethernet, Bluetooth, Data link layer switching			
UNIT-III			9 Hrs
Network Layer: Network layer design issues, Routing algorithms - Optimality principle, Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, broadcast routing, Multicast routing Traffic Management at Network Layer: Congestion, Approaches to traffic management, Traffic aware routing, Admission control, Traffic throttling, Load shedding Internetworking: How networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork routing, Packet fragmentation			
UNIT-IV			9 Hrs
Network Layer In The Internet: IP version 4 protocol, IP addresses, IP version 6 protocol, Internet control protocols, OSPF – Interior gateway routing protocol, BGP – Exterior gateway routing protocol, Internet multicasting Transport Layer: Transport services, Primitives, Elements of transport protocols – Addressing, Connection establishment and release, Error control and flow control, Multiplexing, Crash recovery, Congestion control, Internet transport protocols - UDP,TCP Application Layer: Domain Name System (DNS), Electronic mail, World Wide Web			
Textbook(s):			

1. Andrew S. Tanenbaum, David J. Wetherall, Nick Feamster, *Computer Networks*, 6th ed, London: Pearson Education, 2023.
2. Hallberg, Bruce, *Networking A Beginner's Guide*, 6th ed, USA: McGraw-Hill Osborne Media, 2013.

Reference Book(s):

1. William Stallings, *Data and Computer Communications*, 10th ed, USA: Pearson Education, 2014
2. Behrouz Forouzan, *Data Communication and Networking*, 5th ed, USA: Tata McGraw Hill, 2017
3. Larry L. Peterson, Bruce S. Davie, *Computer Networks*, 5th ed, USA: Morgan Kaufmann Publishers., 2011
4. James F. Kurose and Keith W. Ross, *Computer Networking a Top-Down Approach*, 7th ed, USA: Pearson Education, 2016

Web and Video link(s):

1. <https://www.youtube.com/watch?v=O--rkQNKqIs> Video Lecture on Computer Networks and Internet Protocol, Multiplication by Prof Soumya Kanti Ghosh & Prof Sandip Chakraborty, NPTEL IIT Kharagpur

Course Articulation Matrix (CAM):					U24CS304 COMPUTER NETWORKS									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS304.1	2	2	2	2	2	1	1	-	2	1	1	1	1
CO2	U24CS304.2	2	2	2	2	2	-	-	-	2	1	1	1	1
CO3	U24CS304.3	2	2	3	3	2	-	-	-	2	1	1	2	1
CO4	U24CS304.4	2	2	3	3	2	1	1	-	2	1	1	1	1
U24CS304		2	2	2.5	2.5	2	1	1	-	2	1	1	2.5	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	evaluate OSI and TCP/IP reference models with respect to operational framework and switching infrastructure.	SDG 9	Industry, Innovation and Infrastructure	It promotes engineering solutions, technological innovation, infrastructure development, digital transformation, and industry-relevant problem solving.
CO2	analyze data link layer mechanisms and medium access control protocols for efficient communication.	SDG 4	Quality Education	It strengthens quality education by improving knowledge, skills, competency development, analytical thinking, and lifelong learning.
CO3	apply routing and congestion control algorithms to optimize network performance.	SDG 9	Industry, Innovation and Infrastructure	It promotes engineering solutions, technological innovation, infrastructure development, digital transformation, and industry-relevant problem solving.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO4	analyze services provided by transport and application layer protocols in network communication.	SDG 9	Industry, Innovation and Infrastructure	It promotes engineering solutions, technological innovation, infrastructure development, digital transformation, and industry-relevant problem solving.

OBJECT ORIENTED PROGRAMMING THROUGH JAVA			
Class: B. Tech. III – Semester		Branch: CSE	
Course Code:	U24CS305	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs):			
<i>After completion of this course, the students should be able to,</i> <i>(based on cognitive skills acquired from theory component)</i>			
CO1: analyze the strengths and limitations of various programming paradigms to determine their suitability for solving various programming problems in java			
CO2: develop java programs using classes, constructors, methods and various string concepts			
CO3: apply reusability concepts like inheritance, dynamic method dispatch, interfaces and packages to build java programs			
CO4: develop java programs using I/O, file handling, exception handling and multithreading concepts			
<i>(based on psychomotor skills acquired from laboratory component)</i>			
CO5: develop java fundamental programs using operators, control structures and arrays			
CO6: develop java programs using classes, constructors and various string concepts			
CO7: build java programs on inheritance, dynamic method dispatch, interfaces and packages			
CO8: develop java programs using I/O, exception handling and multithreading concepts			
THEORY COMPONENT			
UNIT-I			9 Hrs
Programming Paradigms: Procedural programming, Modular programming, Object oriented programming (OOP), Generic programming			
Java Basics: The History and evolution of Java, An overview of java, Data types, Variables and arrays, Operators, Control statements			
Introducing Classes: Class fundamentals, Declaring Objects, Object reference variables, Introducing Methods			
UNIT-II			9 Hrs
Classes and Methods: Overloading methods, this keyword, Passing and returning objects, Recursion, Variable length arguments, Constructors, Overloading constructors, Garbage collection, Static variables, Static blocks, Static methods, Nested and inner classes, Command line arguments, Wrapper classes			
Strings: Exploring String, StringBuffer, StringBuilder and StringTokenizer classes			
UNIT-III			9 Hrs
Inheritance: Inheritance basics, Types of inheritance, Using super, Method overriding, Order of constructors Execution, Dynamic method dispatch, Abstract classes, final with inheritance, Object class			
Interfaces: Defining an interface, Implementing interfaces, Nested interfaces, Variables in			

interfaces, Interfaces can be extended	
Packages: Defining a package, Packages and Member Access, Importing packages	
UNIT-IV	9 Hrs
Using I/O: I/O basics, Reading, Writing and copying files using byte and character streams Exception Handling: Fundamentals, Exception types, Uncaught exceptions, Using try and catch, Multiple catch clauses, Nested try statements, throw, throws, finally, Creating your own exception sub classes. Multithreading: Creating a thread, Creating multiple threads, Thread priorities, Synchronization, Interthread communication	
LABORATORY COMPONENT	
Experiment-I: 1. Develop a java program to demonstrate different operators in java. 2. Develop a java program to demonstrate control structures. 3. Develop a java program to demonstrate <i>switch</i> statement. Experiment-II: 1. Develop a java program to read an array and display them using <i>for-each</i> control. Finally display the sum of array elements. 2. Develop a java program to read a matrix and display whether it is an identity matrix or not. Use <i>civilized</i> form of <i>break</i> statement. 3. Develop a java program to define a two dimensional (2D) array where each row contains different number of columns. Display the 2D-array using <i>for-each</i>. Experiment-III: 1. Develop a java program to demonstrate class concept 2. Develop a java program to demonstrate <i>this</i> keyword 3. Develop a java program to demonstrate object reference variable 4. Develop a java program to demonstrate overloading of methods 5. Develop a java program to demonstrate passing and returning objects Experiment-IV: 1. Develop a java program to demonstrate variable length argument (using array and ellipsis notation). 2. Develop a java program to demonstrate constructors and garbage collection. 3. Develop a java program to demonstrate nested and inner classes. 4. Develop a java program to demonstrate <i>static</i> variables, <i>static</i> methods, and <i>static</i> blocks Experiment-V: 1. Read at least five strings from command line argument and display them in sorted order. 2. Develop a java program to demonstrate wrapper class by reading N number of integers from command line and display their sum. 3. Develop a java program to demonstrate wrapper class by reading N floating point numbers from command line and display their average. Experiment-VI: 1. Develop a java program to accept a string, count number of vowels and remove all vowels. 2. Develop a java program to accept a string, count number of vowels and remove all vowels using <i>StringBuffer</i> class. 3. Develop a java program to accept a line of text, tokenize the line using <i>StringTokenizer</i> class and print the tokens in reverse order. Experiment-VII: 1. Develop a java program to demonstrate single level inheritance.	

2. Develop a java program to demonstrate multilevel-inheritance using super.
3. Develop a java program to demonstrate method overriding.

Experiment-VIII:

1. Develop a java program to demonstrate dynamic method dispatch.
2. Develop a java program to demonstrate use of abstract class.
3. Develop a java program to demonstrate the use of overriding *equals()* method of an Object class

Experiment-IX:

1. Develop a java program to implement interfaces.
2. Develop a java program to extend the interfaces
3. Develop a java program to demonstrate implementation of nested interfaces.

Experiment-X:

1. Develop a java program to create a *package* and demonstrate to import the *package* into any java program (Consider the behavior of all access specifiers).

Experiment-XI:

1. Develop a java program to demonstrate *try-catch* block.
2. Develop a java program to demonstrate *throw* clause.
3. Develop a java program to demonstrate *throws* clause.
4. Develop a java program to demonstrate *re-throw* an exception, and *finally* block.

Experiment-XII:

1. Develop a java program to demonstrate read/write/copy a file using *byte stream*.
2. Develop a java program to demonstrate read/write/copy a file using *character stream*.
3. Develop a java program to create a thread (using *Thread* class or *Runnable* interface).
4. Develop a java program to demonstrate *synchronization* of threads.
5. Develop a java program to demonstrate *Interthreadcommunication*.

Textbook(s):

1. Herbert Schildt, *Java The Complete Reference*, McGraw Hill, 13th edition, 2024, New Delhi. (Chapters 1 to 3, 7 to 10, 22 & 25)

Reference Book(S):

1. Balaguruswamy, *Programming with Java: A Primer*, McGraw Hill, 7th edition, 2023, New Delhi.
2. Kathy Sierra and Bert Bates, *Head First Java*, O'Reilly Media, 2nd edition, 2005, Boston
3. Harvey Deitel and Paul J. Deitel, *Java How to Program*, Pearson, 11th edition, 2018 New Delhi.

Web and Video link(s):

ps://nptel.ac.in/courses/106105191 NPTEL Video Lecture on Java Programming by Prof. Debasis Samanta, Professor of CSE, IIT Kharagpur.

Laboratory Manual (for laboratory component):

Object Oriented Programming through java Manual and Record Book, Department of CSE, KITSW.

Course Articulation Matrix (CAM):		U24CS305: OBJECT ORIENTED PROGRAMMING THROUGH JAVA												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS305.1	2	2	2	-	1	-	-	-	-	-	1	1	1
CO2	U24CS305.2	2	2	2	1	2	-	-	1	-	-	1	1	1
CO3	U24CS305.3	2	2	3	2	1	-	-	-	-	-	1	2	2
CO4	U24CS305.4	2	2	3	2	2	-	-	1	-	-	1	2	2
CO5	U24CS305.5	2	2	2	-	1	-	-	-	-	-	1	1	1
CO6	U24CS305.6	2	2	2	1	2	-	-	1	-	-	1	1	1
CO7	U24CS305.7	2	2	3	2	1	-	-	-	-	-	1	2	2
CO8	U24CS305.8	2	2	3	2	2	-	-	1	-	-	1	2	2
U24CS305		2	2	2.5	1.25	1.5	-	-	0.5	-	-	1	1.5	1.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Analyze the strengths and limitations of various programming paradigms to determine their suitability for solving programming problems in Java	SDG4	Quality Education	Understanding different programming paradigms enhances computational thinking and problem-solving skills, supporting the development of effective learning methodologies and quality education.
CO2	Develop Java programs using classes, constructors, methods and string concepts	SDG9	Industry, Innovation and Infrastructure	Development of Java-based applications using object-oriented concepts contributes to building scalable and efficient software systems, supporting innovation and modern industrial applications.
CO3	Apply reusability concepts like inheritance, dynamic method dispatch, interfaces and packages to build Java programs	SDG9	Industry, Innovation and Infrastructure	Application of reusability and modular programming concepts promotes efficient software development practices, enabling the design of robust and maintainable systems for industrial and technological advancement.
CO4	Develop Java programs using I/O, file handling, exception handling and multithreading concepts	SDG8	Decent Work and Economic Growth	Implementation of advanced programming concepts such as multithreading and file handling supports the development of high-performance applications, contributing to digital transformation and employment opportunities in the software industry.

QUANTITATIVE APTITUDE AND LOGICAL REASONING			
Class: B.Tech. III -Semester & IV-Semester		Branch: Common to all Branches	
Course Code:	U24VA306	Credits:	2
Hours/Week (L-T-P-O-E):	2-0-0-2-4	CIE	60 %
Total Number of Teaching Hours:	48 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			12 Hrs
Quantitative Aptitude-I: Number system, Averages, Percentages, Ratios & proportions, Time, Speed & distance, Time and work			
UNIT-II			12 Hrs
Quantitative Aptitude-II: Simple interest, Compound interest, Profit & loss, Ages, Permutations & Combinations, Probability			
UNIT-III			12 Hrs
Logical Reasoning-I: Series completion, Analogy, Coding and decoding, Blood relations, Number, Ranking & Time sequence test, Linear & Circular arrangements			
UNIT-IV			12 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: solve arithmetic relationships and interpret data using mathematical models			
CO2: apply the concepts of simple interest, compound interest, profit & loss, ages, permutations & probability to real world situations.			
CO3: compare & categorize the quantitative information for making decisions.			
CO4: evaluate the validity & possible biases in arguments presented in authentic contexts logically & sensibly			
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)			
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)			
Reference Book(s):			
1. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, New Delhi: Pearson India, 2019.			
2. Nishit K Sinha, Reasoning for Competitive Examinations, New Delhi: Pearson India, 2019.			
3. R.N.Thakur , General Intelligence and Reasoning, New Delhi: McGraw Hill Education, 2017.			

Course Articulation Matrix (CAM):				U24VA306A QUANTITATIVE APTITUDE & 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	PSO1	PSO2
CO1	U24VA306 .1	1	2	-	1	-	-	-	-	-	-	1	1	-
CO2	U24VA306 .2	1	2	-	1	-	-	-	-	-	-	1	1	-
CO3	U24VA306 .3	-	1	-	2	-	2	-	-	-	-	1	1	-
CO4	U24VA306 .4	-	1	-	2	-	2	-	-	-	-	1	1	-
U24VA306		1	1.5	-	1.5	-	2	-	-	-	-	1	1	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

DEPARTMENT OF CSE, KITS, WARANGAL

URR24R25: B.TECH CSE SCHEME OF INSTRUCTION

(W.E.F. A.Y. 2025-26)

IV SEMESTER

Sl. No	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	
1	PCC	U24MH401	Discrete Mathematics and Probability Statistics	2	1	-	3	3
2	PCC	U24CS402	Web programming	2	1	-	3	3
3	PCC	U24CS403	Database Management Systems	2	1	-	3	3
4	PCC	U24CS404	Artificial Intelligence	2	1	-	3	3
5	PCC	U24CS405	Python Programming	2	1	-	3	3
6	VAC	U24VA406B	Soft and Interpersonal Skills@	-	-	2	2	1
7	SEC	U24SE407	Programming Skill Development Lab - 3	-	-	2	2	1
8	PCC	U24CS408	Web programming Laboratory	-	-	2	2	1
9	PCC	U24CS409	Database Management Systems Laboratory	-	-	2	2	1
10	PCC	U24CS410	Python Programming Laboratory	-	-	2	2	1
11	VAC*	U24CH411*	Environmental Studies*	2*	1*	-	5*	3*
Total:				10	5	10	25	20
Additional Learning@:Maximum credits allowed for Honors/Minor				-	-	-	-	5
Total credits for Honours/Minor students				-	-	-	-	25
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)				-NiL-				

**For Lateral Entry Students Only*

Training & Placement Basket

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

DISCRETE MATHEMATICS AND PROBABILITY STATISTICS			
Class: B.Tech. IV -Semester		Branch: Common to CSE, CSN, CSO & IT	
Course Code:	U24MH401	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-0-3	CIE:	60 %
Total Number of Teaching Hours:	36 Hrs	ESE:	40 %
Course Learning Outcomes (COs): <i>On completion of this course, students will be able to...</i> CO1: apply fundamentals of logic to solve various engineering problems CO2: solve different types of enumeration problems and apply them to real-life scenarios CO3: solve various graph theory problems and apply them to real-world applications CO4: interpret the data using various statistical measures and probability distributions			
UNIT-I		9 Hrs	
Foundation: Sets and operations on sets, Relations, Binary relations, Equivalence relations, Partial order relations, Hasse diagram and lattices, Digraphs, Adjacency matrices of binary relations. Fundamentals of Logic: Propositions and connectives, Truth tables, Propositional functions, Logical inferences, First order logic, Predicate calculus and quantified logic. Application: Transitive closure of a relation using Warshal's algorithm. <i>Self-Learning Topics (SLTs):</i> Monoids, Groups. (Ref 2: topic 3.2), Pigeonhole principle (Text 1: topic 1.7, problems1.7.13(2, 3, 4)), Mathematical Induction (Text 1: topic 1.10, problems 1.10.1, 1.10.3, 1.10.6)			
UNIT-II		9 Hrs	
Elementary Combinatorics and Recurrence Relations: Basic concepts of permutations and combinations, Enumeration with unlimited repetition and applications, Enumeration with constrained repetitions and applications. Generating function of sequences: Coefficients of generating function, Recurrence relations and its applications, Solutions of recurrence relations by method of substitution, Characteristic roots, Solving non-linear recurrence relations. Application: Using recurrence relations find the computational complexity of binary search, Towers of Hanoi problem, and Sorting. <i>Self-Learning Topics (SLTs):</i> <i>Solutions of recurrence relations by generating function method (Text 1, topic:3.4, problems: 3.4.4, 3.4.5)</i> <i>Additional problems on recurrence relations (Text 1, topics:3.5 and 3.6, problems:3.5.5, 3.5.6, 3.6.6, 3.6.8, 3.6.10)</i>			
UNIT-III		9 Hrs	
Graphs: Basic concepts, Isomorphism, Sub graphs, Trees and their properties, Spanning trees, Binary trees, Planner graphs, Euler's formula, Multi graphs and Eulerian circuits, Hamiltonian graphs, Chromatic number, Four color problem. Applications: Find the shortest path of a network problem. <i>Self-Learning Topics (SLTs):</i> Additional problems on isomorphism of two graphs (Text 1, topic:5.2, problems:5.2.3, 5.2.4, 5.2.5)			
UNIT-IV		9 Hrs	
Statistics: Correlation, Rank correlation, Regression – Linear regression equations. Curve Fitting: Method of least squares –fitting of (i) Straight line (ii) Second degree parabola. Probability: Random variables, Discrete and continuous probability distributions, mean and			

variance of a distribution, Binomial distribution, Poisson distribution, Normal and Exponential distributions.

Applications: Fitting of Binomial distribution, Poisson distribution to the given real time data.

Self-Learning Topics (SLTs):

Review of the concepts of probability (Text2, topic:26.4 and 26.5, problems:26.15, 26.20, 26.25), Conditional probability and Bayes theorem (Text 2, topic:26.6, problems: 26.26, 26.27), Normal distribution (Text 2, topic:26.16, problems:26.45, 26.47, 26.48), Uniform, exponential distributions (Text 2, topic:26.19)

Textbook(s):

1. Mott. J.L, Kandel. K and, Baker. T.P., *Discrete Mathematics for Computer Scientists*, 2nd ed., New Delhi: PHI,1999
2. Grewal, B.S., *Higher Engineering Mathematics*, 43rd ed., New Delhi: Khanna Publishers, 2017

Reference Book(s):

1. S.C. Gupta V.K. Kapoor, *Fundamentals of Mathematical Statistics*, 12th ed., New Delhi: Sultan Chand & Sons Educational Publishers, 2020
2. Jean-Paul Tremblay, Manohar R, *Discrete Mathematical Structures with Applications to Computer Science*, 1st ed., New York: McGraw-Hill, 1975.
3. Zohar Manna., *Mathematical Theory of Computation*, 1st ed., New York: McGraw-Hill, 1974
4. C. L. Liu, *Elements of Discrete mathematics*, 3rd ed., New Delhi: Tata Mc. Graw Hill, 2008

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc25_cs26/course: NPTEL Video Lecture on Discrete Mathematics by Prof. Sudarshan Iyengar, IIT Ropar
2. https://onlinecourses.nptel.ac.in/noc25_ma33/preview?user_email=dsreddy.hari@gmail.com: NPTEL Video Lecture on Introduction to Probability Theory and Statistics by Prof. S Dharmaraja, IIT Delhi

Course Articulation Matrix (CAM):						U24MH401R25: DISCRETE MATHEMATICS AND PROBABILITY STATISTICS								
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	U24MH401.1	2	2	1	1	-	-	-	1	1	-	1	2	1
CO2	U24MH401.2	2	2	1	1	-	-	-	1	1	-	1	2	1
CO3	U24MH401.3	2	2	1	1	-	-	-	1	1	-	1	2	1
CO4	U24MH401.4	2	2	1	1	-	-	-	1	1	-	1	2	1
U24MH401R25		2	2	1	1	-	-	-	1	1	-	1	2	1

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply fundamentals of logic to solve various engineering problems	SDG9	Industry, Innovation and Infrastructure	Using logical, analytical, and computational skills (algorithms, systems modelling) is essential for developing new technologies, automation, and AI-driven solutions.
CO2	solve different types of enumeration problems and apply them to real-life scenarios	SDG9	Industry, Innovation and Infrastructure	Enumerative combinatorics (counting possibilities) is critical for optimization, efficiency, and resource allocation in industrial and logistical processes.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO3	solve various graph theory problems and apply them to real-world applications	SDG9	Industry, Innovation and Infrastructure	Graph theory is used to model and optimize transportation networks, power grids, and communication systems.
CO4	interpret the data using various statistical measures and probability distributions.	SDG4 & SDG9	Quality Education & Industry, Innovation and Infrastructure	Interpreting data using statistical measures and probability distributions involves summarizing dataset characteristics using descriptive metrics, determining the underlying distribution that generated the data, and justifying the choice by mapping the data type to the appropriate theoretical probability model.

Web Programming			
Class: B.Tech. IV –Semester		Branch: Common to all branches	
Course Code:	U24CS402	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to, (based on cognitive skills acquired from theory component)</i>			
CO1: design static web pages using HTML and CSS with proper document structure and style			
CO2: develop client-side interactivity using JavaScript including ES6 features and asynchronous programming concepts			
CO3: develop and manage modular web applications using ReactJS and modern frontend development practices			
CO4: apply debugging, version control, and deployment strategies to publish responsive and data-driven web applications			
THEORY COMPONENT			
UNIT-I		9 Hrs	
HTML: Document Structure, Basic Tags, Creating Headings, Working with Links, Creating Paragraph, Working with Images, Tables, Frames. Introduction to Forms and Controls: Creating HTML Form, Specifying Action URL and Method to Send the Form, Using HTML Controls			
CSS: CSS (Cascading style sheet) rules and properties, Types: Inline, External and Internal Style Sheets, Style Classes, Multiple Styles			
JAVASCRIPT: JavaScript syntax, Embedding JavaScript in HTML Page. Usage of variables, Working with Operators, Control-Flow Statements, Functions and Array, Creating Objects, Handling Events			
Self Learning Topics (SLTs): Basic Tags (Text2: topics 4.5.1), Form controls (Text2: topic 4.6.5), Inline style sheet (Text2: topic 5.3.4), Arrays in JavaScript (Text2: topic 13.5).			
UNIT-II		9 Hrs	
JavaScript for React: Declaring Variables : The const Keyword, The let Keyword, Template Strings Creating Functions: Function Declarations, Function Expressions, Default Parameters, Arrow Functions, Compiling JavaScript, Objects and Arrays: Destructuring Objects, Destructuring Arrays, Object Literal Enhancement ,The Spread Operator Asynchronous JavaScript: Simple Promises with Fetch, Async/Await, Building Promises Classes, ES6 Modules, CommonJS, Functional programming with JavaScript, Case study: Designing and building the Blog’s user interface with real-world UI/UX designs and component architecture			
Self Learning Topics (SLTs): Declaring variables (Text3: topic 3.1) , Compiling JavaScript (Text3: topic 3.5), Recursion (Text3: topic 4.4)			
UNIT-III		9 Hrs	
Fundamentals of React: Hello React, Requirements, Setting up a React Project, Meet the React, Component, React JSX, Lists in React, React Component Instantiation, React DOM, Handler Function in JSX, Callback Handlers in JSX, React Controlled Components, React Custom Hooks (Advanced), React Fragments, React Asynchronous Data, React Class Components, Styling in			

React: CSS in React, CSS Modules in React, SVGs in React, Case study on designing blogs user interface with standard templates.

Self Learning Topics (SLTs): Lists in React (Text4: topic-1.3) , React Controlled Components (Text4: topic 1.5), CSS in React (Text4: topic: 3)

UNIT-IV	9 Hrs

JSP: Syntax and Semantics, JSP Development Model, Components of JSP page: Directives, Comments, Expressions, Scriptlets, Declarations, Implicit Objects, Standard Actions, Tag Extensions, A Complete JSP Example. Session and Thread Management: Session Tracking, Session API, Thread Management. Application Event Listeners

JDBC: Database access with JDBC, Overview, JDBC drivers, connecting to database with Driver Manager, Statement Interfaces: Statement, Prepared statement, Callable statement, Result Sets

Self Learning Topics (SLTs): Scriptlets (Text2: topic 21.8.4), Standard Actions (Text2: topic 21.8.9), Prepared statement (Text2: topic 21.19).

Textbook(s):

1. Kogent, *Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML*, 1st ed., New Delhi: Dreamtech Press (Black Book), 2013. (Chapters 2, 3, 4, 5, 6, 7, 8, 12, 13)
2. P. Hanna, *JSP: The Complete Reference*, 2nd ed. New York: McGraw-Hill, 2001. (Chapters 5, 6, 7, 8, 9, 10, 13, 14)
3. A. Banks and E. Porcello, *Learning React: Modern Patterns for Developing React Apps*, 2nd ed. New Delhi: Greyscale Indian Edition, O'Reilly Media, 2020. (Chapters 3, 4)
4. R. Weiruch, *The Road to React*, 1st ed. Leanpub Press, 2020. (Chapters 1, 2, 3)

Reference Book(s):

1. I. Bayross, *Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP*, 4th ed. New Delhi: BPB Publications, 2009.
2. U. K. Roy, *Web Technologies*, 7th ed. New Delhi: Oxford Higher Education, 2010.
3. N. Biswas, *Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS*, 1st ed. AVA Publisher, 2021.

Web and Video link(s):

1. https://onlinecourses.swayam2.ac.in/aic20_sp15/preview NPTEL Video Lecture on Joomla CMS By Prof Kannan Moudgalya - Principal Investigator of Spoken Tutorial Project | Indian Institute of Technology Bombay

Course Articulation Matrix (CAM):				U24CS402R25 Web Programming									
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2
CO1 U24CS402.1	3	2	2	2	3	1	-	-	-	1	1	3	3
CO2 U24CS402.2	2	2	3	2	3	1	-	-	-	1	1	3	2
CO3 U24CS402.3	2	3	3	2	3	1	-	-	-	1	1	3	2
CO4 U24CS402.4	2	2	2	3	3	1	-	-	-	1	1	3	3
U24CS402R25	2.25	2.25	2.5	2.25	3	1	-	-	-	1	1	3	2.5

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design static web pages using HTML and CSS with proper document structure and style	SDG4	Quality Education	Designing well-structured and accessible web pages supports the development of e-learning platforms and digital content delivery, promoting inclusive and quality education.
CO2	construct server-side dynamic web pages using JSP and manage data persistence with JDBC	SDG9	Industry, Innovation and Infrastructure	Server-side development and database integration enable scalable web applications used in enterprise systems, e-governance, and digital infrastructure.
CO3	develop and manage modular web applications using ReactJS and modern frontend development practices	SDG9	Industry, Innovation and Infrastructure	Modern frontend frameworks like ReactJS support scalable, efficient, and innovative application development, contributing to digital transformation and industrial innovation.
CO4	develop client-side interactivity using JavaScript including ES6 features and asynchronous programming concepts	SDG8	Decent Work and Economic Growth	Advanced JavaScript skills enhance employability and enable the development of responsive, user-friendly applications, supporting economic growth in the digital sector.

DATABASE MANAGEMENT SYSTEMS			
Class: B.Tech. IV–Semester		Branch: CSE	
Course Code:	U24CS403	Credits :	3
Hours/Week (L-T-P-O-E):	2-1-0-0-3	CIE :	60 %
Total Number of Teaching Hours:	36 Hrs	ESE :	40 %
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1:apply relational data models and constraints for designing effective database CO2:design the databases using ER model CO3:design the database by using normalization techniques to reduce redundancy CO4:apply locking techniques for concurrent transactions and to recover the data base from failure			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Databases and Database Users: Introduction, Characteristics of the database approach, Actors on the scene, Workers behind the scene, Advantages of using a DBMS, When not to use a DBMS Database System Concepts and Architecture: Data models, Schemas and instances, Three-schema architecture and data independence, Database languages and interfaces, Classification of database management systems. The Relational Data Model, Relational Database Constraints: Relational model concepts, Relational constraints and the Relational database schemas, Update operations and dealing with constraint violations <i>Self Learning Topics (SLTs): The database system environment (Text1: Topic2.4), The Enhanced Entity–Relationship (EER) Model (Text1: chapter 8)</i>			
UNIT-II		9 Hrs	
Data modeling using the Entity-Relationship Model: Using high-level conceptual data models for database design, Entity types, Entity sets, Attributes and keys, Relationships types, Relationship sets, Roles and structural constraints, Weak entity types, ER diagrams Relational Database Design by ER-to-Relational Mapping: Relational database design using ER-to-Relational mapping The Relational Algebra and Relational Calculus: Basic relational algebra operations, Examples of queries in relational algebra, The tuple relational calculus <i>Self Learning Topics (SLTs): Enhanced Entity-Relationship (Text1: chapter 8), Domain relational calculus (Text1: chapter 8), No SQL Databases (Text1: chapter 24.1)</i>			
UNIT-III		9 Hrs	
Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Boyce-Codd normal form, Algorithms for relational database schema design Query Processing and Optimization: Translating SQL queries into relational algebra, Using heuristics in query optimization			

Self Learning Topics (SLTs): Multivalued dependency and fourth normal form(Text1: Topic15.6), Join dependencies and fifth normal form(Text1: Topic15.7)

UNIT-IV	9 Hrs
Introduction to Transaction Processing Concepts and Theory: Introduction to transaction processing, Transaction and system concepts, Desirable properties of transactions, Characterizing Schedules Based on Serializability Concurrency Control Techniques: Two-Phase Locking techniques for concurrency control, Concurrency control based on Timestamp Ordering Database Recovery Techniques: Recovery concepts, NO-UNDO/REDO Recovery Based on deferred update, Recovery techniques based on immediate update, Shadow paging. Self Learning Topics (SLTs): Database Security and Authorization: Introduction to database security issues, Discretionary access control based on granting and revoking privileges, Mandatory Access Control and Role Based Access Control for Multilevel Security (Text1: chapter 24)	
Text Book: 1. Ramez Elmasri and Shamkanth B. Navathe, <i>Fundamentals of Database Systems</i>, 6th ed., Pearson Education, 2010.	
Reference Book(s): 1. Raghu Ramakrishnan and Johannes Gehrke, <i>Database Management Systems</i>, 3rd ed., McGraw-Hill Education, 2002. 2. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, <i>Database System Concepts</i>, 3rd ed., McGrawHill Education, 1997. 3. Thomas Connolly and Carolyn Begg, <i>Database Systems</i>, 3rd ed., Pearson Education, 2003.	
Web and Video link(s): https://onlinecourses.nptel.ac.in/noc22_cs91/preview ;NPTEL Video Lecture: Data Base Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur.	

Course Articulation Matrix (CAM):				U24CS403 DATABASE MANAGEMENT SYSTEMS									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1 U24CS403.1	2	1	2	1	-	-	-	-	-	1	1	2	1
CO2 U24CS403.2	2	1	2	1	-	-	-	-	-	1	1	2	1
CO3 U24CS403.3	2	1	2	2	-	-	-	-	-	1	1	2	1
CO4 U24CS403.4	2	1	1	1	-	-	-	-	-	1	1	1	1
U24CS403R25	2	1	1.75	1.25	-	-	-	-	-	1	1	1.75	1

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply relational data models and constraints for designing effective database	SDG9	Industry, Innovation and Infrastructure	Relational models and constraints help in building robust and scalable database systems , which are essential for modern digital infrastructure and innovation.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO2	Design the databases using ER model	SDG4	Quality Education	ER modeling supports structured data design , which is widely used in educational systems and improves learning and knowledge organization.
CO3	Design the database using normalization techniques to reduce redundancy	SDG8	Decent Work & Economic Growth	Normalization reduces redundancy and improves efficiency, leading to cost-effective and high-performance systems , supporting productivity and growth.
CO4	Apply locking techniques for concurrent transactions and recover the database from failures	SDG9	Industry, Innovation and Infrastructure	Locking and recovery techniques ensure data reliability and system availability , which are critical for industrial and real-time applications.

ARTIFICIAL INTELLIGENCE			
Class: B.Tech. IV -Semester		Branch: CSE	
Course Code:	U24CS404	Credits :	3
Hours/Week (L-T-P-O-E):	2-1-0-0-3	CIE :	60%
Total Number of Teaching Hours:	36 Hrs	ESE :	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: apply AI problem solving techniques for various engineering problems CO2: analyze effectiveness of AI algorithms for search optimization, game playing and constraint satisfying solutions CO3: develop effective decision-making AI systems using first order logic and planning concepts CO4: apply probabilistic reasoning for decision-making and demonstrate hardware and software concepts used in robotics			
UNIT-I			9 Hrs
Introduction: Introduction to AI, The foundations and history of AI Intelligent Agents: Agents and environments, Nature of environments, Structure of agents Problem Solving: Problem-solving agents, Example problems searching for solutions, Uninformed and informed search strategies, Heuristic functions <i>Self Learning Topics (SLTs): Foundations of AI (Text1: Chapter 1.2), Risks and Benefits of AI (Text1: Chapter 1.5), Concept of Rationality (Text1: Chapter 2.2), Diagrams and pseudo code related to Structure of Agents (Text book: Chapter 2.4)</i>			
UNIT-II			9 Hrs
Search in Complex Environments: Local search and optimization problems, Local search in continuous space, searching with nondeterministic actions, search in partially observable environments. Constraint Satisfaction Problems (CSP): Constraint propagation, Backtracking search for CSPs. Adversarial Search: Game theory, optimal decision in games, Heuristic Alpha-Beta tree search <i>Self Learning Topics (SLTs): Online search problems (Text1: Chapter 4.5.1), Inference in CSPs (Text1: Chapter 5.2), Examples on Backtracking for CSPs (Text1: Chapter 5.3), Optimal decisions in multiplayer games (Text1: Chapter 6.2.2)</i>			
UNIT-III			9 Hrs
Logical Agents: Knowledge based agents, Wumpus world, Propositional logic First Order Logic (FOL): Syntax and Semantics, Using FOL, Knowledge engineering, Inference in FOL, Forward chaining, Backward chaining, Resolution Automated Planning: Definition, Algorithms for planning state space search, Planning graphs, classical planning approaches, Heuristics for planning, Hierarchical planning, Planning in non deterministic domains, Time schedule and resources <i>Self Learning Topics (SLTs): Logical connectives (Text1: Chapter 7.4.1), Inference and proofs (Text1: Chapter 7.5.1), Compare Propositional and first order inference (Text1: Chapter 9.1), Example proofs of resolution (Text1: Chapter 9.5.3)</i>			

UNIT-IV	9 Hrs
Quantifying Uncertainty: Acting under uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Bayes' Rule Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact and Approximate Inference in Bayesian Networks, Probabilistic reasoning over time, Time and uncertainty, Inference in temporal models, Hidden Markov models, Kalman filters, Dynamic Bayesian networks Robotics: Robotic hardware, Robotic perception, Planning and control, Application domains <i>Self Learning Topics (SLTs): Summarizing uncertainty(Text1: Chapter 12.1.1),Case study: Car insurance(Text1: Chapter 13.2.4),A simple one-dimensional example of Kalman filter (Text1: Chapter 14.4.2),Robotics -Applications domains (Text1: Chapter 26.10)</i>	
Textbook(s):	
1. Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th ed. New Delhi: Prentice Hall Series in AI, 2022. (Chapters 1-9, 11,12,13,14,26)	
Reference Book(s):	
1. Elaine rich and Kevin knight, <i>Artificial Intelligence</i> , 2nd ed. New Delhi: Tata McGraw-Hill, 2002. 2. Mark Stefik, <i>Introduction to Knowledge Systems</i> , 2nd ed. San Francisco: Morgan Kaufman, 1995. 3. Winston, Patrick Henry, <i>Artificial Intelligence</i> , 3rd ed. California: Addison Wesley, 1995. 4. Dan W. Patterson, <i>Introduction to Artificial Intelligence and Expert Systems</i> , 2nd ed. New Delhi, Prentice Hall of India, 1997.	
Web and Video link(s):	
https://onlinecourses.nptel.ac.in/noc25_cs07/preview , NPTEL Video Lecture on Artificial Intelligence: Knowledge Representation And Reasoning by Prof. Deepak Khemani, IIT Madras.	

Course Articulation Matrix (CAM):		U24CS404 ARTIFICIAL INTELLIGENCE												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	U24CS404.1	2	2	2	2	1	1	-	1	1	1	-	1	1
CO2	U24CS404.2	2	3	3	2	1	1	-	1	1	1	-	1	1
CO3	U24CS404.3	2	3	3	2	1	1	-	1	1	1	-	1	1
CO4	U24CS404.4	2	2	2	3	1	1	-	1	1	1	-	1	1
U24CS404R25		2	2.5	2.5	2.25	1	1	-	1	1	1	-	2.75	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	apply fundamentals of artificial intelligence for various engineering problem-solving approaches	SDG3	Good Health and Well-being	Path Planning / Optimization Problems
CO2	analyze search algorithms, game playing and constraint satisfying problem & solutions for designing effective	SDG9	Industry, Innovation and Infrastructure	Path finding (robotics, navigation) Network routing State-space exploration problem
CO3	develop effective decision making artificial intelligent systems using propositional logic, first order logic and planning concepts	SDG11	Sustainable Cities and Communities	. Easy to implement and compute Fast reasoning for simple decision environments
CO4	apply decision theory for simple & complex problems and illustrate the software & hardware used in robotics	SDG9	Industry, Innovation and Infrastructure	best action under uncertainty using: Probabilities Utilities (benefits/costs)

PYTHON PROGRAMMING			
Class: B.Tech. IV -Semester		Branch: Common to All	
Course Code:	U24CS405	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs): After completion of this course, the students should be able to, CO1: develop 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 analysit			
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 <i>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)</i>			
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 <i>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)</i>			
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)

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):

https://onlinecourses.nptel.ac.in/noc23_cs99/ NPTEL Video Lecture on Python For Data Science by By Prof. Ragunathan Rengasamy, IIT Madras.

https://onlinecourses.nptel.ac.in/noc25_cs17 NPTEL Video Lecture on Data Analytics with Python By Prof. A Ramesh, IIT Roorkee.

https://onlinecourses.nptel.ac.in/noc25_cs69/ NPTEL Video Lecture on The Joy of Computing using Python By Prof. Sudarshan Iyengar , IIT Ropar

Course Articulation Matrix (CAM):		U24CS405: 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	U24CS405.1	1	2	2	2	2	1	-	-	-	1	1	2	2
CO2	U24CS405.2	2	2	2	2	2	1	-	-	-	1	1	2	2
CO3	U24CS405.3	2	2	2	2	3	1	-	-	-	1	1	2	2
CO4	U24CS405.4	2	2	2	2	3	1	-	-	-	1	1	2	2
U24 CS 405R25		1.75	2	2	2	2.5	1	-	-	-	1	1	2	2

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Construct functional Python scripts by applying fundamental syntax, operators, and advanced control flow mechanisms.	SDG 4	Quality Education	Providing the essential technical foundation and digital literacy required for the modern workforce. Mastering syntax and control flow empowers learners to transition from basic theory to functional problem-solving and tool creation. By building these core competencies, the course creates a necessary entry point for innovation and participation in the global economy. Consequently, it directly supports the target of increasing the number of youth with relevant technical skills for employment.
CO2	Develop efficient data processing logic using built-in structures, regular expressions, and modular package architecture.	SDG9	Industry, Innovation and Infrastructure	Emphasizing efficient data processing and modular architecture, which are critical for building resilient digital infrastructure. The use of optimized built-in structures and regular expressions promotes technological innovation by enabling faster, more scalable software solutions. Modular packaging fosters sustainable industrialization through code reusability and easier system maintenance. This technical competency directly supports the upgrade of technological capabilities within the IT sector. Ultimately, it equips learners to develop the high-performing backend systems necessary for modern information and communication technology.
CO3	Implement robust software solutions using object-oriented principles, structured exception handling, and persistent file management.	SDG9	Industry, Innovation and Infrastructure	Focusing on object-oriented principles and structured exception handling to build resilient and reliable software. Robust file management and OOP promote sustainable industrialization through modular, maintainable, and scalable codebases. By mastering error-resistant logic, learners contribute to the development of high-quality digital infrastructure and technological advancement. These practices ensure system longevity and reduce "technical debt," directly supporting technological capability upgrades in

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				the industry. This competency is essential for creating the stable applications that power modern information and communication systems.
CO4	Perform complex data analysis and visualization. Building interactive database-driven applications and graphical user interfaces.	SDG9	Industry, Innovation and Infrastructure	It equips learners with the advanced technical skills to design and develop complex digital tools. By creating interactive, database-driven applications, students contribute directly to the innovation and upgrade of industrial technologies. The ability to visualize complex data is essential for managing resilient infrastructure and making informed engineering decisions. Ultimately, this outcome fosters the technological research and development capabilities necessary to support a sustainable and competitive global IT sector.

SOFT AND INTERPERSONAL SKILLS			
Class: B.Tech. III -Semester & IV-Semester		Branch: Common to all Branches	
Course Code:	U24VA406B	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-2-0-2	CIE	100 %
Total Number of Teaching Hours:	24 Hrs	ESE	-
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to...</i> CO1: introspect to convert strengths into opportunities, identify weaknesses, and bypass threats CO2: present views on various issues confidently in a group CO3: make effective PPT presentations CO4: prepare a professional resume, communicate effectively to attain better opportunities			
LIST OF ACTIVITIES Activity 1 Reading Comprehension Activity 2 Listening & Observation (Video Source) Activity 3 Group Discussion Activity 4 Presentations through PPTs Activity 5 Self-Introduction Activity 6 JAM Activity 7 Email Etiquette Activity 8 Resume Writing Activity 9 Interview Etiquette Activity 10 "My Career Plan" SWOT Analysis			
Textbook(s): 1. Krishna Mohan, Meera Benerji, <i>Developing Communications Skills</i> , 1st ed., New Delhi: Mcmillan Publications, 2005			

CO-SDG ALIGNMENT MATRIX				
CO	CO Statement The student should be able to	Relevant SDG	SDG Description	Mapping Justification
CO1	deliver concise & effective self-introduction and demonstrate confidence, spontaneous speaking skills within a limited time	SDG 4	Quality Education	This aligns with SDG-4 as it focuses on developing communication skills, confidence and spontaneous speaking ability along with delivering a concise and effective self-introduction in a time-bound manner, which are essential for effective learning and employability
CO2	conduct a personal SWOT analysis to identify areas for self-improvement and career development	SDG 4	Quality Education	This aligns with SDG-4 as it encourages self-awareness and lifelong learning through personal SWOT analysis, enabling learners to identify

				strengths, weaknesses, opportunities, and threats 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	SDG 4	Quality Education	This aligns with SDG-4 as it develops communication, leadership, teamwork and interpersonal skills through active participation in group discussions, collaborative tasks and mock interviews, enhancing learners' overall competence and employability
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	SDG 4	Quality Education	This aligns with SDG-4 as it enhances learners' professional, digital and communication competencies through the creation of a resume, development of a LinkedIn profile, effective video-based communication and practice of email and workplace etiquette, thereby strengthening employability and career readiness

Course Articulation Matrix (CAM):				U24VA406BR25 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	PS O1	PSO 2
CO1	U24VA406B .1	-	-	-	-	-	-	-	-	2	3	-	1	1
CO2	U24VA406B .2	-	-	-	-	-	-	-	2	3	3	-	1	1
CO3	U24VA406B .3	-	-	-	-	-	-	-	-	2	3	-	1	1
CO4	U24VA406B .4	-	-	-	-	-	-	-	1	2	3	-	1	1
U24VA406B R25		-	-	-	-	-	-	-	1.5	2.25	3	-	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

ENVIRONMENTAL STUDIES			
Class: B.Tech. IV Semester		Branch: Common to all branches	
Course Code:	U24CH411	Credits:	0
Hours/Week (L-T-P-O-E):	2-0-0-0-2	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: identify the natural resources and practice their usage more equitably CO2: develop an action plan for sustainable alternatives and conserving biodiversity CO3: examine and perceive the solutions for the environmental pollution CO4: adapt issues involved in enforcement of environmental legislation and green methodology			
UNIT-I			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): Erach Bharucha, <i>Text Book of Environmental Studies for Under Graduate Courses</i>, 2nd Edn., Universities Press (India) Pvt. Ltd, 2013	
Reference Book(s): Y. Anjaneyulu, <i>Introduction to Environmental Science</i>, B.S. Publications, 2004. - Gilbert M. Masters, <i>Introduction to Environmental Engineering & Science</i>, 3rd Edn., Prentice Hall of India, 1991 - Anubha Kaushik, C.P. Kaushik, <i>Environmental Studies</i>, 4th Edn., New Age International Publishers, 2014 R. Rajagopalan, <i>Environmental Studies from crisis to cure</i>, Oxford University Press, 2nd Edn., 2011	
Web and Video link(s): 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. https://sdgs.un.org/goals; UN's webpage on 17 sustainable Development Goals https://onlinecourses.nptel.ac.in/noc23_hs57/preview United nations Sustainable Development Goals	

Course Articulation Matrix (CAM):					U24CH411 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	U24CH411.1	2	1	2	1	-	2	1	1	1	-	-	-	-
CO2	U24CH411.2	-	-	2	-	-	1	1	1	1	1	-	-	-
CO3	U24CH411.3	1	2	1	-	-	1	1	1	1	1	1	-	-
CO4	U24CH2411.4	-	-	1	-	-	1	1	1	1	-	1	-	-
U24CH411R25		1.50	1.50	1.50	1.00	-	1.25	1.00	1.00	1.00	1.00	1.00	-	-

Web Programming Laboratory			
Class: B.Tech. IV -Semester		Branch: Common to all branches	
Course Code:	U24CS408	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-2-0-2	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: create and validate web forms, apply layout and styling through CSS, and demonstrate DOM manipulation via JavaScript CO2: build interactive UI components using ReactJS, including hooks and functional programming practices CO3: implement and test full-stack applications with React as frontend and JSP/JDBC as backend, showcasing complete web flow CO4: create server-side dynamic web pages using JSP and manage data persistence with JDBC			
LABORATORY COMPONENT			
List of Experiments			
Experiment-I (Unit-1) 1. Design the following static web pages with the following attributes: - Basic Tags. - Heading Tags. - List (Ordered and Un-Ordered). - Textbox, Buttons. Experiment-II (Unit-1)			
2. HTML AIM: Design the following static web pages required for an online book store web site. - HOMEPAGE: - LOGINPAGE - CATALOGUE PAGE DESCRIPTION: a. HOME PAGE The static home page must contain three frames. •<i>Top frame:</i> Logo and the college name and links to Home page, Login page, Registration page, Catalogue page and Cart page (the description of these pages will be given below). •<i>Left frame:</i> At least four links for navigation, which will display the catalogue of respective links. For e.g.: When you click the link "CSE" the catalogue for CSE Books should be displayed in the Right frame. •<i>Right frame:</i> The pages to the links in the left frame must be loaded here. Initially this page contains description of the website.			
Logo	Website Name		
Home	Login	Registration	Catalogue
CSE	Description of website		
ECE			
EEE			
CIV			

b. LOGIN PAGE

Logo	Website Name			
Home	Login	Registration	Catalogue	Cart
CSE ECE EEE CIV	Username: Password: Submit Reset			

Experiment-III (Unit-1)**c. CATALOGUE PAGE:**

The catalogue page should contain the details of all the books available in the web site in a table. The details should contain the following:

- Snap shot of Cover Page.
- Author Name and Publisher.
- Price and Add to cart button.

Logo	Website Name			
Home	Login	Registration	Catalogue	Cart
CSE ECE EEE CIV	  	Book: Web Technologies Author: Kogent Publication: Dreamtech Press Book: JSP Complete Reference Author: Phil Hanna Publication: McGraw Hill Book: Web Technologies Author: Uttam K. Roy Publication: Oxford Higher Ed	\$50 \$28.5 \$40	Add to Cart  Add to Cart  Add to Cart 

Experiment-IV (Unit-1)**3. VALIDATION**

AIM: To do validation for registration page using JavaScript.

DESCRIPTION: Write JavaScript to validate the following fields of the above registration page.

- Name (Name should contains alphabets and the length should not be less than 6 characters).
- Password (Password should not be less than 6 characters length).
- e-mailid (should not contain any invalid and must follow the standard pattern (name@domain.com))
- Phone number (Phone number should contain 10 digit sonly).

Note: You can also validate the login page with these parameters.

4. CSS

AIM: Write a program illustrating various methods in cascading style sheets

- a) Use different font, styles and set a background image
- b) Control the repetition of the image
- c) Define styles for links
- d) Work with layers and add a customized cursor

DESCRIPTION: Design a web page using CSS (Cascading Style Sheets) which includes the following:

- a) Use different font, styles: In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles.
 - b) Set a background image for both the page and single elements on the page. You can define the background image for the page like this:
 - c) Control the repetition of the image with the background-repeat property. As background-repeat: repeat
 - d) Define styles for links
 - e) Work with layers:
 - f) Add a customized cursor:
Selector {cursor: value}
.xlink {cursor: crosshair}
.hlink {cursor: help}
5. Write a program to embed JavaScript in HTML pages.
 6. Design a registration form and validate its field by using JavaScript.
 7. Write a program to create popup boxes in JavaScript

Experiment-V (Unit-2)

1. Declare Variables using const, let, and var; observe scope and reassignment
2. Create a Template String that includes dynamic expressions
3. Write a Function Declaration and call it
4. Create a Function Expression and compare it with a Function Declaration
5. Use Default Parameters in a function
6. Convert a Function to Arrow Function with and without parameters
7. Build and Run a JavaScript File with Babel (Compiling JS)

Experiment-VI (Unit-2)

1. Destructure an Object and log each variable
2. Destructure an Array with element skipping
3. Use Object Literal Enhancement to simplify object creation
4. Use the Spread Operator to clone and merge objects and arrays
5. Create and Resolve a Simple Promise
6. Use fetch() to make an API call and handle the response with .then()
7. Refactor the fetch() example using async/await
8. Chain Multiple Promises to simulate asynchronous steps
9. Define a JavaScript Class and Create Instances

Experiment-VII (Unit-2)

1. Use a Constructor and add Methods to the Class
2. Export and Import modules using ES6 export/import
3. Demonstrate CommonJS Module Syntax with require() and module.exports
4. Create a Higher-Order Function (HOF) and pass a function as an argument
5. Use map(), filter(), and reduce() on arrays to demonstrate functional programming

6. Implement a small functional utility like `compose()` or `pipe()`
7. Compare traditional function and arrow function with this context

Experiment-VIII (Unit-3)

1. Create a Simple "Hello React" Application
2. Check and Install Node.js and npm on Your System
3. Set up a React Project using Create React App
4. Create Your First React Component
5. Use JSX to Display a Dynamic Message
6. Create a List of Items using `.map()` in JSX
7. Pass Props to Components and Render Dynamic Data
8. Use `useState` Hook to Create a Counter App
9. Implement a Controlled Component for Input Field
10. Create a Custom Hook for Form Validation

Experiment-IX (Unit-3)

1. Use Callback Functions in JSX for Button Click Events
2. Use Fragment to Avoid Extra DOM Elements
3. Fetch Data from API using `useEffect` (Asynchronous Data)
4. Convert a Function Component to a Class Component
5. Use Multiple Components to Create a To-Do List
6. Style Components Using CSS File and ClassNames
7. Use CSS Modules to Apply Scoped Styles
8. Embed an SVG Image in a React Component
9. Use Conditional Rendering in JSX
10. Create a Theme Toggle App using Custom Hooks
11. Form Submission and Validation using Controlled Components
12. Implement a React Clock using `setInterval` in `useEffect`
13. Create a Responsive Layout with CSS in React

Experiment-X (Unit-4)

1. JSP program to print current date & time
2. JSP program to auto refresh a page
3. JSP program to count no. of visitors on website
4. JSP program for error handling
5. JSP program to demonstrate expression tag
6. JSP program to Detect locale, language settings & local specific time

Experiment-XI (Unit-4)

1. Create Database Connectivity with JSP page with different JDBC Drivers.
2. JSP Program to Select record from database
3. JSP Program to Insert a record into the database
4. Create a CRUD operation for JSP Page using MySQL
5. JSP Program to upload file into server

Experiment-XII (Unit-4)

1. Demonstrate JSP implicit object
2. JSP Program to display given number in words
3. Write a HTML file to create a simple form with 5 input fields (Name, Password, Email, Pin code, Phone No. and a Submit button) and demonstrate required field validations to validate that all input fields are required and display error messages if the above validations do not hold using JSP
4. Create a JSP Page with and run in JSP Engines
5. Demonstrate Session Tracking in JSP

6. JSP Program to validate username and password using JDBC.
<u>Textbook(s):</u> 1. Kogent, <i>Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML</i>, 1st ed., New Delhi: Dreamtech Press (Black Book), 2013. (Chapters 2, 3, 4, 5, 6, 7, 8, 12, 13) 2. P. Hanna, <i>JSP: The Complete Reference</i>, 2nd ed. New York: McGraw-Hill, 2001. (Chapters 5, 6, 7, 8, 9, 10, 13, 14) 3. A. Banks and E. Porcello, <i>Learning React: Modern Patterns for Developing React Apps</i>, 2nd ed. New Delhi: Greyscale Indian Edition, O'Reilly Media, 2020. (Chapters 3, 4) 4. R. Weiruch, <i>The Road to React</i>, 1st ed. Leanpub Press, 2020. (Chapters 1, 2, 3)
<u>Reference Book(s):</u> 1. I. Bayross, <i>Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP</i>, 4th ed. New Delhi: BPB Publications, 2009. 2. U. K. Roy, <i>Web Technologies</i>, 7th ed. New Delhi: Oxford Higher Education, 2010. 3. N. Biswas, <i>Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS</i>, 1st ed. AVA Publisher, 2021.
<u>Web and Video link(s):</u> 1. https://onlinecourses.swayam2.ac.in/aic20_sp15/preview NPTEL Video Lecture on Joomla CMS By Prof Kannan Moudgalya - Principal Investigator of Spoken Tutorial Project Indian Institute of Technology Bombay
<u>Laboratory Manual (for laboratory component):</u> 1. Web Programming Laboratory Manual and Record Book, Department of CSE, KITSW.

Course Articulation Matrix (CAM):				U24CS408 Web Programming Laboratory									
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2
CO1 U24CS408.1	2	2	2	2	2	1	1	1	1	1	2	2	3
CO2 U24CS408.2	2	2	2	2	2	1	1	1	1	1	2	3	3
CO3 U24CS408.3	1	2	2	2	3	1	1	1	1	1	2	2	1
CO4 U24CS408.4	2	2	2	2	3	1	1	1	1	1	2	1	2
U24CS408	2	2.12	2.25	2.12	2.75	1	1	1	1	1	1.5	2.5	2.4

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design static web pages using HTML and CSS with proper document structure and style	SDG4	Quality Education	Designing well-structured and accessible web pages supports the development of e-learning platforms and digital content delivery, promoting inclusive and quality education.
CO2	construct server-side dynamic web pages	SDG9	Industry, Innovation and Infrastructure	Server-side development and database integration enable scalable web applications used in enterprise systems,

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	using JSP and manage data persistence with JDBC			e-governance, and digital infrastructure.
CO3	develop and manage modular web applications using ReactJS and modern frontend development practices	SDG9	Industry, Innovation and Infrastructure	Modern frontend frameworks like ReactJS support scalable, efficient, and innovative application development, contributing to digital transformation and industrial innovation.
CO4	develop client-side interactivity using JavaScript including ES6 features and asynchronous programming concepts	SDG8	Decent Work and Economic Growth	Advanced JavaScript skills enhance employability and enable the development of responsive, user-friendly applications, supporting economic growth in the digital sector.

DATABASE MANAGEMENT SYSTEMS LABORATORY			
Class: B.Tech. IV-Semester		Branch: CSE	
Course Code:	U24CS409	Credits :	1
Hours/Week (L-T-P-O-E):	0-0-2-0-2	CIE :	60 %
Total Number of Teaching Hours:	24 Hrs	ESE :	40 %
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: implement and test SQL queries using DDL/DML/TCL/DCL commands to create and manipulate data in database by enforcing constraints CO2: implement and test database objects, tables, views, indexes, stored procedures, functions, triggers and constraints using SQL queries CO3: implement and test block structured programming with cursors to enable traversal over the records of the database redundancy and maintain the performance of database. CO4: Implement and test pre-compiled stored programs, run-time errors checking, database objects collection in PL/SQL high-level security using triggers			
LABORATORY COMPONENT			
List of Experiments			
Experiment-I 1. Queries on DDL and DML statements. Experiment-II 2. Queries on TCL and DCL commands. Experiment-III 3. Queries on column level and table level constraints. Experiment-IV 4. Queries using built-in functions of NUMBER, CHARACTER, DATE Data types. Experiment-V 5. Queries on single row functions and operators and aggregate functions. Experiment-VI 6. Queries on joins and nested queries. Experiment-VII 7. Write SQL statements to create simple, composite indexes, user-defined data types, views, sequences. Experiment-VIII 8. Write sample PL/SQL programs using conditional and iterative statements. Experiment-IX 9. Write PL/SQL programs using cursors and parameterized cursors. Experiment-X 10. Write PL/SQL programs to handle exceptions. Experiment-XI 11. Write PL/SQL programs using stored procedures and functions. Experiment-XII 12. Write PL/SQL programs for creating triggers.			
Text Book: 1. Ramez Elmasri and Shamkanth B. Navathe, <i>Fundamentals of Database Systems</i> , 6th ed., Pearson Education, 2010.			
Reference Book(s): 1. Raghu Ramakrishnan and Johannes Gehrke, <i>Database Management Systems</i> , 3rd ed., McGraw-Hill Education, 2002.			

2. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, *Database System Concepts*, 3rd ed., McGrawHill Education, 1997.
3. Thomas Connolly and Carolyn Begg, *Database Systems*, 3rd ed., Pearson Education, 2003.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_cs91/preview ;NPTEL Video Lecture: Data Base Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur.

Laboratory Manual (for laboratory component):

1. *Database Management Systems Laboratory Manual and Record Book*, Department of CSE, KITSW

Course Articulation Matrix (CAM):					U24CS409 DATABASE MANAGEMENT SYSTEMS									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS409.1	2	1	2	1	1	1	1	1	1	1	1	2	1
CO2	U24CS409.2	2	1	2	1	1	1	1	1	1	1	1	2	1
CO3	U24CS409.3	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	U24CS409.4	2	1	2	1	1	1	1	1	1	1	1	2	2
U24CS409		1.87	1	1.75	1.2	1	1	1	1	1	1	1	1.75	1.12

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Implement and test SQL queries using DDL / DML / TCL/ DCL commands to create and manipulate data in database by enforcing constraints	SDG4	Quality Education	builds fundamental database skills through SQL, helping students gain strong technical knowledge and practical learning experience, which directly contributes to quality education.
CO2	Implement and test database objects, tables, views, indexes, stored procedures, functions, triggers and constraints using SQL queries.	SDG9	Industry, Innovation and Infrastructure	focuses on designing and implementing advanced database systems, which are essential for building innovative and scalable software infrastructure in real-world applications.
CO3	Implement and test block structured programming with cursors to enable traversal over the records of the database, reduce redundancy and maintain performance.	SDG9	Industry, Innovation and Infrastructure	emphasizes performance optimization and efficient data handling, which are critical for developing high-performance and reliable database systems, aligning with innovation and infrastructure development.
CO4	Implement and test pre-compiled stored programs, run-time	SDG11	Sustainable Cities and Communities	focuses on database security, automation, and reliability. Secure data systems are essential for smart city applications,

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
	<i>The student should be able to</i> error checking, database object collections in PL/SQL and ensure high-level security using triggers.			governance systems, and sustainable digital infrastructure.

PYTHON PROGRAMMING LABORATORY			
Class: B.Tech. IV -Semester		Branch: Common to All	
Course Code:	U24CS410	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-2-0-2	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: implement and test python programs using operators, control statements & functions CO2: Implement and test python packages using string handling methods, regular expressions, and collections CO3: implement and test object oriented paradigms and database operations in Python programming CO4: build visualization graphs with Matplotlib and adapt packages like Numpy, Pandas for data analysis			
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):

https://onlinecourses.nptel.ac.in/noc23_cs99/ NPTEL Video Lecture on Python For Data Science by By Prof. Ragunathan Rengasamy, IIT Madras.

https://onlinecourses.nptel.ac.in/noc25_cs17/ NPTEL Video Lecture on Data Analytics with Python By Prof. A Ramesh, IIT Roorkee.

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):

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

Course Articulation Matrix (CAM):				U24CS410 PYTHON PROGRAMMING LAB										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS410	1	2	2	2	2	1	1	1	1	1	2	2	2
CO2	U24CS410	2	2	2	2	2	1	1	1	1	1	2	2	2
CO3	U24CS410	2	2	2	2	3	1	1	1	1	1	2	2	2
CO4	U24CS410	2	2	2	2	3	1	1	1	1	1	2	2	2
U24CS410		1.75	2	2	2	2	1	1	1	1	1	1.5	2	2
CO-SDG Alignment Matrix														
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification										
CO1	Construct functional Python scripts by applying fundamental syntax, operators, and advanced control flow mechanisms.	SDG 4	Quality Education	Providing the essential technical foundation and digital literacy required for the modern workforce. Mastering syntax and control flow empowers learners to transition from basic theory to functional problem-solving and tool creation. By building these core competencies, the course creates a necessary entry point for innovation and participation in the global economy. Consequently, it directly supports the target of increasing the number of youth with relevant technical skills for employment.										
CO2	Develop efficient data processing logic using built-in structures, regular expressions, and modular package architecture.	SDG9	Industry, Innovation and Infrastructure	Emphasizing efficient data processing and modular architecture, which are critical for building resilient digital infrastructure. The use of optimized built-in structures and regular expressions promotes technological innovation by enabling faster, more scalable software solutions. Modular packaging fosters sustainable industrialization through code reusability and easier system maintenance. This technical competency directly supports the upgrade of technological capabilities within the IT sector. Ultimately, it equips learners to develop the high-performing backend systems necessary for modern information and communication technology.										
CO3	Implement robust software solutions using object-oriented principles, structured exception handling, and persistent file	SDG9	Industry, Innovation and Infrastructure	Focusing on object-oriented principles and structured exception handling to build resilient and reliable software. Robust file management and OOP promote sustainable industrialization through modular, maintainable, and scalable codebases. By mastering error-resistant logic, learners contribute to the development of high-quality digital										

	management.			infrastructure and technological advancement. These practices ensure system longevity and reduce "technical debt," directly supporting technological capability upgrades in the industry. This competency is essential for creating the stable applications that power modern information and communication systems.
CO4	Perform complex data analysis and visualization. Building interactive database-driven applications and graphical user interfaces.	SDG9	Industry, Innovation and Infrastructure	It equips learners with the advanced technical skills to design and develop complex digital tools. By creating interactive, database-driven applications, students contribute directly to the innovation and upgrade of industrial technologies. The ability to visualize complex data is essential for managing resilient infrastructure and making informed engineering decisions. Ultimately, this outcome fosters the technological research and development capabilities necessary to support a sustainable and competitive global IT sector.

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 CSE)

(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 CSE: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24EC411X	Data Analytics	2	-	2	-	4	3
2	PCC	U24EC412X	Machine Learning Fundamentals	2	-	2	-	4	3
3	PCC	U24EC413X	Essentials of Network security	2	-	2	-	4	3
4	PCC	U24EC414X	Introduction to Internet of Things	2	-	2	-	4	3
5	PCC	U24EC415X	Compiler Design Fundamentals	2	-	2	-	4	3
	PCC	U24CS214X	Any other course approved by BoS Chair and Dean AA	2	-	2	-	4	3

DATA ANALYTICS			
Class: B.Tech. II Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS411X	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 Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: apply analytical algorithms for information retrieval CO2: apply preprocessing techniques in data processing CO3: analyse statistical techniques for data processing CO4: analyse data stream processing application CO5 : implement data analytics applications Hadoop CO6 : implement data preprocessing applications CO7 : develop statistical analytical applications CO8 : implement data stream processing applications			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Data Analytics overview: Importance and applications of data analytics, Types of data, Data sources and formats, Data analytics lifecycle, Phases of data analytics, Introduction to tools (Excel, Python, R, Tableau), Basics of Big Data, Hadoop ecosystem overview			
UNIT-II		4 Hrs	
Data Preprocessing: Data cleaning techniques, Handling missing data, Handling outliers and inconsistencies, Data transformation methods, Normalization and standardization, Encoding categorical variables, Feature engineering, Descriptive statistics, Correlation analysis			
UNIT-III		4 Hrs	
Statistical Analysis: Basics of statistics for data analytics, Probability distributions, Hypothesis testing, t-test and chi-square test, ANOVA, Introduction to machine learning, Supervised learning vs unsupervised learning, Linear regression, Logistic regression, Decision trees, K-means clustering, Model evaluation techniques, Confusion matrix			
UNIT-IV		4 Hrs	
Real-time data analytics: Concepts of streaming data, Tools for real-time analytics (Apache Spark, Kafka overview), Applications of data analytics in various domains (Healthcare, Finance, Marketing, Agriculture), Case studies on data-driven decision making, Ethical issues in data analytics			
LABORATORY COMPONENT			
List of Experiments			
1. Load and clean a real-world dataset using Pandas by handling missing values, duplicates, and inconsistencies.			
2. Perform data transformation techniques such as normalization, standardization, and encoding of categorical variables.			
3. Conduct exploratory data analysis by computing summary statistics and analyzing correlations.			
4. Create various data visualizations using Matplotlib and Seaborn to interpret relationships between variables.			
5. Apply statistical tests like t-test, chi-square, and ANOVA using Python's SciPy library.			

6. Implement linear regression using Scikit-learn and evaluate the model using R^2 and RMSE.
7. Build classification models using logistic regression and decision trees with performance evaluation metrics.
8. Perform K-means clustering on multivariate data and visualize the resulting clusters.
9. Design interactive dashboards using Tableau or Power BI to present data-driven insights.
10. Complete a mini-project involving data preprocessing, analysis, modeling, and visualization on a real-world dataset

Textbook(s):

1. Anil Maheshwari, *Data Analytics*, 1st ed. New Delhi: McGraw-Hill Education, 2017

Reference Book(S):

1. V.K. Jain, *Data Science and Analytics*, 1st ed. New Delhi: Khanna Publishing House, 2019

Laboratory Manual (for laboratory component):

1. *Data Analytics manual and Record Book* Department of CSE

Course Articulation Matrix (CAM):					U24CS411X: Data Analytics									
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	U24CS411X.1	2	2	2	-	1	-	-	-	-	-	1	1	1
CO2	U24CS411X.2	2	2	2	1	2	-	-	1	-	-	1	1	1
CO3	U24CS411X.3	2	2	3	2	1	-	-	-	-	-	1	2	2
CO4	U24CS411X.4	2	2	3	2	2	-	-	1	-	-	1	2	2
CO5	U24CS411X.5	1	1	1	1	1	-	-	1	1	-	1	1	1
CO6	U24CS411X.6	1	2	2	2	2	-	-	1	1	-	1	1	1
CO7	U24CS411X.7	1	2	3	2	2	-	-	1	1	-	1	2	2
CO8	U24CS411X.8	1	2	3	2	2	-	-	1	1	-	1	2	2
U24CS411X		1.5	1.87	2.37	1.5	1.62	-	-	1	1	-	1	1.5	1.5

MACHINE LEARNING FUNDAMENTALS			
Class: B.Tech. II Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS412X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: analyse machine learning workflows and application			
CO2: apply supervised learning algorithms in data processing			
CO3: apply unsupervised learning algorithms in data processing			
CO4: analyse model evaluation technique			
CO5 : implement regression algorithms for data classification			
CO6 : implement decision tree, naive bayes algorithms for data classification			
CO7 : implement unsupervised algorithms for data clustering			
CO8 : apply model evaluation techniques in classification			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Machine learning fundamentals: Definition and types of Machine Learning, Supervised vs Unsupervised vs Reinforcement Learning, Machine Learning workflow, Applications of ML in various domains, Basics of model training and testing, Overfitting and underfitting, Bias-variance trade-off, Introduction to Python libraries: NumPy, Pandas, Scikit-learn			
UNIT-II		4 Hrs	
Supervised learning algorithms: Linear regression, Logistic regression, Decision trees, Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), Naïve Bayes classifier			
UNIT-III		4 Hrs	
Unsupervised learning algorithms: Clustering algorithms: k-Means, Hierarchical clustering, DBSCAN, Dimensionality reduction techniques: PCA, t-SNE, Applications of clustering, Evaluation of clustering results, Feature selection and extraction			
UNIT-IV		4 Hrs	
Model evaluation: Cross-validation techniques, Grid search and hyperparameter tuning, Ensemble methods: Bagging, Random Forest, Boosting (AdaBoost, Gradient Boosting), Introduction to neural networks and deep learning basics, Ethical considerations in ML, Case studies and project-based learning			
LABORATORY COMPONENT			
List of Experiments			
1. Implement linear regression using Scikit-learn on a real-world dataset and evaluate the model using R ² and RMSE.			
2. Perform classification using logistic regression and analyze results using confusion matrix and ROC curve.			
3. Build a decision tree classifier and visualize the decision tree structure and feature importance.			
4. Apply k-Nearest Neighbors algorithm for classification and tune the value of k for optimal performance.			
5. Train a Naïve Bayes classifier on a text dataset for spam detection and evaluate precision			

and recall.

6. Implement Support Vector Machine (SVM) for binary classification with kernel tricks.
7. Perform clustering using k-Means and visualize the clusters with appropriate plots.
8. Apply Principal Component Analysis (PCA) for dimensionality reduction and visualize principal components.
9. Evaluate models using cross-validation techniques and perform grid search for hyperparameter tuning.
10. Develop a mini-project integrating supervised or unsupervised learning techniques with real-world data and present findings.

Textbook(s):

1. Ethem Alpaydin, Introduction to Machine Learning, 4th ed. Cambridge: MIT Press, 2020

Reference Book(S):

1. Tom M. Mitchell, Machine Learning, 1st ed. New Delhi: McGraw-Hill Education, 1997

Laboratory Manual (for laboratory component):

1. *Machine learning manual and Record Book*, Department of CSE

Course Articulation Matrix (CAM):					U24CS412X: Machine Learning Fundamentals									
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	U24CS412X.1	2	2	2	-	1	-	-	-	-	-	1	1	1
CO2	U24CS412X.2	2	2	2	1	2	-	-	1	-	-	1	1	1
CO3	U24CS412X.3	2	2	3	2	1	-	-	-	-	-	1	2	2
CO4	U24CS412X.4	2	2	3	2	2	-	-	1	-	-	1	2	2
CO5	U24CS412X.5	1	1	1	1	1	-	-	1	1	-	1	1	1
CO6	U24CS412X.6	1	2	2	2	2	-	-	1	1	-	1	1	1
CO7	U24CS412X.7	1	2	3	2	2	-	-	1	1	-	1	2	2
CO8	U24CS412X.8	1	2	3	2	2	-	-	1	1	-	1	2	2
U24CS412X		1.5	1.87	2.37	1.5	1.62	-	-	1	1	-	1	1.5	1.5

ESSENTIALS OF NETWORK SECURITY			
Class: B.Tech.II Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS413X	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 Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: analyse network security goals, threats and attacks CO2: analyse crypt arithmetic algorithms CO3: apply network security protocols CO4: analyse wireless security threats CO5 : implement cipher algorithms for network security CO6 : implement cryptography algorithms for network security CO7 : implement network security protocols CO8 : simulate wireless security threats			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Network security fundamentals: Need for network security, Security goals: confidentiality, integrity, availability, Types of threats and attacks, Security services and mechanisms, OSI security architecture, Active and passive attacks, Authentication, Access control models			
UNIT-II		4 Hrs	
Cryptography algorithms: Introduction to cryptography, Symmetric key cryptography: DES, AES, Modes of operation (ECB, CBC), Asymmetric key cryptography: RSA, Key management and distribution, Hash functions: SHA, MD5, Digital signatures and certificates, Public Key Infrastructure (PKI)			
UNIT-III		4 Hrs	
Network Security Protocols: Secure Socket Layer (SSL), Transport Layer Security (TLS), HTTPS, Virtual Private Networks (VPN), IP Security (IPSec), Secure Email (PGP, S/MIME), Firewalls: types and architectures, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS)			
UNIT-IV		4 Hrs	
Wireless Network Security: Wireless security basics, Wi-Fi security protocols: WEP, WPA, WPA2, Attacks on wireless networks, Mobile device security, Security in cloud computing, Zero Trust Architecture, Security in IoT networks, Recent trends in cybersecurity, Case studies on network breache			
LABORATORY COMPONENT			
List of Experiments 1. Implement Caesar Cipher and Vigenère Cipher for basic encryption and decryption of text data. 2. Develop a program to simulate RSA algorithm for secure key exchange and encryption. 3. Perform hashing using MD5 and SHA algorithms on input messages and analyze the			

output. 4. Simulate Digital Signature generation and verification using hashing and RSA. 5. Configure and test firewall rules using IP tables or any firewall simulator tool. 6. Set up a Virtual Private Network (VPN) using open-source tools and analyze encrypted traffic. 7. Demonstrate the working of SSL/TLS protocol using Wireshark to capture and inspect packets. 8. Simulate an Intrusion Detection System (IDS) using tools like Snort and generate basic alerts. 9. Analyze wireless network security protocols (WEP, WPA, WPA2) using packet sniffing tools.
Textbook(s): 1. William Stallings, <i>Network Security Essentials: Applications and Standards</i>, , 6th ed. New Delhi: Pearson Education, 2017
Reference Book(S): 1. Behrouz A. Forouzan, <i>Cryptography and Network Security</i>, 1st ed. New Delhi: McGraw-Hill Education, 2007
Laboratory Manual (for laboratory component): 1. <i>Network security manual and Record Book</i> Department of CSE

Course Articulation Matrix (CAM):					U24CS413X: Network Security Essentials									
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	U24CS413X.1	2	2	2	-	1	-	-	-	-	-	1	1	1
CO2	U24CS413X.2	2	2	2	1	2	-	-	1	-	-	1	1	1
CO3	U24CS413X.3	2	2	3	2	1	-	-	-	-	-	1	2	2
CO4	U24CS413X.4	2	2	3	2	2	-	-	1	-	-	1	2	2
CO5	U24CS413X.5	1	1	1	1	1	-	-	1	1	-	1	1	1
CO6	U24CS413X.6	1	2	2	2	2	-	-	1	1	-	1	1	1
CO7	U24CS413X.7	1	2	3	2	2	-	-	1	1	-	1	2	2
CO8	U24CS413X.8	1	2	3	2	2	-	-	1	1	-	1	2	2
U24CS413X		1.5	1.87	2.37	1.5	1.62	-	-	1	1	-	1	1.5	1.5

INTRODUCTION TO INTERNET OF THINGS			
Class: B.Tech. II Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS414X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: analyse IoT architecture, components, and applications across various domains			
CO2: demonstrate sensor interfacing and data acquisition using microcontroller platforms			
CO3: apply communication protocols and cloud platforms for IoT data transmission			
CO4: develop basic IoT-based systems to address real-world problems with security			
CO5 : implement sensor interfacing and data acquisition using IoT hardware platforms			
CO6 : develop IoT-based communication systems using protocols like MQTT			
CO7 : implement cloud platforms for IoT data visualization and remote monitoring			
CO8 : build and deploy basic IoT prototypes to solve real-world challenges			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Introduction to IoT: Definition of IoT, Evolution of IoT, Importance of IoT, Components of IoT, IoT Architecture, Applications of IoT, Perception Layer, Network Layer, Application Layer, IoT Protocols, MQTT, CoAP, HTTP, LoRa, ZigBee, Bluetooth			
UNIT-II		4 Hrs	
IoT Hardware and Sensors: Arduino, Raspberry Pi, ESP8266, ESP32, Types of Sensors, Temperature Sensor, Humidity Sensor, Infrared Sensor, Ultrasonic Sensor, Gas Sensor, Motion Sensor, Actuators, Sensor Interfacing, Microcontroller Basics, Reading Sensor Data, DHT11, Blinking LED			
UNIT-III		4 Hrs	
IoT Networking and Communication: Wired Communication, Wireless Communication, Wi-Fi, Bluetooth, RFID, ZigBee, LoRaWAN, Data Communication, MQTT Protocol, HTTP Protocol, Cloud Platforms, Thingspeak, Blynk, Google Firebase, Sending Data to Cloud, IoT Data Flow			
UNIT-IV		4 Hrs	
IoT Applications and Project Development: IoT System Design, Sensing Layer, Processing Layer, Communication Layer, Smart Irrigation System, Home Automation, Health Monitoring System, IoT Security, Data Privacy, Ethics in IoT, Mini Project Development, IoT Prototype Presentation			
LABORATORY COMPONENT			
List of Experiments			
1. Implement a basic LED blink program using Arduino or ESP8266			
2. Read temperature and humidity data from DHT11 sensor			
3. Measure distance using an ultrasonic sensor and display output			
4. Send sensor data to Thingspeak cloud using ESP8266 and DHT11\			
5. Display real-time sensor data on a web dashboard using HTTP			
6. Control an LED or relay using a mobile app with Blynk and ESP8266			
7. Detect motion using a PIR sensor and trigger an alert system			
8. Automate household appliances using IoT hardware and Blynk app			

9. Build an IoT-based weather monitoring system using multiple sensors
<u>Textbook(s):</u> 1. Vijay Madiseti and Arshdeep Bahga, <i>Internet of Things: A Hands-On Approach</i> , 1st edition New Delhi: Orient Blackswan Publications, 2014
<u>Reference Book(S):</u> 1. Raj Kamal, <i>Internet of Things: Architecture and Design Principles</i> , 1st ed. New Delhi: McGraw Hill Education, 2017
<u>Laboratory Manual (for laboratory component):</u> 1. <i>IoT manual and Record Book</i> Department of CSE

Course Articulation Matrix (CAM):					U24CS414X: Introduction to Internet of Things									
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	U24CS414X.1	2	2	2	-	1	-	-	-	-	-	1	1	1
CO2	U24CS414X.2	2	2	2	1	2	-	-	1	-	-	1	1	1
CO3	U24CS414X.3	2	2	3	2	1	-	-	-	-	-	1	2	2
CO4	U24CS414X.4	2	2	3	2	2	-	-	1	-	-	1	2	2
CO5	U24CS414X.5	1	1	1	1	1	-	-	1	1	-	1	1	1
CO6	U24CS414X.6	1	2	2	2	2	-	-	1	1	-	1	1	1
CO7	U24CS414X.7	1	2	3	2	2	-	-	1	1	-	1	2	2
CO8	U24CS414X.8	1	2	3	2	2	-	-	1	1	-	1	2	2
U24CS414X		1.5	1.87	2.37	1.5	1.62	-	-	1	1	-	1	1.5	1.5

URR24: SYLLABI FOR V & VI SEMESTERS
of
B.TECH COMPUTER SCIENCE & ENGINEERING
w.e.f. A.Y. 2024-25

V SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE	U24OE501X-SEB	OE- S&E Basket	2	1	-	3	3
2	PCC	U24CS502	Machine Learning	2	1	-	3	3
3	PCC	U24CS503	Full Stack Development	2	1	-	3	3
4	PCC	U24CS504	Design and Analysis of Algorithms	2	1	-	3	3
5	PCC	U24CS505	Quantum Computing	2	1	-	3	3
6	IKSC	U24IK506A	Essence of Indian Traditional Knowledge	2	-	-	2	2
7	HSMC	U26MH507	Technical English	-	-	2	2	1
8	PCC	U24CS508	Machine Learning Laboratory	-	-	2	2	1
9	PCC	U24CS509	Full Stack Development Laboratory	-	-	2	2	1
10	ELC	U24ME510	Seminar	-	-	2	2	1
Total:				12	5	8	25	21
Additional Learning [@] : Maximum credits allowed for Honours /Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	26

Pool -XV		
Startups & Entrepreneurship Basket (OE - S&EB)		
S. No.	Course Code	Course Title
1.	U24OE501A-SEB	Design Thinking
2.	U24OE501B-SEB	Innovative Product Design and Development
3.	U24OE501C-SEB	Entrepreneurship
4.	U24OE501D-SEB	Design Studio
5.	U24OE501Z-SEB	Any other course approved by BoS Chair and Dean AA

Design Thinking			
Class: B. Tech. V -Semester		Branch: Common to All	
Course Code:	U24OE501A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to...</i>			
CO1 : identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks			
CO2 : analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions			
CO3 : develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies			
CO4 : evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching			
UNIT-I			9 Hrs
Identify and Analyze Real-world Problems: The Macro Industry View, Problem Identification & Segment Assembly, Customer Identification & Needs Validation, Assess 'Jobs-To-Be-Done' (JTBD) for a Customer Segment, Develop Customer Persona, Validate Customer-Problem fit, Pivot/Refine Customer-Problem fit for feasibility, Examine Ideation Techniques			
UNIT-II			9 Hrs
Solution Idea Generation & MVP: Opportunity & Competition Mapping, Prototype Development & Minimum Viable Product (MVP), Identify Global Competitors, Review Industry Trends and Estimate Market Size (TAM), Introduction to Financial Planning, Overview of Prototypes & MVP, Build an initial Prototype, Prototypes for Early Validation, Map your Relative Position in the Market, Estimate Opportunity Size			
UNIT-III			9 Hrs
Market Feasibility & Business Modeling: Lean Canvas Assembly, Marketing & Go-To-Market (GTM) Strategy, Examine Revenue Models, Review and Organize Lean Canvas, Build LC for your Start-up, Build LC for your Start-up, Understand Marketing and Sales, Recommend a GTM Approach, Map a Sales Process, Building an Initial Team			
UNIT-IV			9 Hrs
Financial Management, Team Scale & Final Pitch: Funding Pathways & Scaling Orientation, Validation & Venture Presentation/Collaboration, Deep Dive into Financial Planning, Analyse the Path to Profitability, Understand Bootstrapping & Funding Options, Finding Co-Founders and Mentors, Thinking Beyond the Prototype - Scale Opportunity & Orientation, Final Milestone - Venture Idea Feasibility Presentation			
Textbook(s): 1. Chandramouli Subramanian & Thiyagarajan p, Sankaran V, Design Thinking: A Hands-on Approach, University Press (India) Pvt. Ltd., 1st Edn., 2025, Hyderabad.			

Reference Book(s):

1. Andrew Pressman, Design Thinking: A Guide to Creative Problem Solving for Everyone, Routledge, Taylor & Francis Group, 7th Edn., 2019, New York.
2. George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw-Hill Education, 13th Edn, 2020, New Delhi.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperBusiness, 7th Edn., 2009, New York.
4. Karl T. Ulrich, Steven D. Eppinger, and Maria C. Yang, Product Design and Development, McGraw-Hill Education, 2020, New Delhi.
5. Tom Kelley and David Kelley, Creative Confidence: Unleashing the Creative Potential Within Us All, Crown Business, 2013, New York.
6. Idris Mootee, Design Thinking for Strategic Innovation, John Wiley & Sons, 1st Edn., 2013, New Jersey.

Web and Video link(s):

<https://nptel.ac.in/courses/110106124>; NPTEL Video Lecture on Design Thinking - A Primer by Prof. Ashwin Mahalingam & Prof. Bala Ramadurai, IIT Madras.

Course Articulation Matrix (CAM):		U24OE501A/U24OE605A - Design Thinking												
CO		PO1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PS O1	PS O2
CO1	U24OE501A.1	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	U24OE501A.2	1	2	2	2	1	1	1	1	1	-	1	1	1
CO3	U24OE501A.3	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	U24OE501A.4	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE501A		1.25	1.7 5	2.2 5	1.7 5	1.5	1.2 5	1	1.2 5	1.2 5	1.5	1.25	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks	SDG 4	Quality Education	Promotes creative learning, problem-solving, and innovation skills among students.
		SDG 9	Industry, Innovation and Infrastructure	Encourages innovative thinking for solving engineering and societal challenges.
CO2	analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for	SDG 3	Good Health and Well-being	Human-centered design improves usability, safety, and user well-being.
		SDG 11	Sustainable Cities and Communities	Supports identification of sustainable and community-oriented

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	validating innovative solutions			solutions.
CO3	develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies	SDG 9	Industry, Innovation and Infrastructure	Promotes innovation, product development, and technological advancement.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization and sustainable product development.
CO4	evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

Innovative Product Design & Development			
Class: B. Tech. – V-Semester		Branch: Common to All	
Course Code:	U24OE501B	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to...</i>			
CO1 :create the systematic lifecycle of engineering design from customer requirements to technical specifications			
CO2 :choose principles of industrial design, materials science, and ergonomics to optimize product usability			
CO3 :implement the advanced rapid prototyping tools to compress the product development cycle			
CO4 :design and build prototype performance using structural validation, risk analysis, and engineering metrics			
UNIT-I		9 Hrs	
Introduction to product design engineering: Translating user needs into Product Design Specifications (PDS); Quality Function Deployment (QFD) and the House of Quality framework; Functional decomposition and physical architecture mapping; Regulatory compliance, standards, and safety considerations in product architecture.			
UNIT-II		9 Hrs	
Principles of Industrial Design (ID): Human-centered design and Ergonomics (Anthropometry); Visual hierarchy, form generation, and product aesthetics; Material selection frameworks (structural, thermal, electrical properties) and manufacturing process mapping (DFM/DFA: Design for Manufacturing and Assembly); Design semantics and user-interface touchpoints.			
UNIT-III		9 Hrs	
Prototyping strategies: proof-of-concept vs. alpha/beta prototypes: Additive manufacturing (3D Printing: FDM, SLA, SLS) and subtractive techniques (CNC machining); Rapid tooling, silicone molding, and vacuum forming; Digital prototyping: Computer-Aided Design (CAD) modeling, assembly verification, and finite element simulations; Virtual and Augmented Reality (VR/AR) workflows for product spatial validation.			
UNIT-IV		9 Hrs	
Design of Experiments (DoE) for physical/digital prototypes: Robust design testing and failure analysis; Cost modeling, Bill of Materials (BOM) management, and engineering change orders (ECO); Sustainable engineering: Design for Environment (DFE) and lifecycle evaluation; Preparing the product blueprint for production scaling and supply chain onboarding.			
Textbook(s): 1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, Tata McGraw-Hill, 10th Edn, 2012, New Delhi.			
Reference Book(S): 1. Devdas Shetty, Product Design for Engineers, Cengage Learning, 9th Edn, 2015, Boston. 2. A.K. Chitale and R.C. Gupta, Product Design and Manufacturing, PHI Learning, 2013, 13th Edn, New Delhi.			

3. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education, 2001, New Delhi.
4. Benjamin W. Niebel and Alan B. Draper, Product Design & Process Engineering, McGraw-Hill, 1974, New York.
5. Paul Trott, Innovation Management and New Product Development, Pearson Education, 2016, Harlow.

Web and Video link(s):

<https://nptel.ac.in/courses/112107217>; NPTEL Video Lecture on Product Design and Development by Prof. Inderdeep Singh, Professor of Mechanical and Industrial Engineering, IIT Roorkee.

Course Articulation Matrix (CAM):		U24OE501B - Innovative Product Design & Development												
CO		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PS O1	PS O2
C O1	U24OE501B.1	2	2	1	1	1	1	-	1	1	-	1	1	1
C O2	U24OE501B.2	1	2	2	2	1	1	1	1	1	-	1	1	1
C O3	U24OE501B.3	1	2	3	2	2	1	1	1	1	1	1	1	1
C O4	U24OE501B.4	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE501B		1.2 5	1.7 5	2.2 5	1.7 5	1.5	1.2 5	1	1.2 5	1.2 5	1.5	1.25	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

Course Outcome and SDG Goal Mapping:

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	create the systematic lifecycle of engineering design from customer requirements to technical specifications	SDG 4	Quality Education	Promotes creative learning, problem-solving, and innovation skills among students.
		SDG 9	Industry, Innovation and Infrastructure	Encourages innovative thinking for solving engineering and societal challenges.
CO2	choose principles of industrial design, materials science, and ergonomics to optimize product usability	SDG 3	Good Health and Well-being	Human-centered design improves usability, safety, and user well-being.
		SDG 11	Sustainable Cities and Communities	Supports identification of sustainable and community-oriented solutions.
CO3	implement the advanced rapid prototyping tools to compress the product development cycle	SDG 9	Industry, Innovation and Infrastructure	Promotes innovation, product development, and technological advancement.
		SDG 12	Responsible Consumption	Encourages efficient resource utilization and sustainable product development.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
			and Production	
CO4	design and build prototype performance using structural validation, risk analysis, and engineering metrics	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

Entrepreneurship			
Class: B. Tech. – V/VI -Semester		Branch: Common to All	
Course Code:	U24OE501C	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to...			
CO1 :	develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility		
CO2 :	analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques		
CO3 :	create students with practical knowledge of business modeling, unit economics, and venture monetization		
CO4 :	build a clear roadmap for executing, legally safeguarding, and pitching a new venture		
UNIT-I		9 Hrs	
Introduction to Entrepreneurship: definitions, characteristics, and the evolution of an entrepreneurial ecosystem; Myths vs. Realities of starting up; Types of entrepreneurship (Social, Tech, Lifestyle, and Corporate);			
Developing an entrepreneurial mindset: risk-taking, resilience, self-efficacy, and dealing with failure; Identifying personal strengths and alignment with venture archetypes.			
UNIT-II		9 Hrs	
Deep-dive Problem Identification: moving from generic ideas to systemic problems; Root-cause analysis, stakeholder mapping, and ecosystem friction points;			
Customer Discovery methodology: conducting ethnographic interviews, building user personas, and mapping customer archetypes; Validating market pain points vs. "nice-to-have" solutions; Value Proposition Canvas framework.			
UNIT-III		9 Hrs	
Designing the business architecture: Introduction to the Lean Canvas and Business Model Canvas (BMC); Revenue streams, pricing strategies, and cost structures;			
Fundamentals of Unit Economics: Customer Acquisition Cost (CAC), Lifetime Value (LTV), and break-even analysis; Competitor analysis and establishing a Sustainable Competitive Advantage (Moat); Basics of bootstrapping vs. external funding.			
UNIT-IV		9 Hrs	
Building the Go-To-Market (GTM) strategy: marketing channels, sales funnels, and early user acquisition; Basics of business registration, legal structures (LLP, Pvt Ltd), and intellectual property (IP) awareness; Building an early founding team, equity splitting models, and culture; Final capstone venture pitch preparation: structuring an investor pitch deck.			
Textbook(s):			
1. Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd, Entrepreneurship, McGraw-Hill Education, 1st Edn, 2020, New Delhi.			

Reference Book(S):

1. Poornima M. Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 5th Edn, 2018, New Delhi.
2. Bruce R. Barringer and R. Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, Pearson, 4th Edn, 2019, New Delhi.
3. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation, Crown Business, 2011, New York.
4. S. S. Khanka, Entrepreneurship Development, S. Chand & Company, 2010, New Delhi.
5. Peter Thiel, Zero to One: Notes on Startups, or How to Build the Future, Crown Business, 2014, New York.

Web and Video link(s):

<https://nptel.ac.in/courses/110105067>; NPTEL Video Lecture on Entrepreneurship Essentials by Prof. Rajeev Roy, Entrepreneurship Development Cell, IIT Kharagpur.

Course Articulation Matrix (CAM):		U24OE501C - Entrepreneurship												
CO		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PS O1	PS O2
CO1	U24OE501C.1/U24OE605C.1	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	U24OE501C.2/U24OE605C.2	1	2	2	2	1	1	1	1	1	-	1	1	1
CO3	U24OE501C.3/U24OE605C.3	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	U24OE501C.4/U24OE605C.4	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE501C/U24OE605C		1.2 5	1.7 5	2.2 5	1.7 5	1.5	1.2 5	1	1.2 5	1.2 5	1.5	1.25	1	1-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility	SDG 4	Quality Education	Enhances entrepreneurial learning by fostering creativity, critical thinking, and practical problem-solving skills.
		SDG 9	Industry, Innovation and Infrastructure	Promotes innovation and entrepreneurship by encouraging the development of scalable ventures that contribute to industrial and technological growth.
CO2	analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques	SDG 3	Good Health and Well-being	Facilitates the identification and validation of healthcare-related needs, leading to more user-centric and impactful well-being solutions.
		SDG 11	Sustainable Cities and Communities	Supports the development of community-focused innovations by understanding urban challenges and designing solutions

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				aligned with citizens' needs
CO3	create students with practical knowledge of business modeling, unit economics, and venture monetization	SDG 9	Industry, Innovation and Infrastructure	Strengthens innovation ecosystems by enabling the commercialization and scaling of technology-driven ventures.
		SDG 12	Responsible Consumption and Production	Encourages sustainable business practices by integrating resource efficiency, value creation, and responsible production principles into venture planning
CO4	build a clear roadmap for executing, legally safeguarding, and pitching a new venture	SDG 8	Decent Work and Economic Growth	Promotes entrepreneurship and job creation by enabling the successful launch and growth of innovative ventures.
		SDG 9	Industry, Innovation and Infrastructure	Supports innovation-driven enterprises by facilitating the protection, development, and scaling of new technologies and business models
		SDG 17	Partnerships for the Goals	Encourages collaboration with investors, industry partners, mentors, and institutions to strengthen venture growth and impact.

Design Studio			
Class: B. Tech. – V/VI -Semester		Branch: Common to All	
Course Code:		U24OE501D	Credits: 3
Hours/Week (L-T-P- E):		2-1-0-3	CIE: 60%
Total Number of Teaching Hours:		36 Hrs	ESE: 40%
CO1 :	deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques.		
CO2 :	apply system-level architecture and feasibility models to design technical solutions.		
CO3 :	build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools.		
CO4 :	validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan.		
UNIT-I		9 Hrs	
Foundations of R&D-led entrepreneurship; Identifying deep-tech and high-impact industry problems; Advanced root-cause analysis; Literature review, patent landscaping, and prior art search; Defining the innovation thesis and scientific/technological core; Drafting the initial Product Design Brief.			
UNIT-II		9 Hrs	
Translating insights into technical concepts; Systematic brainstorming and TRIZ (Theory of Inventive Problem Solving) basics; Technology readiness level (TRL) mapping; Engineering/architectural design and system topology; Value proposition design and business-technical feasibility modeling; The "Napkin Pitch" for technical solutions.			
UNIT-III		9 Hrs	
Rapid prototyping paradigms (Software/Hardware/Service); Formulating the Minimum Viable Product (MVP) core feature matrix; Materials selection and Agile development sprints; UI/UX wireframing or hardware schematics; Functional architecture implementation; Risk assessment and failure mode effects analysis (FMEA).			
UNIT-IV		9 Hrs	
Surface key engineering and market assumptions; Empirical testing protocols, simulation, and data collection; Customer co-creation loops and iterative engineering; Feedback analysis from key industry stakeholders; Creating the product "On-Ramp" strategy (Go-To-Market roadmap, Pilot launch framework, and IP Protection).			
Textbook(s):			
1. Brian Sullivan, The Design Studio Method: Creative Problem Solving with UX Sketching, Routledge, 2015, New York.			
Reference Book(S):			
1. Elizabeth Boling, James Benedict Brown, Colin M. Gray, and Derek Jones, Studio Properties: A Field Guide to Design Education, Yale Press, 2021, New Haven.			
2. Charles Eastman, W. Michael McCracken, and Wendy Newstetter, Design Knowing and Learning: Cognition in Design Education, Elsevier, 2001, Oxford.			
3. Donald A. Schön, Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions, Jossey-Bass, 17th Edn, 1987, San Francisco.			
4. Jerzy Wojtowicz, Virtual Design Studio, Hong Kong University Press, 8th Edn, 1995, Hong			

Kong.

5. Lois Hetland and Ellen Winner, Studio Thinking: The Real Benefits of Visual Arts Education, Teachers College Press, 12th Edn, 2007, New York.

Web and Video link(s):

<https://nptel.ac.in/courses/124105003>; NPTEL Video Lecture on Understanding Design by Prof. Prasad Onkar, Department of Design, IIT Hyderabad.

Course Articulation Matrix (CAM):		U24OE501D/U24OE605D - Design Studio												
CO		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PS O1	PS O2
CO1	U24OE501D.1/U24OE605D.1	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	U24OE501D.2/U24OE605D.2	1	2	2	2	1	1	1	1	1	-	1	1	1
CO3	U24OE501D.3/U24OE605D.3	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	U24OE501D.4/U24OE605D.4	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE501D/U24OE605D		1 . 2 5	1.7 5	2.2 5	1.7 5	1.5	1.2 5	1	1.2 5	1.2 5	1.5	1.25	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	Course Outcome	Mapped SDGs		Justification
CO1	deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques.	SDG 4	Quality Education	Promotes experiential and innovation-based learning by equipping learners with problem-solving, research, and intellectual property skills essential for the 21st century
		SDG 9	Industry, Innovation and Infrastructure	Fosters innovation capacity by encouraging the development of novel technologies, strengthening industry-oriented research, and supporting sustainable technological advancement.
CO2	apply system-level architecture and feasibility models to design technical solutions.	SDG 3	Good Health and Well-being	Supports the design of reliable healthcare technologies and systems that enhance accessibility, efficiency, and overall well-being
		SDG 11	Sustainable Cities and Communities	Facilitates the creation of smart, resilient, and resource-efficient infrastructure solutions that improve urban sustainability and quality of life.
CO3	build and synthesize	SDG 9	Industry,	Promotes technological innovation and

CO-SDG Alignment Matrix				
CO	Course Outcome	Mapped SDGs		Justification
	functional high-fidelity prototypes / MVPs leveraging modern engineering tools.		Innovation and Infrastructure	strengthens engineering capabilities by accelerating product development and industry-relevant solutions.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization, iterative design, and sustainable product development practices that minimize waste and optimize production processes.
CO4	validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan.	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven employment, and sustainable economic growth through market-oriented solution development.
		SDG 9	Industry, Innovation and Infrastructure	Strengthens industry-academia innovation ecosystems by facilitating the translation of validated technologies into scalable solutions.
		SDG 17	Partnerships for the Goals	Encourages collaboration among academia, industry, government, and end users to co-create impactful and sustainable innovations.

MACHINE LEARNING			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS502	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : analyze fundamental machine learning concepts including learning types, statistical techniques, bias-variance tradeoff, linear models such as perceptron and linear regression for problem solving CO2 : examine multi-layer perceptron models, backpropagation algorithms and dimensionality reduction techniques for handling complex data CO3 : utilize probabilistic learning methods, support vector machines, reinforcement learning methods to address data modeling and optimization problems CO4 : construct solutions using decision trees, ensemble techniques and clustering algorithms like k-means for decision-making tasks			
UNIT-I			9 Hrs
Introduction: Learning, Types of machine learning, Supervised learning Preliminaries: Some terminology, Knowing what you know: testing machine learning algorithms, Turning data into probabilities, Some basic statistics, The bias-variance tradeoff Neurons, Neural Networks and Linear Discriminants: The brain and the neuron, Neural networks, The perceptron, Linear separability, Linear regression			
UNIT-II			9 Hrs
The Multi-Layer Perceptron: Going forwards, Going backwards: Backpropagation of error, Multi-layer perceptron in practice, Examples of using the multi layer perceptron, Deriving backpropagation Dimensionality Reduction: Linear discriminant analysis, Principal component analysis, Independent component analysis			
UNIT-III			9 Hrs
Probabilistic Learning: Gaussian mixture models, Nearest neighbour methods Support Vector Machines: Optimal separation, Kernels, The support vector machine algorithm, Extensions to the support vector machines Reinforcement Learning: Overview, Example: Getting Lost, Markov Decision Processes			
UNIT-IV			9 Hrs
Learning with Trees: Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees Ensemble Learning: Boosting, Bagging, Different Ways to Combine Classifiers Unsupervised Learning: The K-Means and K-Medoids Algorithm			
Textbook(s): 1. Stephen Marsland, <i>Machine Learning: An Algorithmic Perspective</i> , Taylor & Francis, 2 nd edition, 2015, New York. (<i>Chapters 1 to 8, 10 to 14</i>)			
Reference Book(S):			

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill Education, Indian Edition, 2013, New Delhi.
2. Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, Cambridge University Press, 1st edition, 2012, New York.
3. Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, John Wiley & Sons, 1st edition, 2014, New Jersey.
4. Ethem Alpaydin, *Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)*, MIT Press, Third Edition, 2014, Massachusetts.
5. William W Hsieh, *Machine Learning Methods in the Environmental Sciences, Neural Networks*, Cambridge University Press, 1st edition, 2009, Cambridge.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_cs74/preview; NPTEL Video Lecture on Introduction to Machine Learning by Prof. Balaraman Ravindran, Professor of Computer Science, IIT Madras.

Course Articulation Matrix (CAM):				U24CS502 : MACHINE LEARNING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS502.1	2	2	2	2	-	-	1	-	1	-	2	2	2
CO2	U24CS502.2	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	U24CS502.3	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	U24CS502.4	2	2	2	2	-	-	1	-	1	-	2	2	2
U24CS502		2	2	2	2	-	-	1	-	1	-	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply data preprocessing techniques and supervised learning models including regression and classification algorithms	SDG3	Good Health and Well-being	Machine learning models support healthcare applications such as disease prediction, medical diagnosis and data-driven treatment planning, improving health outcomes.
CO2	Analyze neural network architectures, backpropagation and dimensionality reduction techniques	SDG4	Quality Education	Neural networks and intelligent systems enable adaptive learning platforms and personalized education systems, improving access to quality education.
CO3	Analyze probabilistic learning methods, support vector machines and optimization techniques	SDG9	Industry, Innovation and Infrastructure	Machine learning techniques enhance industrial automation, predictive analytics and intelligent systems, supporting innovation and infrastructure development.
CO4	Apply decision trees, ensemble methods and clustering techniques for solving real-world problems	SDG11	Sustainable Cities and Communities	Machine learning solutions enable smart city applications such as traffic prediction, resource management and urban planning for sustainable development.

FULL STACK DEVELOPMENT			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS503	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
(based on cognitive skills acquired from theory component)			
CO1 :	Apply the basic web development framework to model interactions between user, browser, web server, and backend services, and develop Node.js applications using event-driven programming and callbacks.		
CO2 :	Apply Node.js modules to process data, manage file systems, and develop HTTP/HTTPS client-server applications using Node.js.		
CO3 :	Apply NoSQL concepts to design, manage, and manipulate databases using MongoDB and integrate them with Node.js applications		
CO4 :	Apply routing to develop web applications using Express.js and build dynamic front-end applications using Angular with components, data binding, directives, and services.		
THEORY COMPONENT			
UNIT-I			9 Hrs
Introducing the Node.js: Understanding the Basic Web Development Framework- User, Browser, Webserver, Backend Services, Full Stack Components - Node.js, MongoDB, Express			
Getting Started with Node.jsUnderstanding Node.js, Installing Node.js, Working with Node Packages, creating a Node.js Application.			
Using Events, Listeners, Timers, and Callbacks in Node.js Understanding the Node.js Event Model, Adding Work to the Event Queue, Implementing Callbacks.			
UNIT-II			9 Hrs
Handling Data I/O in Node.js-Working with JSON, Using the Buffer Module to Buffer Data, Using the Stream Module to Stream Data			
Implementing HTTP Services in Node.js- Processing URLs, Processing Query Strings and Form Parameters, Understanding Request, Response, and Server Objects, Implementing HTTP Clients and Servers in Node.js, Implementing HTTPS Servers and Clients			
UNIT-III			9 Hrs
Understanding NoSQL and MongoDB Why NoSQL? Understanding MongoDB, MongoDB Data Types, Planning Your Data Model.			
Getting Started with MongoDB -Building the MongoDB Environment, Administering User Accounts, Configuring Access Control, Administering Databases, Managing Collections.			
Getting Started with MongoDB and Node.js Adding the MongoDB Driver to Node.js,			

Connecting to MongoDB from Node.js, Understanding the Objects used in the MongoDB Node.js Driver, Accessing and Manipulating Databases, Accessing and Manipulating Collections(CRUD Operations)	
UNIT-IV	9 Hrs
Implementing Express in Node.js -Getting Started with Express, Configuring Routes, Using Requests Objects, Using Response Objects Getting Started with Angular -Why Angular? Understanding Angular, Angular template, creating a Basic Angular Application Angular Components: Routing, Expressions, Data Binding, Built-in Directives, Custom Directives	
<u>Textbook(s):</u> 1. Brad Dayley, Brendan Dayley, Caleb Dayley., Node.js, MongoDB and Angular Web Development, Addison-Wesley,2nd Edition, 2019.	
<u>Reference Book(S):</u> 1. Vasan Subramanian, <i>Pro MERN Stack, Full Stack Web App Development with Mongo,Express, React, and Node</i> , Apress,2nd Edition, 2019. 2. Chris Northwood, <i>The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer</i> , Apress, 1st edition, , 2018. 3. Kirupa Chinnathambi, <i>Learning React: A Hands-On Guide to Building Web Applications Using React and Redux</i> , Addison-Wesley Professional, 2nd edition, , 2018.	
<u>Web and Video link(s):</u> Nptel related web and video links are not available.	

Course Articulation Matrix (CAM):				U24CS503 : FULL STACK DEVELOPMENT										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS503.1	3	2	3	2	3	1	1	2	1	3	2	2	3
CO2	U24CS503.2	3	2	3	2	3	1	1	2	1	3	2	2	3
CO3	U24CS503.3	3	2	3	2	3	1	1	2	1	3	2	2	3
CO4	U24CS503.4	3	2	3	2	3	1	1	2	1	3	2	2	3
U24CS503		3	2	3	2	3	1	1	2	1	3	2	2	3
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply the basic web development framework to model interactions between user, browser, web server, and backend services, and develop Node.js applications using event-driven programming and callbacks	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	Developing web applications and backend systems using Node.js, contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				helps in building scalable, innovative, and resilient digital infrastructure.
CO2	Apply Node.js modules to process data, manage file systems, and develop HTTP/HTTPS client-server applications using Node.js.	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	Server-side programming and application development skills using Node.js contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.
CO3	Apply NoSQL concepts to design, manage, and manipulate databases using MongoDB and integrate them with Node.js applications	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	NoSQL database design and integration contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.
CO4	Apply routing to develop web applications using Express.js and build dynamic front-end applications using Angular with components, data binding, directives, and services.	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	Enables the development of dynamic and interactive web applications contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.

DESIGN AND ANALYSIS OF ALGORITHMS			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS504	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : analyze the efficiency of algorithms using asymptotic notations and apply divide-and-conquer strategies and disjoint set operations to solve computational problems effectively.			
CO2 : design and implement algorithmic solutions using greedy and backtracking paradigms for optimization and decision-making problems, and evaluate their correctness and efficiency.			
CO3 : apply dynamic programming techniques to solve complex optimization problems and compare them with other paradigms in terms of time and space efficiency.			
CO4 : develop and analyze solutions using branch and bound techniques and classify computational problems based on NP-hard and NP-complete concepts to understand problem tractability.			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction: Algorithm analysis, Performance analysis, Space complexity and time complexity, Big ‘O’ notation, Omega notation, Theta notation Sets and Disjoint Set Union: Introduction, Union operation, Find operation Divide and Conquer: General method, Binary search, Finding the Maximum and Minimum, Merge sort, Quick sort			
UNIT-II			9 Hrs
Greedy Method: General method, Knapsack problem, Job sequencing with deadlines, Optimal storage on tapes, Optimal merge patterns, Single source shortest paths Back Tracking: General method, N-Queens problem, Sum of subsets, Graph coloring problem			
UNIT-III			9 Hrs
Dynamic Programming: General method, Multistage graphs, All pairs shortest paths, Single source shortest paths, Optimal binary search trees, String editing, 0/1 Knapsack problem, Reliability design problem, Travelling sales person problem			
UNIT-IV			9 Hrs
Branch and Bound: General method, Least cost (LC) search, The 15-puzzle problem, Control abstractions for LC search, 0/1 Knapsack problem, Travelling sales person problem NP Hard and NP Complete Problems: Basic concepts - Nondeterministic algorithms, The classes NP hard and NP complete; COOK’s theorem, NP hard graph problems - Clique decision problem, Node cover decision problem, Chromatic number decision problem			
Textbook(s):			

2. E.Horowitz, S.Sahni, S.Rajasekaran, *Fundamentals of Computer Algorithms*, 2nd ed. Universities Press, 2019

Reference Book(S):

4. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein, *Introduction to Algorithms*, Prentice-Hall of India, 3rd edition, , 2010, New Delhi.
5. Gajendra Sharma, *Design and Analysis of Algorithms*, Khanna Publishing, 4th edition, , 2019, New Delhi.
6. S.Sridhar, *Design and Analysis of Algorithms*, Oxford University Press, 3rd edition, 2015, Noida.
7. Mark Allen Weiss, *Data Structures and Algorithm Analysis in Java*, Pearson, 3rd edition, 2012, Chennai.

Web and Video link(s):

[ps://nptel.ac.in/courses/106106131](https://nptel.ac.in/courses/106106131) NPTEL Video Lecture on Design and Analysis of Algorithms by Prof. Madhavan Mukund, Chennai Mathematical Institute.

Course Articulation Matrix (CAM):				U24CS504 DESIGN AND ANALYSIS OF ALGORITHMS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS504.1	3	2	2	2	1	-	1	-	1	-	2	2	2
CO2	U24CS504.2	3	3	3	2	1	-	1	-	1	-	2	2	2
CO3	U24CS504.3	3	3	3	2	1	-	1	-	1	-	2	2	2
CO4	U24CS504.4	3	2	2	2	1	-	1	-	1	-	2	2	2
U24CS504		3	2.5	2.5	2	1	-	1	-	1	-	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Analyze algorithm efficiency and apply divide-and-conquer and disjoint set techniques	SDG9	Industry, Innovation and Infrastructure	Algorithm efficiency is fundamental to scalable computing systems (cloud, networks, data processing), enabling robust and efficient digital infrastructure and technological innovation.
CO2	Design and implement solutions using greedy and backtracking techniques for optimization problems	SDG8	Decent Work and Economic Growth	Optimization and scheduling algorithms are directly used in industrial planning, logistics, and workforce/resource management, improving productivity and operational efficiency.
CO3	Apply dynamic programming to solve complex optimization problems and evaluate their efficiency	SDG12	Responsible Consumption and Production	Dynamic programming focuses on optimal resource utilization (time, memory, cost), which supports sustainable computing practices and efficient consumption of computational resources.
CO4	Develop solutions using branch and bound and classify problems based on NP-hard and NP-complete concepts	SDG9	Industry, Innovation and Infrastructure	Branch and bound and NP-based problem classification are foundational to solving real-world optimization problems such as routing, scheduling, and network design, enabling efficient and scalable infrastructure solutions.

QUANTUM COMPUTING			
Class: B. Tech. V - Semester		Branch: CSE	
Course Code:	U24CS505	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: describe the concepts of classical information processing, logic gates, reversible computation, and error handling techniques. CO2: apply the principles of qubits, superposition, measurement, and quantum gate operations to construct basic quantum circuits. CO3: analyze quantum states involving multiple qubits and evaluate the role of entanglement and error correction in quantum systems. CO4: implement simple quantum programs using Qiskit/IBM Quantum tools and explain the working of quantum communication protocols and algorithms.			
UNIT-I			9 Hrs
Classical Information and Computation: Bits, Coins, Dice, Encoding information, Physical bits, Binary representation. Logic Gates: Single-bit gates, Two-bit gates, Logic gates as physical circuits, Universal gates. Circuit simplification Reversible Logic Gates: Reversible gates, Irreversible gates, Toffoli gate. Error Detection and Correction: Errors in physical devices, Error detection and error correction.			
UNIT-II			9 Hrs
One Quantum Bit: Introduction to qubits and superposition, Review of complex numbers for quantum computing Quantum Measurement: measurement in Z-basis, normalization, measurement in other bases Bloch sphere mapping: Global and relative phases, spherical coordinates, Cartesian coordinates, Physical qubits Quantum Gates: Classical reversible gates, Common one-qubit quantum gates, Quantum circuits and circuit diagrams.			
UNIT-III			9 Hrs
Multiple Quantum Bits and Entanglement: Entanglion mechanics, Connection to quantum computing States and measurement: Tensor product, Measuring individual qubits, Product states and entangled states Quantum Gates: One-qubit and two-qubit quantum gates, Toffoli gate, No-cloning theorem, Definition of universal quantum gates, Components of a universal gate set, Examples of universal gate sets Quantum Adders: Classical adder, Quantum sum, Quantum carry, Quantum ripple-carry adder Introduction to Quantum Error Correction: Decoherence, Bit-flip code.			
UNIT-IV			9 Hrs

Quantum Programming and Quantum Applications: IBM quantum services, Quantum composer, Quantum processor and simulator, Introduction to OpenQASM and Qiskit

Quantum Communication Protocols: Superdense coding, Quantum teleportation, Quantum key distribution (BB84)

Introduction to Quantum Algorithms: Deutsch algorithm, Grover's searching algorithm, Shor's factoring algorithm, Applications and future scope of quantum computing

Textbook(s):

1. Thomas G. Wong, *Introduction to Classical and Quantum Computing*, Rooted Grove Publications, 2022, 1st edition, Nebraska, USA.

Reference Book(S):

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 2010, 10th Anniversary edition, United Kingdom.
2. David McMahon, *Quantum Computing Explained*, Wiley Publishing, 2008, 1st edition, United States of America.
3. Eric Johnston, Nic Harrigan, Mercedes Gimeno-Segovia, *Programming Quantum Computers*, O'Reilly Media, 2019, 1st edition, United States of America.

Web and Video link(s):

1. <https://nptel.ac.in/courses/106106232>, NPTEL: Introduction to Quantum Computing: Quantum Algorithms and Qiskit, by Prabha Mandayam, Anupama Ray, and Sheshashayee Raghunathan, Offered by Indian Institute of Technology Madras and IBM.

Course Articulation Matrix (CAM):				U24CS505: QUANTUM COMPUTING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS505.1	3	2	1	1	1	-	1	-	1	-	1	2	2
CO2	U24CS505.2	3	2	2	2	1	-	1	-	1	-	1	2	2
CO3	U24CS505.3	2	3	2	2	2	-	1	-	1	-	2	2	2
CO4	U24CS505.4	2	3	2	2	2	-	1	-	1	-	2	2	2
U24CS505		2.5	2.5	1.75	1.75	1.5	-	1	-	1	-	1.5	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	describe the concepts of classical information processing, logic gates, reversible computation, and error handling techniques.	SDG 4	Quality Education	Understanding the foundational principles of computation equips students with advanced scientific knowledge and promotes lifelong learning in emerging technologies.
CO2	apply the principles of qubits, superposition, measurement, and quantum gate operations to construct basic quantum circuits.	SDG 9	Industry, Innovation and Infrastructure	Quantum computing is an emerging technological paradigm that drives innovation in next-generation computing infrastructure and advanced digital technologies.
CO3	analyze quantum states involving multiple qubits and evaluate the role of entanglement and error correction in quantum systems.	SDG 9	Industry, Innovation and Infrastructure	Knowledge of entanglement, quantum communication, and error correction contributes to the development of reliable and scalable quantum technologies for future industries.
CO4	implement simple quantum programs using Qiskit/IBM Quantum tools and explain the working of quantum communication protocols and algorithms.	SDG 3	Good Health & Well-Being	Quantum computing and quantum machine learning can support advancements in healthcare analytics, drug discovery, and intelligent medical systems.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE			
Class: B.Tech. V- Semester	Branch: Common to All branches		
Course Code:	U24IK506A	Credits:	2
Hours/Week (L-T-P-E):	2-0-0-2	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga CO2 : explain Vedas as principal source of knowledge for scientific inventions CO3 : describe different yogasanas, breathing techniques, chakras, meditation and their benefits CO4 : discuss the benefits of yoga as an effective tool for management of human crisis			
UNIT-I			6 Hrs
Basic Structure of Indian Knowledge System: Introduction, Vedas – origin, classification, structure, Rig Veda, Sama Veda, Yajur Veda, Atharva Veda, UpaVedas – DhanurVeda, SthapatVeda, GandharvaVeda, AyurVeda, Vedanga – Shiksha, Chanda, Vyakarna, Nirukta, Kalpa, Jyothisha, Upanga – Dharmashastra, Mimamsa, Tarkashastra, Purana			
UNIT-II			6 Hrs
Modern Science and Indian Knowledge System: Introduction, Vedas as basis for modern science, architectural developments, medicine and its relevance, mathematical sciences in Vedas, space and military related developments, chemical sciences			
UNIT-III			6 Hrs
Yoga and Holistic Health Care: Healthy mind in healthy body, yoga: definition, types, yoga to keep fit: diet, yoga asanas, fundamentals, breathing techniques in Patanjali yoga tradition, pranayama, chakras, meditation, benefits of yoga – physical health, emotional health, prevention of disease, reducing or alleviating symptoms of problems.			
UNIT-IV			6 Hrs
Case Studies – Yoga Practice: Yoga as an effective tool for management of human crisis – depression, self-concept & mental health, yoga for stress management, yoga: a way to cure for insomnia. Requisite: Yoga practice sessions are to be conducted for all students taking this course by the time they complete Unit 1 and Unit 2.			

Textbook(s):

1. Sathish Chandra Chatterjee, Dhirendramohan Datta, *An Introduction to Indian Philosophy*, New Delhi: Rupa Publications Pvt. Ltd. (Chapter 2, 3).
2. Priyadarshan Ray, S.N. Sen, *The Cultural Heritage of India*, Vol. 6, Science and Technology, Kolkata: The Ramakrishna Mission Institute of Culture.
3. *Yoga Sutra of Patanjali*, Kolkata: Ramakrishna Mission.
4. RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, New Delhi: Vidyanidhi Prakasham, 2016 (Chapter 4, 5, 6, 7, 8).

Reference Book(S):

1. Swami Jitatmananda, *Holistic Science and Vedanta*, Mumbai: Bharatiya Vidya Bhavan (Chapter 2, 3).

Web and Video link(s):

1. NPTEL courses on Indian Philosophy, Yoga and Vedic Sciences available at <https://onlinecourses.nptel.ac.in>

Course Articulation Matrix (CAM):				U24IK506A: ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE											
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	U24IK506A.1	-	-	-	-	-	1	-	2	1	1	-	-	-	-
CO2	U24IK506A.2	-	-	-	-	-	1	1	2	1	1	-	-	-	-
CO3	U24IK506A.3	-	-	-	-	-	1	-	2	2	1	-	2	-	-
CO4	U24IK506A.4	-	-	-	-	-	1	1	2	2	1	-	2	-	-
U24IK506A		-	-	-	-	-	1	1	2	1.5	1	-	2	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW															

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga	SDG4	Quality Education	Understanding the foundational structure of Indian knowledge systems supports holistic education, critical thinking, and cultural literacy, contributing to quality and inclusive education.
CO2	explain Vedas as principal source of knowledge for scientific inventions	SDG9	Industry, Innovation and Infrastructure	Recognizing Vedic contributions to science and technology highlights indigenous innovation in areas such as mathematics, architecture and medicine, inspiring modern sustainable technological development.
CO3	describe different yogasanas, breathing techniques, chakras, meditation and their benefits	SDG3	Good Health and Well-being	Knowledge of yoga, pranayama, and meditation directly promotes physical health, mental well-being, and disease prevention, supporting the SDG goal of ensuring healthy

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				lives for all.
CO4	discuss the benefits of yoga as an effective tool for management of human crisis	SDG3	Good Health and Well-being	Understanding yoga as a therapeutic tool for depression, stress, and insomnia contributes to mental health management and holistic wellness, aligning with SDG3 targets on mental health.

Technical English			
Class: B. Tech. V & VI- Semesters		Branch: Common to all Branches	
Course Code:	U24MH507	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	100
Total Number of Teaching Hours:	24 Hrs	ESE:	-
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation.			
CO2 : enhance communication and professional writing skills through podcast comprehension, group discussions, resume and email writing			
CO3 : develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports.			
CO4 : develop the ability to perform well in interviews and present effectively with clarity of speech and appropriate accent.			
Activity-1			2 hrs
Phonetic Foundations, Authentic Audio-Visual Comprehension & Vocabulary Enhancement: Speech Sounds- Phonemes (Vowels and consonant sounds), word stress, syllables - their role and importance in spoken English, Authentic Audio-Visual Comprehension: Movie Clips - Screening of a short native-speaker clip - context comprehension, focus attention on accent features and key expressions, Vocabulary: Word Formation- Prefixes-Suffixes. Activity: Practice pronunciation through Read-Record-Reflect, analyze audio-visual content for comprehension and expression usage.			
Activity - 2			2 hrs
Story Narration, Writing Skills and Vocabulary Enhancement- Narrative structure (beginning, build-up, climax, conclusion), Cohesive devices, Voice modulation & Expression. Writing: Principles of Paragraph Writing- Importance of Coherence in Writing- Cause and Effect Paragraphs. Vocabulary: Synonyms and antonyms. Activity: Narrate structured stories with peer interaction, Read-Record-Reflect storytelling activity for pronunciation and expression enhancement, Write a coherent cause and effect paragraph, Vocabulary practice exercises on synonyms and antonyms.			
Activity - 3			2 hrs
Reading Comprehension, Vocabulary Enhancement & Elocution Skills- Reading Comprehension: Main idea identification, interpretation, critical analysis. Vocabulary Enhancement: One-word substitutes. Elocution: Speech delivery skills (organisation, voice modulation, fluency, pronunciation, and audience engagement).			

Activity: Read and analyze passages for comprehension and critical interpretation, Read-Record-Reflect activity for improving reading fluency and pronunciation, Vocabulary exercises on one-word substitutes, and deliver a short speech with emphasis on clarity, confidence, and effective expression.	
Activity-4	2 hrs
Think-Pair-Share Conversation (Podcast-Based), Vocabulary Enhancement: Introduction to authentic spoken English through podcasts, listening for gist and specific information, and note-taking. Think-Pair-Share strategy, use of linking words and expressing agreement/ disagreement politely Vocabulary Enhancement: Idioms in context and usage Activity: Listen to podcasts for comprehension and note-making, Think-Pair-Share discussions to exchange ideas and respond confidently, Speak-Record-Reflect activity for improving speaking fluency, pronunciation, and expression	
Activity -5	2 hrs
Group Discussion, Vocabulary Enhancement: GD format and roles, rules of participation, Vocabulary – Word Pairs, commonly confused words Activity: Engage in group discussions focusing on clear expression and interaction and word pair exercises	
Activity -6	2 hrs
Reading Comprehension, Visual Interpretation & Vocabulary Enhancement: Skimming and scanning, identifying main and supporting ideas, distinguishing fact and opinion. Visual Interpretation: Interpreting visual cues, logical sequence. Vocabulary: Phrasal Verbs: separable and inseparable forms, and contextual usage. Activity: Engage in reading comprehension tasks for critical analysis, describe pictures , Speak-Record-Reflect activity for improving fluency, pronunciation, and expression, and phrasal verbs practice exercises	
Activity -7	2 hrs
Motivational Speeches, Presentation Skills & Vocabulary Enhancement: identifying central theme and tone, note-taking, Narrative techniques. Presentation – Speak to Inspire- topic selection, structure (introduction–body–conclusion), Vocabulary Enhancement – Collocations- Introduction to collocations, types of collocations, and contextual usage Activity: Listen to motivational speeches for comprehension and analysis, deliver a 3–5-minute inspirational presentation, Speak–Record–Replay activity for improving fluency, pronunciation, and expression, and collocations practice exercises	
Activity -8	2 hrs
Writing & Vocabulary Enhancement: Professional Resume Writing techniques, Action verbs in resume writing, Letter of Application, E-mail Etiquette – vocabulary: Jumbled sentences Activity: Prepare a professional resume using an appropriate format and action verbs, write a letter of application and formal e-mail following etiquette and jumbled sentence exercises	
Activity -9	2 hrs

Reading Comprehension, Newspaper Reading & Vocabulary Enhancement: Intensive reading , Extensive reading, Newspaper reading:5W1H method, Summarization, vocabulary building Activity: Reading comprehension exercises, Summarizing news content, discussion of current events, Speak-Record-Replay activity for improving fluency, pronunciation and expression. Vocabulary building through contextual usage from news articles	
Activity -10	2 hrs
PowerPoint Presentations: Concept and purpose of presentations, layout and structure (title, introduction-body-conclusion), slide design elements, visual aids, common mistakes to avoid Activity: Design and present a poster or PowerPoint presentation on a given topic, Speak-Record-Replay activity for improving fluency, pronunciation and expression, peer interaction and feedback sessions	
Activity-11	2 hrs
Essay Writing, Vocabulary Enhancement - Concept and Types of Essays, Essay structure (introduction-body-conclusion), paragraph coherence, clarity and objectivity, Sentence completion with correct word/Group alternative word/group Activity: Write essays on given topics focusing on structure, coherence, and clarity. Sentence completion practice exercises	
Activity-12	2 hrs
Mock Interview - Technical & HR: Introduction to mock interviews: Purpose and importance, types of interviews, interview etiquette, self-introduction, common HR questions, self-assessment Activity: Mock interview with appropriate dress code. Record and review own performance, Feedback session	
<u>Textbook(s):</u> 1. Arun Sharma & Meenakshi Upadhyay, “Verbal Ability and Reading Comprehension for CAT & Other Management Examinations”, 8th Edition, McGraw Hill Education (India) Private Ltd, Chennai, 2018 2. Meenashki Raman & Sangeethe Sharma, “Technical Communication: Principles and Practice, 3rd Edition, New Delhi; New York: Oxford University Press,2004	
<u>Reference Book(S):</u> 1. Nishit K. Sinha, “Verbal Ability and Reading Comprehension for the CAT”, 3rd Edition Pearson India Education Services Pvt. Ltd., Chennai 2. Harper Collins, “Collins COBUILD English Grammar” Third Edition, Harper Collins Publishers Ltd. 3. Jerald J. Alfred, Charles T. Brusaw and Walter E. Oliu,” Handbook for Technical Writing”12th Edition, Macmillan 4. R.S. Agarwal, “A modern Approach to Verbal and Non-Verbal Reasoning” Revised edition 2025 , Chand Publishing, India.	

1. <https://www.youtube.com/watch?v=5SfQhkMsUFk&list=PLA7INLNvxTzig5dqfGl8DGBLOvUI08yXg&index=2>
2. Learn English with WRECK-IT RALPH
<https://www.youtube.com/watch?v=wVhG59zh4uQ&list=PLA7INLNvxTzig5dqfGl8DGBLOvUI08yXg&index=4>
3. The Pursuit of Happiness (2006): Most Powerful Moments!
<https://www.youtube.com/watch?v=TkD1QvjKlqU>
4. **Podcast by Raul John** "Inside the Mind of India's AI Kid". Business Today
<https://www.youtube.com/watch?v=biCrIlhZrC4>
5. Podcast by Sudha Murthy - So What If I Lost the Battle, I Lived the War | The Ranveer Show
<https://www.youtube.com/watch?v=KwXtalUuhLc>
6. Motivational Talk by Gour Gopal Das, SLEEPLESS Nights for Overnight SUCCESS
https://www.youtube.com/watch?v=YyCXp_E4sMU
7. Motivational Talk by Admiral McRaven's Speech for Your Day, "5 Minutes to Start Your Day Right! - MORNING MOTIVATION"
<https://www.youtube.com/watch?v=b-Pn0yXL9y8>

Laboratory Manual (for laboratory component):

1. Technical English Manual prepared by the faculty of English, KITSW.

Course Articulation Matrix (CAM):				U24MH507: Technical English										
	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24MH507.1	-	-	-	-	-	-	-	-	2	-	2	1	1
CO2	U24MH507.2	-	-	-	-	-	-	-	2	2	-	2	1	1
CO3	U24MH507.3	-	-	-	-	-	-	-	-	2	-	2	1	1
CO4	U24MH507.4	-	-	-	-	-	-	-	2	2	-	2	1	1
	U24MH507	-	-	-	-	-	-	-	2	2	-	2	1	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO1	The student should be able to develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using	SDG 4	Quality Education	This aligns with SDG-4 as it develops effective listening, speaking, reading and writing skills that enable learners to understand native-speakers communication and communicate clearly and fluently with appropriate vocabulary and pronunciation to

	appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation.			promote quality education
CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO2	enhance communication and professional writing skills through podcast comprehension, group discussions, resume and Quality Education email writing	SDG 4, 8	Quality Education & Decent work and Economic growth	This aligns with SDG-4 as it promotes quality education by enhancing employability skills and professional writing skills through podcast comprehension, resume writing, critical reading and group discussion This aligns with SDG-8 as it helps students expect productive employment and decent work opportunities by fostering academic and creative thinking
CO3	develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports	SDG 4	Quality Education	This aligns with SDG-4 as it develops the ability to interpret visual information and produce clear and well-structured technical reports for academic and professional contexts
CO4	develop the ability to present effectively with clarity of speech and appropriate accent	SDG 4	Quality Education	This aligns with SDG-4 as it enhances effective presentation skills and perform well in interviews

MACHINE LEARNING LABORATORY			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS508	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : implement data preprocessing techniques and linear models including regression and perceptron using Python libraries for analyzing datasets CO2 : construct neural network models, backpropagation, radial basis function networks and apply dimensionality reduction techniques for improving model performance CO3 : utilize probabilistic classifiers, support vector machines and genetic algorithms for classification and optimization tasks CO4 : develop machine learning solutions using decision trees, ensemble methods and clustering techniques for solving real-world problems			
Experiment-1 (UNIT-I)			
1. Use python libraries NumPy and pandas to perform data handling operations such as indexing, slicing, aggregation and dataset manipulation. 2. Perform data preprocessing by handling missing values and applying normalization and encoding techniques on a given dataset.			
Experiment-2 (UNIT-I)			
1. Implement simple linear regression on a dataset to model relationships between variables and interpret feature correlation. 2. Implement multiple linear regression using multiple input variables and evaluate performance using error metrics such as mean squared error, root mean square error and r-squared or coefficient of determination.			
Experiment-3 (UNIT-I)			
1. Implement the perceptron algorithm for binary classification on a linearly separable dataset and visualize the decision boundary. 2. Compare perceptron with logistic regression by evaluating classification performance and separability of data.			
Experiment-4 (UNIT-II)			
1. Implement multi-layer perceptron using a neural network model and train it using backpropagation on a dataset. 2. Evaluate multilayer perceptron performance and analyze the effect of hidden layers and			

neurons on prediction accuracy.
Experiment-5 (UNIT-II)
1. Implement radial basis function (RBF) network for classification using kernel-based transformation of input features. 2. Compare RBF network with multilayer perceptron by analyzing accuracy and computational efficiency.
Experiment-6 (UNIT-II)
1. Implement principal component analysis (PCA) to reduce dimensionality of a dataset while preserving maximum variance. 2. Compare original and reduced datasets after PCA and analyze the impact on model performance.
Experiment-7 (UNIT-III)
1. Implement naive bayes classifier for probabilistic classification using prior and likelihood estimation. 2. Evaluate classifier performance using confusion matrix and analyze accuracy, precision and recall.
Experiment-8 (UNIT-III)
1. Implement support vector machine (SVM) with linear kernel to classify data by identifying optimal hyperplane. 2. Apply polynomial and RBF kernels in SVM and compare classification performance.
Experiment-9 (UNIT-III)
1. Implement genetic algorithm for solving an optimization problem using selection, crossover and mutation operations. 2. Analyze convergence behavior and evaluate solution quality over iterations.
Experiment-10 (UNIT-IV)
1. Implement decision tree algorithm for classification using splitting criteria such as gini index or entropy. 2. Evaluate model performance and analyze overfitting through tree structure.
Experiment-11 (UNIT-IV)
1. Implement ensemble techniques such as bagging and random forest by training multiple decision trees. 2. Compare ensemble methods with decision tree and analyze improvement in accuracy and variance reduction.
Experiment-12 (UNIT-IV)
1. Implement K-Means clustering algorithm to partition dataset into clusters based on

centroid distance.

- Determine optimal number of clusters using elbow method and analyze clustering patterns.

Textbook(s):

- Stephen Marsland, *Machine Learning: An Algorithmic Perspective*, Taylor & Francis, 2nd edition, 2015, New York. (Chapters 1 to 8, 10 to 14)

Reference Book(S):

- Tom M. Mitchell, *Machine Learning*, McGraw Hill Education, 1st Edition, 2013, New Delhi.
- Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, Cambridge University Press, 1st edition, 2012, New York.
- Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, John Wiley & Sons, 1st edition, 2014, New Jersey.
- Ethem Alpaydin, *—Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)*, MIT Press, 3rd Edition, 2014, Massachusetts.
- William W Hsieh, *Machine Learning Methods in the Environmental Sciences, Neural Networks*, Cambridge University Press, 1st edition, 2009, Cambridge.

Web and Video link(s):

[ps://onlinecourses.nptel.ac.in/noc26_cs74/preview](https://onlinecourses.nptel.ac.in/noc26_cs74/preview); NPTEL Video Lecture on Introduction to Machine Learning by Prof. Balaraman Ravindran, Professor of Computer Science, IIT Madras.

Laboratory Manual (for laboratory component):

- Machine Learning Laboratory Manual*, Department of CSE , KITSW

Course Articulation Matrix (CAM):				U24CS508 : MACHINE LEARNING LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS508.1	2	2	2	1	2	1	1	1	1	-	1	2	2
CO2	U24CS508.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24CS508.3	2	2	2	2	2	1	1	1	1	-	2	2	2
CO4	U24CS508.4	2	2	2	2	2	1	1	1	1	-	2	2	2
U24CS508		2.00	2.00	2.00	1.75	2.00	1.00	1.00	1.00	1.00	-	1.75	2.00	2.00
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Implement data preprocessing techniques and linear models using Python libraries	SDG3	Good Health and Well-being	Application of data preprocessing and regression models supports healthcare analytics such as disease prediction, early diagnosis, and medical data analysis systems.
CO2	Construct neural	SDG4	Quality	Development of neural

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
	network models and apply dimensionality reduction techniques		Education	network-based intelligent systems enables adaptive learning platforms, virtual labs, and personalized education systems.
CO3	Utilize probabilistic classifiers, SVM, and genetic algorithms for classification and optimization	SDG9	Industry, Innovation and Infrastructure	Implementation of advanced machine learning algorithms supports industrial automation, predictive systems, and innovation in data-driven infrastructure.
CO4	Develop machine learning solutions using decision trees, ensemble methods, and clustering techniques	SDG11	Sustainable Cities and Communities	Machine learning solutions enable smart city applications such as traffic prediction, surveillance systems, and urban planning using data-driven approaches.

FULL STACK DEVELOPMENT LABORATORY			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS509	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : Develop basic Node.js applications using packages, events, listeners, timers, and callbacks for server-side programming. CO2 : Develop programs using Node.js modules for JSON processing, file handling, streams, buffers, and HTTP/HTTPS client-server applications. CO3 : Design and implement MongoDB databases, collections, and integrate MongoDB with Node.js applications for data manipulation. CO4 : Develop full stack web applications using Express.js routing and Angular components, data binding, directives, and services.			
THEORY COMPONENT			
Experiment-1 (UNIT-I)			
1. Install Node.js and create a basic Node.js application. 2. Develop a program using npm packages. 3. Develop a program using console, process, and global objects.			
Experiment-2 (UNIT-I)			
4. Develop a program using EventEmitter. 5. Develop a program using listeners and custom events. 6. Develop a program using timers and callbacks.			
Experiment-3 (UNIT-I)			
7. Develop a program to demonstrate asynchronous programming. 8. Develop a program using callback functions for task execution. 9. Develop a simple event queue implementation.			
Experiment-4 (UNIT-II)			
10. Develop a program to work with JSON data. 11. Develop a program using Buffer module. 12. Develop a program using Stream module for reading and writing data.			
Experiment-5 (UNIT-II)			
13. Develop a Node.js program to read and write data using Readable and Writable Streams 14. Develop a Node.js program to copy a large file efficiently using Streams			

Experiment-6 (UNIT-II)
15. Develop an HTTP server using Node.js. 16. Develop an HTTP client using Node.js. 17. Develop a program to process URLs, query strings, and form parameters.
Experiment-7 (UNIT-III)
18. Develop an HTTPS server using Node.js. 19. Install and configure MongoDB environment.
Experiment-8 (UNIT-III)
20. Develop a MongoDB program to demonstrate various MongoDB data types and implement an appropriate data model for a real-world application 21. Create database, collections, and documents using MongoDB shell. 22. Perform CRUD operations in MongoDB.
Experiment-9 (UNIT-III)
23. Develop a Node.js program to connect MongoDB. 24. Develop a program for insert, update, delete, and find operations using MongoDB driver.
Experiment-10 (UNIT-IV)
25. Install Express.js and create a basic Express application. 26. Develop a program using routing in Express.js. 27. Develop a program using request and response objects.
Experiment-11 (UNIT-IV)
28. Install Angular CLI and create a basic Angular application. 29. Develop Angular components and expressions. 30. Develop programs using data binding techniques.
Experiment-12 (UNIT-IV)
31. Develop programs using built-in directives. 32. Develop programs using custom directives. 33. Develop a mini full stack application using Node.js, Express.js, MongoDB, and Angular.
<u>Textbook(s):</u>
Brad Dayley, Brendan Dayley, Caleb Dayley, <i>Node.js, MongoDB and Angular Web Development</i> , Addison-Wesley, 2nd Edition, 2019.
<u>Reference Book(S):</u>
1) Vasan Subramanian, <i>Pro MERN Stack</i> , Apress, 2nd Edition, 2019. 2) Chris Northwood, <i>The Full Stack Developer</i> , Apress, 1st Edition, 2018. 3) Kirupa Chinnathambi, <i>Learning React</i> , Addison-Wesley Professional, 2nd Edition,

2018.
Web and Video link(s):
1) No NPTEL Web or Video Links are available
2) Full Stack Mern Project with React, NodeJS, MongoDB, Express (from Udemy Academy)
Laboratory Manual (for laboratory component):
Full Stack Development Laboratory Manual, Department of CSE, KITSW

Course Articulation Matrix (CAM):				U24CS509: FULL STACK DEVELOPMENT LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS509.1	2	2	2	1	2	1	1	1	1	-	-	2	2
CO2	U24CS509.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24CS509.3	2	2	3	2	3	1	1	1	1	-	2	2	2
CO4	U24CS509.4	2	2	3	3	3	1	1	1	1	-	2	2	3
U24CS509		2	2	2.5	2	2.5	1	1	1	1	-	2	2	2.25
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Develop basic Node.js applications using packages, events, listeners, timers, and callbacks	SDG4, SDG8, SDG9	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure	Node.js programming improves employability, supports quality education, and enables scalable backend infrastructure development.
CO2	Develop programs using Node.js modules for data handling and HTTP services	SDG4, SDG8, SDG9	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure	Server-side application development strengthens technical skills for modern software industries and digital infrastructure.
CO3	Design and implement	SDG4,	Quality	Database design and NoSQL

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
	MongoDB databases integrated with Node.js	SDG8, SDG9	Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure	integration support scalable applications and innovation-driven industries.
CO4	Develop full stack applications using Express.js and Angular	SDG4, SDG8, SDG9	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure	Full stack development enables modern web application development and supports sustainable digital transformation.

SEMINAR			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS510	Credits:	1
Hours/Week (L-T-P-E):	0-0-2-2	CIE:	100%
Total Number of Teaching Hours:	-	ESE:	-
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines/ conference proceedings			
CO2: demonstrate the skills for performing a literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report			
CO3: create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic			
CO4: write a “seminar paper” in scientific journal style & format from the prepared seminar report			
<i>Student has to give an independent seminar on the state-of-the-art technical topics relevant to their program of study, which would supplement and complement the program assigned to each student.</i>			
Guidelines:			
1. The HoD shall constitute a Department Seminar Evaluation Committee (DSEC)			
2. DSEC shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format, and (iv)effective seminar presentation			
3. There shall be only Continuous Internal Evaluation (CIE) for seminar			
4. The CIE for seminar is as follows:			
Assessment		Weightage	
Seminar Supervisor Assessment		20%	
Seminar Report		30%	
SDG Alignment		10%	
DSEC Assessment: Oral presentation with PPT and viva-voce		40%	
Total Weightage:		100%	
Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation			
(a) Seminar Topic: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest.			
(b) Report: Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by DSEC.			
(c) Anti-Plagiarism Check: The seminar report should clear the plagiarism check as per the Anti-Plagiarism (including AI Plagiarism) policy of the institute.			
(d) Presentation: Each student should prepare a PPT with informative slides and make an effective oral presentation before the DSEC as per the schedule notified by the department.			

- (e) The student has to register for the Seminar as a supplementary examination in the following cases:
- The student is absent for oral presentation and viva-voce
 - The student fails to submit the report in prescribed format
 - The student fails to fulfill the requirements of seminar evaluation as per specified guidelines.
 - The CoE shall send a list of students registered for supplementary to the HoD concerned
 - The DSEC, duly constituted by the HoD, shall conduct seminar evaluation and send the award list to the CoE within the stipulated time

Course Articulation Matrix (CAM):			U24CS510: SEMINAR											
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS510.1	2	2	-	2	2	1	1	-	1	-	3	1	1
CO2	U24CS510.2	2	3	1	3	2	1	1	1	2	-	3	1	1
CO3	U24CS510.3	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	U24CS510.4	1	2	1	2	2	1	2	1	3	-	2	1	1
U24CS510		1.5	2	1	2	2	1.25	1.25	1.33	2.33	1	2.5	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines / conference proceedings	SDG 4	Quality Education	Identifying and studying emerging ECE technologies such as 6G communications, VLSI, IoT, Artificial Intelligence, Embedded Systems, and Signal Processing promotes self-directed learning, technical competency, and continuous knowledge acquisition.
CO2	demonstrate the skills for performing literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report	SDG 9	Industry, Innovation and Infrastructure	Literature review and technical analysis of advanced communication systems, semiconductor technologies, smart electronics, and intelligent networks foster innovation, research culture, and technological infrastructure development.
CO3	create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic	SDG 11	Sustainable Cities and Communities	Seminar presentations on smart cities, intelligent transportation systems, IoT-enabled urban services, disaster management systems, and smart communication networks highlight the role of ECE technologies in building sustainable and connected communities.
CO4	write a "seminar paper" in scientific journal style & format from the prepared seminar report	SDG 12	Responsible Consumption and Production	Preparation of technical papers promotes ethical dissemination of research findings, proper citation practices, responsible use of information resources, and documentation of sustainable engineering solutions.

VI SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	
1	OC	U24OE601X-MB	OE-Management Basket	2	1	-	3	3
2	PEC	U24CS602	Program Elective -I / MOOCs-I	2	1	-	3	3
3	PCC	U24CS603	Deep Learning	2	1	-	3	3
4	PCC	U24CS604	Compiler Design	2	1		3	3
5	PCC	U24CS605	Internet of Things	2	1		3	3
6	PCC	U24CS606	Cryptography & Network Security	2	1	-	3	3
7	SEC	U24SE607	Compiler Design Laboratory	-	-	2	2	1
8	PCC	U24CS608	Internet of Things Laboratory	-	-	2	2	1
9	PCC	U24CS609	Programming Skill Development Lab - 3	-	-	2	2	1
10	ELC	U24CS610	Mini Project	-	-	2	2	1
Total:				12	6	8	26	22
Additional Learning [@] : Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	27

Pool -XVII Management Courses Basket (OE-MB)		
S. No.	Course Code	Course Title
1.	U24OE601A-MB	Management Economics and Accountancy
2.	U24OE601B-MB	Engineering Finance
3.	U24OE601C-MB	Organizational Behavior
4.	U24OE601D-MB	E-Commerce and Digital Marketing
5.	U24OE601Z-MB	Any other course approved by BoS Chair and Dean AA

MANAGEMENT ECONOMICS AND ACCOUNTANCY			
Class: B. Tech. VI – Semester		Branch: Common To All	
Course Code:	U24OE601A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : comprehend the basic concepts of management, functions of management			
CO2 : distinguish between micro & macroeconomics & forms of business organizations			
CO3 : pass journal entries & post them into ledgers, prepare profit & loss accounts and assesses the financial position through the balance sheet			
CO4 : evaluate financial statements with a the help of various ratios and reveal the financial health of the organization			
UNIT-I			9 Hrs
Introduction to Management: Concept of Management, Features of Management, Importance of Management, Nature and Scope of Management, Fayol’s Administrative Management, Taylor’s Scientific Management			
Functions of Management: Planning- Concept of Planning, Nature of Planning, Importance of Planning, Planning Process, Types of Planning; Organizing-Concept of Organizing, Organization Structure- line and staff, Advantages of Organizing; Staffing - Meaning, Functions of Human Resources Management; Directing- Elements of Directing- Supervision; Leadership- Nature; Motivation - Nature, Types; Communication- Process, Types, Barriers to effective communication; Co-ordination- Definition, Steps to achieve effective coordination; Controlling- Definition, Process			
UNIT-II			9 Hrs
Economics: Meaning and definition, Scope, Micro and Macro Economics, Methods of Economics			
Forms of Business Organization: Sole Proprietor ship, Partnership firm - Types of Partners, Limited Liability Partnership (LLP), Joint Stock Company - Features, Types, Merits and demerits, Cooperative society			
UNIT-III			9 Hrs
Introduction to Financial Accounting: Accounting concepts and conventions, Double Entry System and Book Keeping, Overview of accounting cycle, Journal-meaning, Journalizing, Ledger - Meaning, Ledger posting, Balancing; Cash book (Single column), Preparation of Trial balance			
Final Accounts: Trading Account, profit and loss account and Balance Sheet with simple adjustments			

UNIT-IV	9 Hrs
Financial Statement Analysis: Introduction to Financial Statement Analysis, Ratio Analysis, Introduction, Types of Ratios, Analysis and Interpretation of Liquidity Ratios, Profitability ratios, Activity Ratios, and Capital structure Ratios (simple problems)	
<u>Textbook(s):</u>	
1. L.M.Prasad, <i>Principles and Practices of Management</i> , Sultan Chand & Sons Educational Publishers, 11 th edition.2025, New Delhi. (Part -I to Part-VI) 2. D. N. Dwivedi, <i>Engineering Economics: Text & Cases</i> , Vikas Publishing, 5th edition, 2014. (Chapter-3) 3. R. Narayana Swamy, <i>Financial Accounting – A Managerial Perspective</i> , Prentice Hall of India, 7 th edition, 2023,new Delhi.(Chapter VI)	
<u>Reference Book(S):</u>	
1. Harold Koontz and Heinz Weihrich, <i>Essentials of Management</i> , 6th ed. New Delhi: Tata Mc Graw Hill Publications, 2015. 2. Maheshwari, S. N., & Maheshwari, S. K. (2024). <i>Financial Accounting</i> (7th ed.). Vikas Publishing House Pvt. Ltd, 2024.	
<u>Web and Video link(s):</u>	
https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg52 https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ec10	

Course Articulation Matrix (CAM):														
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE601A-MB	-	3	3	2	-	2	2	3	3	3	3	1	1
CO2	U24MB601A-MB	-	2	2	-	-	2	3	3	3	3	3	1	1
CO3	U24MB601A-MB	-	1	2	1	-	2	3	2	3	3	3	1	1
CO4	U24MB601A-MB	-	2	2	2	-	1	2	-	3	2	3	1	1
		-	2	2.25	1.67	-	1.75	2.5	2.67	3	2.75	3	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

ENGINEERING FINANCE			
Class: B.Tech. VI		Branch: Common to All	
Course Code:	U24OE601B-MB	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.			
CO2: apply capital budgeting techniques including inflation adjusted Net Present Value/Internal Rate Return for project evaluation and selection.			
CO3: analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects.			
CO4: evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.			
UNIT-I			9 Hrs
Fundamentals of Engineering Finance			
Engineering Finance - Meaning, Definition, and Scope; Role of Finance in Engineering - Importance for engineers in decision making and cost control; Ethics in Engineering Finance - Transparency, Cost estimation honesty, Avoidance of financial conflicts of interest; Financial Management - Meaning, Functions, Objectives (profit maximization v/s. wealth maximization), Sources of Finance, Time value of Money			
UNIT-II			9 Hrs
Investment Decisions			
Investment Decisions- Types of Investment projects, Investment evaluation criteria; Methods of capital budgeting - Discounted cash flow techniques v/s. non discounted cash flow techniques, Inflation adjusted NPV and IRR, Comparison and selection of mutually exclusive engineering projects			
UNIT-III			9 Hrs
Cost-Volume-Profit Analysis			
Cost concepts- Fixed, Variable, Marginal, Sunk, Opportunity costs, Direct and Indirect costs; Breakeven analysis - Meaning, Assumptions, Graphical and Mathematical determination of breakeven point; Make or buy decisions using breakeven analysis; Application of breakeven analysis in engineering projects			
UNIT-IV			9 Hrs
Replacement Decisions and Valuation of engineering assets			
Replacement analysis - Meaning, Need, Defender v/s. Challenger concept; Economic service life; Valuation of equipment's and physical assets - Depreciation definition, Depreciation fund; Methods of depreciation - straight line, Declining balance, Sum of the years-digits, Sinking fund and Service output method, Application of depreciation methods on equipment's and physical asset with the passage of time.			
Textbook(s):			
1. M YKhan and P K Jain, <i>Financial Management</i> , Tata McGraw Hill 5 th edition, ISBN:978-0-07-065614-7 (<i>Unit-I in part 1 of section 1,2&3 and Unit-II in part 3 of 9&10</i>).			

2. R. Panneerselvam, *Engineering Economics*, PHI Learning 2nd edition, ISBN:978-81-203-4837-0 (Unit-III in Chapter 1&16 and Unit-IV in Chapter 8& 9).

Reference Book(S):

1. F.K. Crundwell, *Finance for Engineers: Evaluation and Funding of Capital Projects*, Springer London Ltd, Atlantic Publishers and Distributors (P) Ltd., ISBN: 978-1849967082, 2010.
2. Robert L. Kosowski, Salih N. Neftci, *Principles of financial engineering*, Academic press, Atlantic Publishers and Distributors (P) Ltd. 3rd edition, ISBN: 978-0123869685, 2014.
3. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th edition, ISBN: 9788126510887, 2014.
4. Prasanna Chandhra, *Financial Management: Theory and Practice*, Tata Mc Graw Hill Education (India) private limited, ISBN-10: 93-392-1225-8, 2015.
5. Chan S. Park, *Fundamentals of Engineering Economics*, Pearson Education. 3rd edition, ISBN: 978-9352864379, 2017.
6. Chatterjee Partha Sheikh Salim, *Engineering Economy & Financial Management*, Himalaya Publishing House, ISBN:978-9350247389, 2011.

Course Articulation Matrix (CAM):

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	U24OE601B-MB	2	-	-	-	-	-	2	-	-	2	2	1	1
CO2	U24OE601B-MB	-	3	-	-	2	-	-	-	-	-	3	1	1
CO3	U24OE601B-MB	-	-	2	-	-	-	-	2	-	2	-	1	1
CO4	U24OE601B-MB	-	-	2	2		2	-	-	-	2	2	1	1
U24OE601B-MB		2	3	2	2	2	2	-	2	-	2	2.3	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix

CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.	SDG 4 And SDG 16	Quality Education and Peace, Justice and Strong Institutions	Promotes financial literacy, ethical decision-making, and professional responsibility essential for quality education and transparent institutional practices.
CO2	Apply capital budgeting techniques including inflation adjusted NPV/IRR for project evaluation and selection.	SDG 8 And SDG 9	Decent Work and Economic Growth And Industry, Innovation and Infrastructure	Supports economically viable investment decisions, efficient resource allocation, industrial growth, and sustainable infrastructure development.
CO3	Analyse various cost concepts and determine breakeven point for make or buy decisions in	SDG 9 And SDG 12	Industry, Innovation and Infrastructure and	Encourages cost efficiency, optimized production planning, and responsible utilization of resources

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	engineering projects.		Responsible Consumption and Production	in engineering and industrial projects
CO4	Evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.	SDG 8 And SDG 12	Decent Work and Economic Growth and Responsible Consumption and Production	Promotes sustainable asset management, economic efficiency, lifecycle optimization, and responsible use of engineering resources.

ORGANIZATIONAL BEHAVIOUR			
Class: B. Tech. VI – Semester		Branch: Common to All	
Course Code:	U24OE601C	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	40%
Total Number of Teaching Hours:	36 Hrs	ESE:	60%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: evaluate the fundamentals, importance, influencing factors, and communication processes of Organizational Behaviour.			
CO2: analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation.			
CO3: examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings.			
CO4: evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour.			
UNIT-I			9 Hrs
Introduction: Foundations of organizational behavior, Concept, Importance, Factors influencing organizational behavior, Challenges and opportunities for organization behavior; Managerial perspective of OB; Communication-Process-channels-communication barriers , Measures to overcome barriers			
UNIT-II			9 Hrs
Individual Behavior: Individual in the organization, Nature of man, Models of man, Personality-Stages of development of personality; Perception-Factors influencing perception; Learning-Theories of Learning-Cognitive Learning Theory, Behaviourist Learning Theory; Attitudes-Formation of attitudes; Personality and emotions, Managing emotions and stress in organizations; Motivation- Motivation theories-Maslow's Needs Hierarchy Theory and Herzberg's Two-Factor Theory			
UNIT-III			9 Hrs
Group decision making: Groups in organization, Basic group concepts, Groups vs. Teams, Understanding work teams-Types of teams, Creating effective teams; Conflicts-Types of conflicts, Strategies for resolution of conflicts in groups Group dynamics: Group dynamics, Leadership-Leadership types and managerial effectiveness, Trust and leadership, Power and politics, Basis of power, Organizational politics			
UNIT-IV			9 Hrs
Organization structure: Organization structure, Size and design; Organizational culture; Organizational change-Resistance to change; Organizational stress- Factors			

contribute to stress, Coping strategies, Stress and performance; Organizational effectiveness-concepts; Quality of work life-concepts; International organizational behavior-concepts

Textbook(s):

4. Stephen P. Robbins, Timothy A. Judge & Neharika Vohra, *Organizational Behavior*, Pearson India, 18th edition, 2022, New Delhi. (Chapter I to IV)
5. K. Aswathappa, *Organizational Behaviour*, Himalaya Publishing House, 14th edition, 2021, Mumbai. (Chapter I to IV)

Reference Book(S):

1. Fred Luthans, *Organizational Behavior*, McGraw Hill Education, 13th edition, 2020, New York.
2. Uma Sekaran, *Organizational Behavior: Text and Cases*, McGraw Hill Education, 2nd edition, 2019, New Delhi.
3. S. S. Khanka, *Organizational Behavior*, S. Chand Publishing, 11th edition, 2021, New Delhi.

Web and Video link(s):

1. Harvard Business Review – Organizational Behavior Articles and Videos; Web resources and expert videos on leadership, teamwork, communication, conflict management, and organizational effectiveness.

Course Articulation Matrix (CAM):				U24OE601C-MB ORGANIZATIONAL BEHAVIOUR										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE601C.1	2	-	-	-	-	-	-	2	2	-	-	1	1
CO2	U24OE601C.2	-	3	-	-	-	-	2	--	-	-	3	1	1
CO3	U24OE601C.3	-	2	-	-	-	-	-	2	2	2	-	1	1
CO4	U24OE601C.4	-	-	2	-	-	2	-	-	-	2	2	1	1
		2	2.5	2	-	-	2	2	2	2	2	2.5	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

E-COMMERCE & DIGITAL MARKETING			
Class: B. Tech. VI – Semester		Branch: Common to All	
Course Code: U24OE601D-MB	U24OE601D	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : interpret the concepts, scope, types, functions, framework, opportunities, and limitations of E-Commerce, and analyse its role in modern business and electronic transactions			
CO2 : analyze e-payment systems, e-finance operations, e-banking, e-trading, and the legal framework governing e-commerce transactions			
CO3 : evaluate digital marketing practices, emerging trends, and consumer behaviour in the online environment			
CO4 : determine digital marketing channels and design effective online marketing plans			
UNIT-I			9 Hrs
Introduction to E-Commerce: E-Commerce – Introduction, Definition, Scope, Evolution, Internet Commerce vs E-Commerce; Electronic Commerce Market; E-Commerce Industry Framework; Trade Cycle in E-Commerce; Electronic Data Interchange (EDI); E-Commerce Functions; Types of E-Commerce – B2B, B2C, C2C, C2B, B2G, G2B, and G2C; Forces fuelling E-Commerce – Differences between Traditional Commerce and E-Commerce; Limitations of E-Commerce; Introduction to Artificial Intelligence (AI) in E-Commerce			
UNIT-II			9 Hrs
E-payment Systems: Digital payment Requirements; Types of E-Payment Systems - Digital Token-based E-payment systems, Credit card as E-payment system, Mobile payments, smart card cash payment system, Micropayment system, E-Security, E- Cash; E-Finance: Areas of Financing; E-Banking - Traditional Banking Vs. E-Banking; Operations in E-Banking; E-Trading – Stock Market trading; Importance and advantages of E-Trading Legal Framework for E-Commerce: E-Commerce Legal Framework - The Information Technology Act 2000, Information Technology (Amendment) Act, 2008, Copyrights, Defamation, Privacy, Contracts, Taxation, Signing a contract Electronically, Domain name and Registration			
UNIT-III			9 Hrs
Digital Marketing: Concept, Components of Digital Marketing, Need and Scope of Digital Marketing, Benefits of Digital Marketing, Digital Marketing Platforms and Strategies, Comparison of Marketing and Digital Marketing, Digital Marketing Trends, Marketing in the Digital Era: Segmentation – Importance of Audience Segmentation, different segments used in Digital Media – Organizational characteristics, purchasing characteristics, using Digital Media to Reach, acquisition and retention of new customers, Digital Media for Customer Loyalty			

UNIT-IV	9 Hrs
Channels of Digital Marketing: Digital Marketing, Website Marketing, Search Engine Marketing, Search Engine optimization, Online Advertising, Email Marketing-Campaign Design, Automation, Personalization, Blog Marketing-Content Creation, Blogging Platforms, Social Media Marketing-Marketing through Facebook, Instagram, LinkedIn, X (Twitter), and youtube, Audio, Video and Interactive Marketing, Mobile Marketing; Digital Marketing Plan: Need for Digital Marketing Plan, Elements of Digital Marketing Plan, Writing the Marketing Plan and Implementation	
Textbook(s): 1. C. S. V. Murthy- <i>E-Commerce: Concepts, Models & Strategies</i>, Himalaya Publishing House 2nd Edition (2025). 2. Seema Gupta – <i>Digital Marketing</i>, <u>McGraw-Hill</u> 3rd Edition, 2022/2023. 3. Tracy L. Tuten & Michael R. Solomon – <i>Social Media Marketing</i>, SAGE Publication, 5th Edition, 2023.	
Reference Book(S): 1. Matthew Reynolds – <i>Beginning E-Commerce with Visual Basic, ASP, SQL Server 7.0 & MTS</i>, published by <u>Wrox Publisher</u>. 2. P. T. Joseph, S.J. <i>E-Commerce: An Indian Perspective, Latest Edition: 7th Edition</i> (2023) Publisher: PHI Learning Pvt. Ltd. 3. Michael Miller – <i>B2B Digital Marketing: Using the Web to Market Directly to Businesses</i> 1st Edition (2012; Indian reprint 2014/2015) Pearson India / Que Publishing.	
Web and Video link(s): 1. https://youtu.be/qnBhOVH1QQ8?si=6UtzpR5d6t8Rk5da Digital Marketing Full Course 2026 In 24 Hrs Digital Marketing Tutorial For Beginners 2. https://youtu.be/qsO_YCjgBFI?si=zVdKwrU8l6eEr4wg	

Course Articulation Matrix (CAM):				E-COMMERCE & DIGITAL MARKETING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE601D	2	2	1	-	2	1	-	-	1	-	2	1	1
CO2	U24OE601D	2	2	1	1	2	2	1	-	1	1	1	1	1
CO3	U24OE601D	2	2	2	1	2	1	1	1	2	1	2	1	1
CO4	U24OE601D	2	2	2	2	2	1	1	2	2	2	2	1	1
		2	2	1.5	1.3	2	1.25	1	1.5	1.5	1.3	1.75	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

COMPUTER VISION AND IMAGE PROCESSING			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS602A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : make use of sampling, quantization, and basic relationships between pixels during preprocessing stages of computer vision CO2 : apply spatial domain filters, image restoration and reconstruction techniques for input digital images for image smoothing and sharpening CO3 : analyse the efficiency of morphological and segmentation techniques in extracting image components and identifying segments CO4 : apply feature extraction and classification techniques to identify the object present in an input image			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction: What is digital image processing, Examples of fields that use digital image processing, Fundamental steps in digital image processing Digital Image Fundamentals: Elements of visual perception, Light and the electromagnetic spectrum, Image sensing and acquisition, Image sampling and quantization, some basic relationships between pixels, Introduction to the mathematical tools used in digital image processing			
UNIT-II			9 Hrs
Intensity Transformations & Spatial Filtering: The basics of intensity transformations and spatial filtering, Basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods Image Restoration and Reconstruction: A model of the image degradation/restoration process, Noise models, Restoration in the presence of noise only-spatial filtering, Periodic noise reduction using frequency domain filtering			
UNIT-III			9 Hrs
Morphological Image Processing: Preliminaries, Erosion and dilation, Opening and closing, Hit-or-miss transformation, Some basic morphological algorithms Image Segmentation: Fundamentals, Point, Line and edge detection, Thresholding, Segmentation by region growing and by region splitting and merging, Region segmentation using clustering and superpixels, Segmentation using morphological watersheds			
UNIT-IV			9 Hrs

Feature Extraction: Background, Boundary preprocessing, Boundary feature descriptors, Region feature descriptors, Principal components as feature descriptors.

Image Pattern Classification: Background, Patterns and pattern classes, Pattern classification by prototype matching, Optimum (Bayes) statistical classifiers, Neural networks and Deep Learning, Deep convolution neural networks.

Textbook(s):

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Pearson, 4th edition, 2018, New York. (Chapters 1 to 3, 9 to 12)

Reference Book(S):

1. Anil K. Jain, *Fundamentals of Image Processing*, Pearson, 1st edition, 2015, Chennai.
2. B. Chanda, D. Dutta Majumder, *Digital Image Processing and Analysis*, Prentice Hall of India, 2nd edition, 2011, New Delhi.
3. S. Sridhar, *Digital Image Processing*, Oxford University Press, 2nd edition, 2016, Noida.
4. Munesh C. Trivedi, *Digital Image Processing*, Khanna Book Publishing, 1st edition, 2014, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_ee116/preview; NPTEL Video Lecture on Dital Image Processing by Prof. Prabir Kumar Biaswas, Professor of EEE, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CS602A: COMPUTER VISION AND IMAGE PROCESSING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS602A.1	2	2	2	2	2	1	1	-	1	1	1	2	2
CO2	U24CS602A.2	2	2	2	2	2	-	-	-	-	-	1	2	2
CO3	U24CS602A.3	2	2	3	3	2	-	-	-	-	-	1	2	2
CO4	U24CS602A.4	2	2	3	3	2	1	1	-	1	1	1	2	2
U24CS602A		2	2	2.5	2.5	2	1	1	-	1	1	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	make use of sampling, quantization, and basic relationships between pixels during preprocessing stages of computer vision	SDG3	Good Health and Well-being	Image pre-processing enhances medical images (MRI, CT, X-ray) by reducing noise and improving contrast, enabling accurate diagnosis and early disease detection.
CO2	Apply spatial domain filters, image restoration and reconstruction techniques for input digital images for image smoothing and	SDG9	Industry, Innovation and Infrastructure	Spatial filtering and restoration techniques improve image quality in industrial and satellite imaging systems, supporting reliable infrastructure monitoring and innovation.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	sharpening			
CO3	Analyse the efficiency of morphological and segmentation techniques in extracting image components and identifying segments	SDG11	Sustainable Cities and Communities	Image segmentation and morphological analysis enable applications like traffic analysis, surveillance, and urban monitoring, contributing to safer and smarter cities.
CO4	Apply feature extraction and classification techniques to identify the object present in an input image	SDG9	Industry, Innovation and Infrastructure	Feature extraction and classification form the backbone of AI-driven systems such as autonomous vehicles, industrial automation, and smart analytics, fostering technological innovation.

DATA MINING			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS602B	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: design multi dimensional models & preprocessing strategies for data warehouses applications			
CO2: apply frequent pattern mining techniques on data sets for association rules extraction			
CO3: analyze efficiency of classification algorithms			
CO4: evaluate clustering techniques and design data mining applications on web & financial domains			
THEORY COMPONENT			
UNIT-I			9 Hrs
Data Warehouse: Basic concepts, Multitier architecture, Data warehouse models, ETL tools, Metadata repository			
Multidimensional Data Modeling: Data cube, Star, Snowflake and Fact constellation schemas, Dimensions, Measures, OLAP operations, Star net query model			
Data Warehouse Implementation: Efficient data cube computation, Indexing OLAP, Efficient processing of OLAP queries, OLAP servers			
Data Preprocessing: Data cleaning, Integration, Reduction and Transformation			
UNIT-II			9 Hrs
Data Mining: Introduction, Types of data and patterns can be mined, Technologies Used, Applications Targeted, Major issues in data mining			
Association Rule Mining: Basic concepts, Apriori algorithm, Generating association rules from frequent item sets, Improvements of Apriori algorithm, Patten-Growth approach, Mining frequent Item sets using vertical data format, Mining closed frequent item sets, Correlation analysis, Patten mining in multilevel and multidimensional space, Constraint based frequent pattern mining			
UNIT-III			9 Hrs
Classification: Basic Concepts, Classification by decision tree induction, Bayesian classification, Rule based classification, Model evaluation and Selection			
Advanced Classification: Classification by back propagation, Associative classification, K Nearest Neighbor classifiers, Rough set and Fuzzy set approaches			
UNIT-IV			9 Hrs
Cluster Analysis: Introduction, Types of data in cluster analysis, Partitioning methods by K- Means and K- Medoids, Agglomerative versus Divisive hierarchical clustering, BIRCH Multiphase hierarchical clustering, Density based method with DBSCAN algorithm, Grid based method with STING, Evaluation of clusters, Outlier Analysis and detection methods			
Data Mining Trends: Mining sequence data, Web data mining, Data mining applications with Finance data analysis, Retail industry and Recommender systems			

Textbook(s):

1. Jiawei Han, Micheline Kamber, *Data Mining Concepts and Techniques*, 3rd ed., Singapore: Morgan Kaufmann Publishers, 2016.

Reference Book(S):

1. Sam Anahory, Dennis Murray, *Data warehousing in the real world*, New Delhi: Pearson Education, 2003.
2. C.S.R.Prabhu, *Data Warehousing Concepts, Techniques, Products and Applications*, 2nd ed. New Delhi: Prentice-Hall of India, 2002.
3. Arun K.Pujari, *Data Mining Techniques*, 2nd ed. Hyderabad: Universities press, 2010

Web and Video link(s):

<https://nptel.ac.in/courses/106105174>; NPTEL Course on Data Mining by Prof. Pabitra Mitra, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CS602B- DATA MINING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	U24CS602B.1	1	2	2	2	1	-	-	-	-	1	1	1	2	1	2
CO2	U24CS602B.2	1	2	2	2	-	-	-	-	-	1	-	1	2	1	2
CO3	U24CS602B.3	1	2	2	2	1	-	-	-	1	1	-	1	2	1	2
CO4	U24CS602B.4	1	2	2	2	-	-	-	-	1	1	-	1	2	1	2
U24CS602B		1	2	2	2	1	-	-	-	1	1	1	1	2	1	2
3 - HIGH, 2 - MEDIUM, 1 - LOW																

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design multi dimensional models & preprocessing strategies for data warehouses applications	SDG3	Good Health and Well-being	Data warehousing and preprocessing techniques help organize large-scale healthcare data such as patient records, disease trends, and medical analytics. Efficient storage and preprocessing support accurate diagnosis, health monitoring, and better decision-making in healthcare systems, thereby contributing to improved well-being.
CO2	apply frequent pattern mining techniques on data sets for association rules extraction	SDG4	Quality Education	Frequent pattern mining enables discovery of useful learning patterns from educational datasets such as student performance, attendance, and learning behavior. These insights can improve teaching strategies,

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				personalize learning, and enhance educational quality, supporting inclusive and effective education.
CO3	analyze efficiency of classification algorithms	SDG9	Industry, Innovation and Infrastructure	Classification algorithms are widely used in intelligent automation, predictive maintenance, fraud detection, and industrial analytics. Analyzing algorithm efficiency improves innovation in data-driven systems and strengthens smart infrastructure and technological development in industries.
CO4	evaluate clustering techniques and design data mining applications on web & financial domains	SDG11	Sustainable Cities and Communities	Clustering techniques can analyze urban traffic patterns, financial inclusion trends, customer segmentation, and web usage behaviors. Such analysis helps in smart city planning, efficient resource allocation, digital services improvement, and sustainable community development.

DevOps Engineering			
Class: B.Tech. VI –Semester		Branch: CSE	
Course Code:	U24CS602C	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to, (based on cognitive skills acquired from theory component)</i>			
CO1 : explain DevOps principles, Agile practices, and continuous delivery models			
CO2 : analyze software architectures and apply DevOps lifecycle for scalable applications			
CO3 : apply version control systems and project management tools in collaborative environments			
CO4 : implement continuous integration, testing, and automated deployment using DevOps tools			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction: Introduction to DevOps and its evolution, Agile development model and principles, DevOps vs ITIL, DevOps lifecycle and continuous delivery, Release management concepts, Scrum and Kanban methodologies, Continuous delivery pipeline, Identifying bottlenecks in software delivery			
UNIT-II			9 Hrs
Software Development Models and Architecture in DevOps: Software development models in DevOps, DevOps lifecycle for business agility, Continuous testing in DevOps, Software architecture fundamentals, Monolithic vs Microservices architecture, Separation of concerns, Database migration strategies, Microservices and data management, Resilience in DevOps architecture			
UNIT-III			9 Hrs
Project Management and Source Code Control: Importance of source code management, Evolution of version control systems, Roles and collaboration in DevOps teams, Git fundamentals and workflows, Hosted Git servers and implementations, Pull request model, Tools: GitLab, Gerrit			
UNIT-IV			9 Hrs
Continuous Integration: Build systems and dependency management, Jenkins build server and plugins, Build pipelines and job chaining, Infrastructure as Code (IaC), Build automation and phases			
Deployment and Testing in DevOps: Types of testing (unit, integration, system), Test automation: advantages and limitations, Selenium: features and usage, JavaScript testing and backend testing, Test-driven development (TDD), Deployment strategies and systems, Virtualization and containerization concepts			

Textbook(s):														
1. Joakim Verona., Practical DevOps, Packt Publishing, 2016. (All units)														
Reference Book(S):														
1. I. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications.														
2. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley.														
Web and Video link(s):														
https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/cicd-devops-automation-and-devsecops-automation/?v=13b5bfe96f3e NPTEL Video Lecture on CICD - DevOps Automation and DevSecOps - Automation.														

Course Articulation Matrix (CAM):				U24CS602C : DevOps Engineering										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS602C.1	3	2	1	2	2	1	-	-	1	2	1	2	3
CO2	U24CS602C.2	3	3	2	3	2	1	-	-	1	2	1	2	2
CO3	U24CS602C.3	2	2	3	2	3	1	-	-	2	2	2	2	2
CO4	U24CS602C.4	2	3	3	3	3	1	-	-	2	2	2	2	2
U24CS602C		2.5	2.5	2.25	2.5	2.5	1	-	-	1.5	2	1.5	2	2.25
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	explain DevOps principles, Agile practices, and continuous delivery models	SDG4	Quality Education	Understanding DevOps and Agile methodologies promotes modern software engineering knowledge and industry-relevant skills, supporting lifelong learning and quality technical education.
CO2	analyze software architectures and apply DevOps lifecycle for scalable applications	SDG9	Industry, Innovation and Infrastructure	DevOps lifecycle and scalable architectures (microservices, resilience) enable robust, efficient, and innovative software systems used in modern industries and digital infrastructure.
CO3	apply version control systems and project management tools in collaborative environments	SDG8	Decent Work and Economic Growth	Collaboration tools like Git and Agile practices enhance teamwork, productivity, and employability, contributing to efficient workplaces and economic growth in the IT sector.
CO4	implement continuous integration, testing, and automated deployment using DevOps tools	SDG12	Responsible Consumption and Production	Automation, CI/CD, and efficient deployment pipelines reduce resource wastage, optimize system usage, and promote sustainable and efficient software development practices.

ETHICAL HACKING			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS602D	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : alyze security vulnerabilities, security models and phases of penetration testing frameworks CO2 : alyze various cyber attacks and security threats in business and network environments CO3 : apply reconnaissance, enumeration and exploitation techniques using ethical hacking tools CO4 : evaluate penetration testing results and recommend suitable mitigation and defense mechanisms			
UNIT-I			9 Hrs
Introduction: Hacking impacts, The hacker-Type of hacker, Script kiddies Framework: Planning the test, Sound operations, Reconnaissance, Enumeration, Vulnerability analysis, Exploitation, Final analysis, Deliverable, Integration Information Security Models: Computer security, Network security, Service security, Application security, Security architecture Information Security Program: The process of information security, Component parts of information security programs, Risk analysis and ethical hacking			
UNIT-II			9 Hrs
The Business Perspective: Business objectives, Security policy, Previous test results, Business challenges Planning for a Controlled Attack: Inherent limitations, Imposed limitations, Timing is everything, Attack type, Source point, Required knowledge, Multi-phased attacks, Teaming and attack structure, Engagement planner, The right security consultant, The tester, logistics, Intermediates, Law enforcement			
UNIT-III			9 Hrs
Reconnaissance: Social engineering, Physical security, Internet reconnaissance Preparing for a Hack: Technical preparation, Managing the engagement Enumeration: Enumeration techniques, Soft objective, Looking around or attack, Elements of enumeration, Preparing for the next phase Exploitation: Intuitive testing, Evasion, Threads and groups, Operating systems, Password crackers, Rootkits, Applications, Wardialing, Network, Services and areas of concern			
UNIT-IV			9 Hrs
Deliverable: The deliverable, The document, Overall structure, Aligning findings, Presentation Integration: Integrating the results, Integration summary, Mitigation, Defense planning,			

Incident management, Security policy, Conclusion Case study: various attacks scenarios and their remedies
Textbook(s): [1] James S. Tiller, <i>The Ethical Hack: A Framework for Business Value Penetration Testing</i> , Auerbach Publications, 1 st edition, 2019, New York.
Reference Book(S): 1. Michael Simpson, Kent Backman, James Corley, <i>Hands-On Ethical Hacking and Network Defense</i> , Cengage Learning, 2nd edition, 2005, New York. 2. Patrick Engebreston, <i>The Basics of Hacking and Penetration testing</i> , : SyngressPublishers, , 2011, New York. 3. EC-Council, <i>Ethical Hacking and Counter measures: Attack Phases</i> , Course Technology Press, 2016, New York. 4. Hein Smith, Hilary Morrison, <i>ETHICAL HACKING: A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking</i> , Kindle Edition, 2018, New York.
Web and Video link(s): https://nptel.ac.in/courses/106105217 ; NPTEL Video Lecture on Ethical Hacking by Prof. Indranil Sengupta, Department of Computer Science and Engineering, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CS602D: Ethical Hacking										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS602D.1	2	3	1	-	2	-	2	-	-	-	1	1	-
CO2	U24CS602D.2	2	3	2	-	2	1	2				1	2	1
CO3	U24CS602D.3	2	2	2	2	3	-	1	1	-	-	1	2	2
CO4	U24CS602D.4	2	3	3	2	2	2	2	-	1	-	2	2	2
U24CS602D		2	2.75	2	2	2.25	1.5	1.75	1	1	-	1.25	1.75	1.67
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Analyze security vulnerabilities, security models and phases of penetration testing frameworks	SDG9	Industry, Innovation and Infrastructure	Analysis of security vulnerabilities and penetration testing frameworks supports the development of secure and resilient digital infrastructure for industrial and communication systems.
CO2	Analyze various cyber attacks and security threats in business and network environments	SDG16	Peace, Justice and Strong Institutions	Understanding cyber attacks and security threats helps in protecting information systems and ensuring secure and trustworthy digital environments.
CO3	Apply reconnaissance, enumeration and exploitation techniques	SDG9	Industry, Innovation and Infrastructure	Application of ethical hacking and reconnaissance tools enables proactive identification of system vulnerabilities,

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	using ethical hacking			supporting reliable and secure computing infrastructure.
CO4	Evaluate penetration testing results and recommend suitable mitigation and defense mechanisms	SDG11	Sustainable Cities and Communities	Evaluation of penetration testing results and implementation of defense mechanisms contribute to securing smart systems, communication networks and digital services in modern communities.

IOT COMMUNICATION PROTOCOLS			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS602E	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : examine IoT network architectures and select suitable short-range connectivity protocols for IoT applications. CO2 : analyze IP-based optimization, routing and discovery protocols used in constrained IoT networks. CO3 : compare application layer, messaging, web and semantic protocols for IoT data communication. CO4 : evaluate LPWAN, cellular, industrial, device management and security protocols for real-world IoT deployments.			
UNIT-I			9 Hrs
IoT Network Architecture and Communication Design: Need for protocol-based communication in IoT; IoT communication requirements: low power, scalability, reliability, latency, interoperability and security; device-to-device, device-to-gateway, gateway-to-cloud and device-to-cloud communication models; IoT protocol stack; role of sensors, actuators, gateways, cloud and edge nodes. IoT Standardized Architectures: OneM2M architecture, IoT World Forum (IoTWF) architecture, simplified IoT architecture, core IoT functional stack, IoT data management and compute stack. Short-range and Local Connectivity Protocols: RFID and NFC basics; Bluetooth Low Energy (BLE) architecture and use cases; IEEE 802.15.4 architecture, topology, addressing modes and frame structure; Zigbee protocol stack, topology, addressing and security; Z-Wave overview, topology, routing and home automation use cases; Thread protocol overview and IPv6-based mesh networking.			
UNIT-II			9 Hrs
Constrained IoT Networks: Constrained nodes, constrained networks, low-power and lossy networks (LLNs), challenges in IP communication for memory-limited and energy-limited devices; IPv6 and Lightweight IP Adaptation: Need for IPv6 in IoT; IPv6 addressing; UDP and TCP in IoT; 6LoWPAN architecture; header compression; fragmentation and reassembly; mesh addressing; mesh-under and mesh-over routing. Routing and Time-Slotted Communication: 6Lo and 6Lo working group overview; 6TiSCH architecture; Time-Slotted Channel Hopping (TSCH); RPL routing protocol: DODAG, objective function, control messages and route formation; LOADng overview. Emerging Infrastructure Protocols: uIP and nanoIP concepts; QUIC overview for modern Internet communication; Content-Centric Networking (CCN) overview; discovery protocols:			

Multicast DNS (mDNS), Universal Plug and Play (UPnP), Physical Web.	
UNIT-III	9 Hrs
IoT Application Layer Communication: Need for lightweight application protocols; request-response and publish-subscribe communication models; message broker concept; telemetry data exchange; event-driven communication. Messaging Protocols: MQTT architecture, broker, publisher, subscriber, topics, QoS levels and control packet types; MQTT-SN architecture, topology, transparent and aggregating gateways, gateway advertisement and discovery; AMQP architecture and reliable message queuing; XMPP for messaging and presence; DDS for real-time publish-subscribe communication. Web and Data Protocols: CoAP architecture, REST model, methods, confirmable/non-confirmable messages and message format; HTTP/HTTPS in IoT; RESTful web APIs; WebSocket for full-duplex communication; JSON and XML data formats; JSON-LD and Web Thing Model for semantic interoperability.	
UNIT-IV	9 Hrs
LPWAN and Cellular IoT Protocols: Need for long-range low-power communication; LoRa and LoRaWAN architecture, physical layer, MAC layer, topology and device classes; Sigfox overview; NB-IoT and LTE-M architecture and use cases; Wi-SUN overview; Weightless and DASH7 overview. Industrial IoT Communication Protocols: Industrial IoT requirements: determinism, reliability, availability and safety; Modbus overview and communication model; OPC UA architecture and service model; PROFINET overview; EtherCAT overview; WirelessHART and ISA100.11a for industrial wireless networks; Identification and Device Management Protocols: EPC, uCode and URI-based identification; device provisioning, monitoring, configuration and firmware update; LwM2M overview; TR-069 and OMA-DM device management. IoT Security Protocols and Mechanisms: Security needs in IoT; authentication, encryption, integrity and secure boot concepts; TLS and DTLS; OSCORE for constrained RESTful environments; security issues in MQTT, CoAP and LPWAN deployments.	
<u>Textbook(s):</u> 1. Sudip Misra, Anandarup Mukherjee and Arijit Roy, <i>Introduction to IoT</i>, New Delhi: Cambridge University Press, 2020. (Chapters 7 and 8; recommended primary student textbook for protocol topics.) 2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, <i>IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things</i>, Indianapolis: Cisco Press, 2017. (Chapters 2, 3, 4, 5, 8, 13 and 15.) 3. Arshdeep Bahga and Vijay Madisetti, <i>Internet of Things: A Hands-On Approach</i>, Hyderabad: University Press, 2015.	

Reference Book(S):

1. Jeeva Jose, *Internet of Things*, New Delhi: Khanna Publishing, 2018.
2. Kamal Raj, *Internet of Things - Architecture and Design Principles*, New Delhi: McGraw Hill Education India, 2017.
3. Mayur Ramgir, *Internet of Things - Architecture, Implementation, and Security*, New Delhi: Pearson Education, 2019.
4. Perry Lea, *Internet of Things for Architects*, Birmingham: Packt Publishing, 2018.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_cs37/preview?utm_source=chatgpt.com; Introduction To Internet Of Things By Prof. Sudip Misra at IIT Kharagpur

Course Articulation Matrix (CAM):				U24CS602E: IoT Communication Protocols										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS602E.1	3	2	2	1	2	1	1	1	1	1	2	2	1
CO2	U24CS602E.2	3	3	2	2	2	1	1	1	1	1	2	2	2
CO3	U24CS602E.3	3	2	2	2	3	1	1	1	2	1	2	3	2
CO4	U24CS602E.4	3	3	3	2	3	2	2	2	2	2	3	3	3
U24CS602E		3	2.5	2.25	1.75	2.5	1.25	1.25	1.25	1.5	1.25	2.25	2.5	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement: <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	examine IoT network architectures and select suitable short-range connectivity protocols for IoT applications.	SDG 9	SDG 9: Industry, Innovation and Infrastructure	Promotes engineering solutions, digital transformation, and technological innovation and connects IoT network architectures and connectivity protocols to industry-relevant problem solving.
CO2	analyze IP-based optimization, routing and discovery protocols used in constrained IoT networks.	SDG9 SDG4	SDG 9: Industry, Innovation and Infrastructure SDG 4: Quality Education	SDG 9: Industry, Innovation, and Infrastructure Drives technological innovation, digital transformation, and infrastructure development and links IP-based optimization and routing in constrained networks to engineering solutions. SDG 4: Quality Education Enhances analytical thinking, lifelong learning, and specialized skills to strengthen the educational foundation in advanced IoT networking protocols.
CO3	compare application layer, messaging, web and semantic protocols for IoT data communication.	SDG17	SDG17: Partnerships for the Goals	Encourages interdisciplinary collaboration and stakeholder engagement to highlight the need for global technical partnerships.
CO4	evaluate LPWAN, cellular, industrial, device management and security protocols for real-world IoT deployments.	SDG9:	SDG9:Industry, Innovation and Infrastructure	Drives digital transformation and infrastructure development through engineering solutions and evaluates LPWAN, cellular, and security protocols for practical, large-scale IoT implementation.

DEEP LEARNING			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS603	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : understand fundamental machine learning concepts and apply deep learning principles to build and evaluate predictive models. CO2 : apply optimization and regularization techniques to improve generalization and efficiently train deep learning CO3 : analyse and apply Convolutional Neural Network concepts to model structured data and understand their role in deep learning advancements. CO4 : apply Recurrent and Recursive Neural Network architectures to model sequences and address long-term dependency challenges.			
UNIT-I			9 Hrs
Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Performance Metrics, Default baseline models, debugging strategies, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Challenges Motivating Deep Learning. Introduction to Deep learning: Deep learning, Historical trends in deep learning. Deep Feed Forward Networks: Learning XOR, Gradient based learning, Hidden Units, Architecture Design, Back propagations and differentiation algorithms.			
UNIT-II			9 Hrs
Regularization for Deep learning: Parameters norm penalties, Norm penalties as constrained optimization, Regularization and under constrained problems, Dataset augmentation, Noise robustness, semi supervised learning, multitask learning, Parameter tying and sharing, Sparse representation Optimization for Training Deep Models: Pure optimization, challenges in neural network optimization, Basic algorithms, Parameter initialization strategies, Algorithms with adaptive learning rates			
UNIT-III			9 Hrs
Convolutional Neural Networks: Convolution operations, Motivation, Pooling, Convolution and pooling as an infinitely strong prior, Variants of the basic convolution functions, Structured outputs, Data types, Efficient convolution algorithms, random or unsupervised features, Convolution networks and the history of deep learning.			
UNIT-IV			9 Hrs
Sequence Modelling - Recurrent Neural Networks - Architecture, Unfolding computational graphs, Recurrent neural networks, Bidirectional Recurrent neural networks, Encoder-decoder architectures, Deep recurrent networks Sequence Modelling - Recursive Neural networks - Architecture, Challenges of long-term dependencies, Echo state networks, Leaky units, Strategies for multiple time scales, Long and short-term memory for recursive neural networks			

Textbook(s):

1. Ian Goodfellow and YoshuaBengio and Aaron Courville, *Deep Learning*, 1st ed., MIT Press, 2017.

Reference Book(S):

1. Tom M. Mitchell, *Machine Learning*, MGH, Indian Edition, ISBN 1259096955, 2013 Deng & Yu, *Deep Learning: Methods and Applications*, 1st ed., USA:Now Publisher, 2013.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, *Deep Learning*, 1st ed., Massachusetts: MIT Press, 2016.
3. Astian Raschka, Vahid Mirjalili - *Python Machine Learning*, 2nd ed., Mumbai: Packt, 2019.
4. Antonio Gulli, Amita Kapoor, Sujit Pal, *Deep Learning with TensorFlow 2.0 and Keras*, 2nd ed., Mumbai:Packt, 2019 (Chapters : 1, 3, 4, 5).

Web and Video link(s):

nptel.ac.in/courses/106106201 *Deep Learning - YouTube*

Course Articulation Matrix (CAM):				U24CS603 : DEEP LEARNING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS603	3	3	2	2	3	1	–	1	2	2	1	1	2
CO2	U24CS603	3	3	3	2	3	–	–	1	2	1	2	1	2
CO3	U24CS603	3	3	3	3	3	2	1	1	2	2	2	1	2
CO4	U24CS603	3	3	3	3	3	2	1	1	2	2	2	1	2
U24CS603		3.0	3.0	2.75	2.50	3.0	1.25	0.50	1.0	2.0	1.75	1.75	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Understand fundamental machine learning concepts and apply deep learning principles to build and evaluate predictive models.	SDG 3	Ensure healthy lives and promote well-being for all at all ages	by enabling students to develop machine learning and deep learning models for predictive analytics, which can be applied in healthcare domains such as disease prediction, medical diagnostics, and health monitoring systems.
CO2	apply optimization and regularization techniques to improve generalization and efficiently train deep learning	SDG 4	Ensure inclusive and equitable quality education and promote lifelong	by enabling students to apply optimization and regularization techniques to develop efficient and generalized deep learning models, which are essential for building

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
			learning opportunities for all.	adaptive learning systems, intelligent tutoring platforms, and data-driven educational technologies.
CO3	analyse and apply Convolutional Neural Network concepts to model structured data and understand their role in deep learning advancements.	SDG 9	Build resilient infrastructure, promote sustainable industrialization, and foster innovation	by enabling students to analyze and apply Convolutional Neural Networks for structured data modeling, contributing to innovation and the development of advanced AI-driven systems in industrial and real-world applications.
CO4	apply Recurrent and Recursive Neural Network architectures to model sequences and address long-term dependency challenges.	SDG 11	Make cities inclusive, safe, resilient, and sustainable	by enabling students to apply recurrent and recursive neural networks for modeling sequential and time-dependent data, which supports smart city applications such as traffic prediction, urban planning, and intelligent monitoring systems.

COMPILER DESIGN			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS604	Credits:	3
Hours/Week (L-T-P- E):	3-2-1-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: design lexical analyzer using regular expressions to generate tokens from the given programming statements CO2: construct syntax tree and parsing table for the given context-free grammar CO3: generate intermediate code for the given programming statements CO4: write target code from the intermediate form and apply code optimization techniques to improve the performance of the code			
UNIT-I			9 Hrs
Introduction to Compiling: Compilers, Analysis of the source program, Phases of a compiler, Cousins of the compiler, Grouping of phases, Compiler construction tools Lexical Analysis: Role of lexical analyzer, Input buffering, Specification of tokens, Recognition of tokens, A language for specifying lexical analyzers, Finite automata, Design of a lexical analyzer, Optimization of deterministic finite automata based pattern matchers			
UNIT-II			9 Hrs
Syntax Analysis: Role of the parser, Writing grammars, Context free grammars, Top down parsing, bottom up parsing, Operator precedence parsing, LR parsers, Using ambiguity grammars, Parser generators Syntax Directed Translation: Syntax directed definitions, Construction of syntax trees, bottom up evaluation of S-attributed definitions, L-attributed definitions, Top down translation, bottom up evaluation of inherited attribute, Space for attribute values at compile time, Analysis of syntax directed definition			
UNIT-III			9 Hrs
Type Checking: Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions Runtime Environments: Source language issues, Storage organization, Storage allocation strategies, Symbol tables, Language facilities for dynamic storage allocation, Dynamic storage allocation techniques Intermediate Code Generation: Intermediate languages, Declarations, Assignment statements, Boolean expressions, Back patching			
UNIT-IV			9 Hrs
Code Generation: Issues in the design of code generator, The target machine, Runtime storage management, Basic blocks and flow graphs, Next-use information, A simple code generator, Register allocation and assignment, Directed acyclic graph representation of basic blocks, Peephole optimization, Generating code from directed acyclic graphs, Code generation algorithm Code Optimization: Introduction, The principal sources of optimization, Optimization of basic			

blocks, Loops in flow graphs, Introduction to global data flow analysis, Code improving transformations

Textbook(s):

6. Alfred V.Aho, Ravi Sethi and Jeffrey D.Ullman, *Compilers: Principles, Techniques and Tools*, 2nd ed. Hong Kong: Pearson Education Asia, 2013.

Reference Book(S):

7. Allen I. Holub, *Compiler Design in C*, 2nd ed. New Jersey: Prentice Hall of India, 2003.
8. C. N. Fischer, R. J. LeBlanc, *Crafting a compiler with C*, California: Pearson Education, 2003.
9. J.P. Bennet, *Introduction to Compiling Techniques*, 2nd ed. New York: McGraw-Hill, 2003.
10. Henk Alblas, Albert Nymeyer, *Practice and Principles of Compiler Building with C*, London: PHI, 2001.

Web and Video link(s):

<https://nptel.ac.in/courses/106104123>; NPTEL Course on Compiler Design by Prof. Y. N. Srikanth, IISc. Bangalore, Prof. Sanjeev K. Aggarwal, IIT Kanpur, Prof. Santanu Chattopadhyay, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CS604-COMPILER DESIGN										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS604.1	2	2	2	2	1	1	-	-	1	1	1	2	2
CO2	U24CS604.2	2	2	2	2	1	1	-	-	1	1	1	2	2
CO3	U24CS604.3	2	2	2	2	1	1	-	-	1	1	1	2	2
CO4	U24CS604.4	2	2	2	2	1	1	-	-	1	1	1	2	2
U24CS604		2	2	2	2	2	1	1	-	-	1	1	1	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design lexical analyzer using regular expressions to generate tokens from the given programming statements	SDG3	Good Health and Well-being	Designing efficient lexical analyzers improves software reliability and performance, which is critical in healthcare systems (e.g., medical software, diagnostic tools). Accurate tokenization ensures fewer errors in health-related applications, contributing indirectly to better healthcare delivery and system safety.
CO2	construct syntax tree and parsing table for the given context-free grammar	SDG4	Quality Education	Understanding parsing techniques strengthens foundational knowledge in computer science education. It promotes analytical thinking and problem-solving skills, which are essential for quality technical education and lifelong learning in computing disciplines.
CO3	generate intermediate code for the given programming statements	SDG9	Industry, Innovation and Infrastructure	Intermediate code generation is a core step in building efficient compilers used in software development industries. It supports innovation by enabling the development of optimized and portable software systems, which are vital for modern digital infrastructure.
CO4	write target code from the intermediate form and apply code optimization techniques to improve the performance of the code	SDG11	Sustainable Cities and Communities	Code optimization leads to efficient use of computational resources, reducing energy consumption in large-scale systems (e.g., smart city applications, IoT systems). Efficient software contributes to sustainable digital infrastructure supporting smart and sustainable communities.

INTERNET OF THINGS			
Class: B. Tech. VI- Semester		Branch: CSE	
Course Code: U24CS605	U24CS605	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : understand the fundamentals, architecture, and applications of the Internet of Things (IoT) along with sensors, actuators, and IoT hardware platforms.			
CO2 : analyze and compare IoT connectivity and communication technologies such as IEEE 802.15.4, Zigbee, LoRa, RFID, NFC, Wi-Fi, Bluetooth, and constrained networks.			
CO3 : apply IoT data communication and discovery protocols including MQTT, MQTT-SN, CoAP, AMQP, XMPP, REST, SOAP, WebSocket, mDNS, and UPnP in IoT systems.			
CO4 : evaluate IoT infrastructure protocols such as IPv6, RPL, 6LoWPAN, QUIC, μ IP, NanoIP, and CCN for designing IoT applications and smart systems.			
UNIT-I			9 Hrs
Internet of Things (IoT): Introduction, Evolution of IoT, IoT Architectures - drivers behind new network architectures, OneM2M IoT standardized architecture, IoT World Forum (IoTWF) standardized architecture, A Simplified IoT architecture, Core IoT Functional stack, IoT data management and compute stack Sensors: Definition, Characteristics, deviations, Types and considerations Actuators: Definition, Types, Characteristics Classification of IoT boards: Microcontroller boards, Single board controller, System on chipboard			
UNIT-II			9 Hrs
IoT Connectivity Technologies: Overview, IEEE 802.15.4- 802.15 standards, Zigbee-Overview, Physical layer and Media Access Control(MAC) Layer, Protocol stack, Addressing modes and packet structure, Topology, Security, Long Range (LoRa)-Physical layer, Media Access Control (MAC) layer and topology, Z-Wave, RFID, NFC, Wi-Fi, Bluetooth IoT Communication Technologies: Constrained nodes, Constrained networks, Types of constrained devices, Low power and lossy networks			
UNIT-III			9 Hrs
Data Protocols: Message Queue Telemetry Transport(MQTT)-Publish-Subscribe Architecture, Packet structure and communication format; Message Queue Telemetry Transport -Sensor Networks (MQTT-SN)-Architecture, Topology; Constrained Application Protocol(COAP) – Architecture, Message formats; Advanced Message Queuing Protocol(AMQP), Extensible Messaging and Presence Protocol(XMPP), Simple Object Access Protocol(SOAP), Representational State Transfer(REST), WebSocket Discovery protocols: Physical web, Multicast Domain Name System (mDNS), Universal plug and play(UPnP)			
UNIT-IV			9 Hrs

Infrastructure Protocols : Internet Protocols version6(IPv6), Lightweight On-demand Ad-hoc distance vector Routing protocol – Next Generation(LOADng), Routing Protocols for Low-power(RPL), IPv6 over Low-Power Wireless Personal Area Networks (6LoWPAN), Quick UDP Internet Connections (QUIC), Micro Internet protocols(μIP), Nano Internet Protocols (NanoIP), Content-Centric Networking(CCN)

Case Study: Smart Green House

Textbook(s):

1. Sudip Misra, Anandarup Mukherjee, Arljit Roy, *Introduction to IoT*, New Delhi: Cambridge University Press ,2020(chapter 7,8)
2. Cornel Amariei, *Arduino Development Cook Book*, Birmingham: Packet Publishing Ltd., 2015(chapter 2,6)

Reference Book(S):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Hyderabad: University Press, 2015
2. Marco Schwartz, *Internet of Things with ESP8266*, Birmingham: Packt Publishing Ltd., 2016
3. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, *Internet of things With Raspberry Pi and Arduino*, Boca Raton: CRC Press, Taylor & Francis Group,2020
4. Brian Evans, *Beginning Arduino Programming*, New York: Apress, 2011

Web and Video link(s): <https://nptel.ac.in/courses/106105191> NPTEL *Video Lecture on internet of things* Prof. Supidmistra, Professor of CSE, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CS605: INTERNET OF THINGS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS605.1	2	2	1	1	2	-	-	1	-	-	-	2	2
CO2	U24CS605.2	2	2	2	1	2	-	-	1	1	-	-	2	2
CO3	U24CS605.3	2	2	2	2	2	-	-	1	1	-	-	2	2
CO4	U24CS605.4	2	2	2	2	2	-	-	1	2	-	1	2	2
U24CS605		2	2	1.7 5	1.5	2	-	-	1	1.3 3	-	1	2	2
- HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	understand the fundamentals, architecture, sensors, actuators, and IoT hardware platforms.	SDG 9	Industry, Innovation and Infrastructure	IoT fundamentals and hardware platforms support the development of smart infrastructure, industrial automation, and innovative connected systems...
CO2	analyze and compare	SDG4	Quality Education	IoT connectivity technologies enable

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	IoT connectivity and communication technologies such as IEEE 802.15.4, Zigbee, LoRa, RFID, NFC, Wi-Fi, Bluetooth, and constrained networks.			reliable communication among smart devices, supporting the development of efficient industrial networks, smart infrastructure, and innovative digital ecosystems.
CO3	apply IoT data communication and discovery protocols including MQTT, MQTT-SN, CoAP, AMQP, XMPP, REST, SOAP, WebSocket, mDNS, and UPnP in IoT systems.	SDG11	Sustainable Cities and Communities	IoT communication protocols facilitate real-time monitoring, data exchange, and intelligent decision-making in smart city applications such as traffic management, environmental monitoring, and smart utilities.
CO4	evaluate IoT infrastructure protocols such as IPv6, RPL, 6LoWPAN, QUIC, μIP, NanoIP, and CCN for designing IoT applications and smart systems.	SDG9	Industry, Innovation and Infrastructure	Advanced IoT infrastructure protocols support scalable, secure, and efficient communication networks that form the backbone of next-generation industrial and smart infrastructure systems.

CRYPTOGRAPHY AND NETWORK SECURITY			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS606	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> <i>(based on cognitive skills acquired from theory component)</i>			
CO1 : classify different security attacks, services, mechanisms and symmetric key cryptographic algorithms			
CO2 : ply mathematical concepts in cryptographic algorithms for providing security & key exchange			
CO3 : egorize the hash & message authentication techniques and examine key management for distribution of keys			
CO4 : analyze the security issues in application, transport & network layers for protecting data from unauthorized persons, intruders & malicious software			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Information and Network Security Concepts: The OSI security architecture, Security attacks, Security services, Security mechanisms			
Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques			
Block Ciphers and the Data Encryption Standard: Traditional block cipher structure, Simplified DES, The data encryption standard, The strength of DES, Block cipher design principles, Block cipher operation			
Advanced Encryption Standard: AES structure, AES transformation functions, AES key expansion			
UNIT-II		9 Hrs	
Introduction to Number Theory: Modular arithmetic, Prime numbers, Fermat’s and Euler’s theorems, Discrete logarithms			
Public-Key Cryptography and RSA: Principles of public-key cryptosystems, The RSA algorithm			
Other Public-Key Cryptosystems: Diffie-Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography			
UNIT-III		9 Hrs	
Cryptographic Hash functions: Applications of cryptographic hash functions, Two simple hash functions, Secure hash algorithm (SHA)			
Message Authentication Codes: Message authentication requirements, Message authentication functions, Requirements for message authentication codes, Security of MACs, MACs based on Hash functions (HMAC), Digital signatures			
Cryptographic Key Management and Distribution: Symmetric key distribution using symmetric and asymmetric encryption, Distribution of public keys, X.509 certificates			

UNIT-IV	9 Hrs
Electronic Mail Security: Internet Mail Architecture, Email formats, Email threats and comprehensive email security, S/MIME Transport-Level Security: Web security considerations, Transport layer security IP Security: IP security overview, IP security policy, Encapsulating security payload, Combining security associations Network Endpoint Security: Firewalls, malicious software	
Textbook(s): [1] William Stallings, <i>Cryptography and Network Security: Principles and Practice</i>, Pearson Education, 8th edition, 2023, United Kingdom. (Chapters 1 to 4, 6 to 7, 9 to 13, 15, 17 to 21)	
Reference Book(S): 8. Behrouz A. Forouzan and Debdeep Mukhopadhyay, <i>Cryptography and Network Security</i>, Mc Graw Hill Education, 2nd edition, 2010, New Delhi. 9. <u>Atul Kahate</u>, <i>Cryptography and Network Security</i>, McGraw Hill Education, New Delhi, 2003. 10. Denning. D, <i>Cryptography and Data Security</i>, Addison Wesley, 1982, United Kingdom. 11. V. K. Iain, <i>Cryptography and Network Security</i>, Khanna Publishing House, 2013, New Delhi.	
Web and Video link(s): https://onlinecourses.nptel.ac.in/noc26_cs57/preview; NPTEL Video Lecture on Cryptography and Network Security by Prof. Sourav Mukhopadhyaya, Department of Mathematics, IIT Kharagpur.	

Course Articulation Matrix (CAM):				U24CS606: CRYPTOGRAPHY AND NETWORK SECURITY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS606.1	1	-	-	-	-	-	-	-	-	-	-	-	1
CO2	U24CS606.2	2	2	2	1	-	-	-	-	-	-	-	1	2
CO3	U24CS606.3	3	3	2	1	-	1	-	-	-	-	-	1	2
CO4	U24CS606.4	2	2	1	1	-	1	-	-	-	-	-	2	2
U24CS606		2	2.33	1.67	1	-	1	-	-	-	-	-	1.33	1.75
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	classify different security attacks, services, mechanisms and symmetric key cryptographic algorithms	SDG9	Industry, Innovation and Infrastructure	Understanding security attacks and cryptographic mechanisms helps in building secure communication systems and resilient digital infrastructure, supporting innovation and safeguarding industrial and information systems.
CO2	apply mathematical concepts in cryptographic algorithms for providing security & key exchange	SDG9	Industry, Innovation and Infrastructure	Mathematical foundations in cryptography enable secure key exchange and data protection, which are essential for modern digital technologies, secure communications, and innovation in cybersecurity systems.
CO3	categorize the hash & message authentication techniques and examine key management for distribution of keys	SDG16	Peace, Justice and Strong Institutions	Hashing, authentication, and secure key management ensure data integrity, confidentiality, and trust in digital transactions, contributing to secure information systems and strong institutional frameworks.
CO4	analyze the security issues in application, transport and network layers for protecting data from unauthorized persons, intruders & malicious software	SDG16	Peace, Justice and Strong Institutions	Identifying and mitigating application, transport and network layer vulnerabilities enhances cybersecurity, protects users from cyber threats, and ensures safe digital communication environments.

COMPILER DESIGN LABORATORY			
Class: B. Tech. V – Semester		Branch: CSE	
Course Code:	U24CS607	Credits:	3
Hours/Week (L-T-P- E):	3-2-1-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: design lexical analyzer and construct predictive parser from the FIRST and FOLLOW of context-free grammar CO2: construct look ahead LR parser and generate assemble code from the intermediate representation of source code CO3: implement lexical analyzer based on regular expressions for the given problem CO4: write yet another compiler compiler program based on context-free grammar for the given problem			
LAB COMPONENT			
Experiment-I - Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines - Implement the lexical analyzer using LEX tool to generate tokens from the given C program			
Experiment-II - Write a program to compute FIRST and FOLLOW for the given context-free grammar - Design a predictive parser for the given context-free grammar			
Experiment-III - Design a look ahead LR bottom up parser for the given context-free grammar - Convert the Backus-Naur form or Backus normal form rules into yet another compiler compiler form and write code to generate abstract syntax tree			
Experiment-IV - Write a program to generate assembly code from the intermediate representation of source code - Write a program to implement operator precedence parsing for the given context-free grammar			
Experiment-V Write a lexical analyzer program for the following: To count the number of keywords and identifiers in the given program			

2. To convert an octal number to decimal number
3. To recognize numbers in the given program

Experiment-VI

Write a lexical analyzer program for the following:

1. To count the number of vowels and consonants in the given string
2. To count the number of characters, words and lines in the given text
3. To count the number of '+ve' and '-ve' integers from the given program

Experiment-VII

Write lexical analyzer program for the following:

1. To count the number of comment lines in the given C program
2. To count the number of scanf and printf statements in the given C program
3. To illustrate no pattern and no action concept

Experiment-VIII

Write lexical analyzer program for the following:

1. To add line numbers to the given file and displays the same onto the standard output
2. To extract only comments from C program and display the same onto the standard output

Experiment-IX

Write yet another compiler compiler program for the following:

1. To identify a simple and a compound statement in the given C program
2. To construct a context-free grammar which accepts the language $L = \{ a^n b^n \mid n \geq 1 \}$

Experiment-X

Write yet another compiler compiler program for the following:

1. To check the validity of given arithmetic expression
2. To construct a context-free grammar which accepts the language $L = \{ a^n b \mid n \geq 10 \}$

Experiment-XI

Write yet another compiler compiler program for the following:

1. To recognize nested if control statements and display the level of nesting
2. To check the validity of given simple sentence

Experiment-XII

Write yet another compiler compiler program for the following:

1. To check the validity of given date
2. To test for balanced parentheses in the given input

Laboratory Manual:

1. Compiler Design Laboratory Manual, Dept. of CSE, KITSW.

Reference Book(s):

11. Alfred V.Aho, Ravi Sethi and Jeffrey D.Ullman, *Compilers: Principles, Techniques and Tools*, 2nd ed. Hong Kong: Pearson Education Asia, 2013.
12. Allen I. Holub, *Compiler Design in C*, 2nd ed. New Jersey: Prentice Hall of India, 2003.
13. C. N. Fischer, R. J. LeBlanc, *Crafting a compiler with C*, California: Pearson Education, 2003.
14. J.P. Bennet, *Introduction to Compiling Techniques*, 2nd ed. New York: McGraw-Hill, 2003.
15. Henk Alblas, Albert Nymeyer, *Practice and Principles of Compiler Building with C*, London: PHI, 2001.

Web and Video link(s):

<https://nptel.ac.in/courses/106104123>; NPTEL Course on Compiler Design by Prof. Y. N. Srikanth, IISc. Bangalore, Prof. Sanjeev K. Aggarwal, IIT Kanpur, Prof. Santanu Chattopadhyay, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CS607- COMPILER DESIGN LABORATORY										
	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS607.1	2	2	2	2	1	1	-	-	2	1	2	2	2
CO2	U24CS607.2	2	2	2	2	1	1	-	-	2	1	2	2	2
CO3	U24CS607.3	2	2	2	2	1	1	-	-	2	1	2	2	2
CO4	U24CS607.4	2	2	2	2	1	1	-	-	2	1	2	2	2
	U24CS607	2	2	2	2	2	1	-	-	2	2	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design lexical analyzer and construct predictive parser from the FIRST and FOLLOW of context-free grammar	SDG3	Good Health and Well-being	This outcome develops strong foundational knowledge in compiler construction, enhancing analytical and problem-solving skills, which directly contributes to quality technical education and lifelong learning.
CO2	construct look ahead LR parser and generate assemble code from the intermediate representation of source code	SDG4	Quality Education	The ability to design efficient parsers and generate machine-level code supports innovation in software development tools and compilers, which are essential for building robust computing infrastructure.
CO3	implement lexical analyzer based on regular expressions for the given problem	SDG9	Industry, Innovation and Infrastructure	This CO strengthens programming and pattern recognition skills, improving students' technical competence and contributing to skill-based education aligned with modern industry needs.
CO4	write yet another compiler compiler program based on context-free grammar for the given problem	SDG11	Sustainable Cities and Communities	Designing compiler tools promotes innovation in system software development and supports advanced computing solutions, which are crucial for technological growth and industrial advancement.

INTERNET OF THINGS LABORATORY			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code: U24CS608	U24CS608	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	60 %
Total Number of Teaching Hours:	36 Hrs	ESE:	40 %
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: identify the basics of IoT, sensors, actuators and IoT boards in real time environment CO2: make use of Arduino IDE, i/o functions for problem solving CO3: demonstrate analog and digital communications with Arduino CO4: design a real time application using sensors, actuators and Arduino board compare			
Experiment-1 (UNIT-I)			
Demonstration of Arduino IDE, setup () and loop (), serial.begin(), serial.print() functions.			
Experiment-2 (UNIT-I)			
Develop an arduino program to demonstrate data types, variables and operators, if statements, loops and arrays.			
Experiment-3 (UNIT-I)			
Develop an Arduino program to demonstrate light an LED and Button.			
Experiment-4 (UNIT-II)			
Develop an Arduino program to demonstrate 7-segment display.			
Experiment-5 (UNIT-II)			
Develop an Arduino program to demonstrate temperature sensor.			
Experiment-6 (UNIT-II)			
Demonstrate interfacing of PIR sensor and buzzer.			
Experiment-7 (UNIT-III)			
Demonstrate interfacing of infrared and ultrasonic sensor.			
Experiment-8 (UNIT-III)			
Demonstrate interfacing of potentiometer.			
Experiment-9 (UNIT-III)			
Demonstrate interfacing of DC motor, servo motor and stepper motor.			
Experiment-10 (UNIT-IV)			
Demonstrate I2C communication protocol.			
Experiment-11 (UNIT-IV)			
Demonstrate SPI communication protocol.			
Experiment-12 (UNIT-IV)			
Demonstrate UART communication protocol.			
Textbook(s):			
1. Sudip Misra, Anandarup Mukherjee, Arljit Roy, <i>Introduction to IoT</i> , New Delhi:			

Cambridge University Press ,2020(chapter7,8)

2. Cornel Amariei, *Arduino Development CookBook*, Birmingham: Packet Publishing Ltd., 2015(Chapter 2-6)

Reference Book(S):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Hyderabad: University Press, 2015
2. Marco Schwartz, *Internet of Things with ESP8266*, Birmingham: Packt Publishing Ltd., 2016
3. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, *Internet of things With Raspberry Pi and Arduino*, Boca Raton: CRC Press, Taylor & Francis Group,2020
4. Brian Evans, *Beginning Arduino Programming*, New York: Apress, 2011

Laboratory Manual (for laboratory component):

1. Internet of things *Manual and Record Book*, Department of CSN, KITSW.

Course Articulation Matrix (CAM):		U24CS608: INTERNET OF THINGS LABORATORY												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS608.1	2	1	-	-	1	-	-	-	-	-	-	2	2
CO2	U24CS608.2	2	2	1	1	2	-	-	-	1	-	-	2	2
CO3	U24CS608.3	2	2	2	1	2	-	-	-	-	-	-	2	2
CO4	U24CS608.4	2	2	2	2	2	-	-	-	1	-	-	2	2
U24CS608		2	1.75	1.67	1.33	1.75	-	-	-	1	-	-	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	identify the basics of IoT, sensors, actuators, and IoT boards in real-time environments	SDG9	Industry, Innovation and Infrastructure	Understanding IoT fundamentals enables development of smart infrastructure systems such as industrial automation, smart devices, and connected networks, promoting innovation and technological advancement.
CO2	make use of Arduino IDE and I/O functions for problem solving	SDG4	Quality Education	Hands-on use of Arduino and embedded systems enhances practical learning, technical skills, and problem-solving abilities, supporting quality education through experiential and skill-based learning.
CO3	demonstrate analog and digital communications with Arduino	SDG9	Industry, Innovation and Infrastructure	Knowledge of communication techniques supports reliable data transmission in IoT systems, enabling efficient industrial communication, smart monitoring systems, and infrastructure development.
CO4	design a real-time	SDG11	Sustainable Cities and	Designing IoT-based real-time applications enables smart city

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
	application using sensors, actuators, and Arduino boards		Communities	solutions such as traffic control, energy management, and environmental monitoring, contributing to sustainable and efficient urban development.

MINI PROJECT

Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS610	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-1	CIE:	60%
Total Number of Teaching Hours:	-	ESE:	40%

Course Learning Outcomes (COs):

*After completion of this course, the students should be able to,
(based on cognitive skills acquired from theory component)*

CO1: apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship

CO2: demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report

CO3: make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project

CO4: write a “Mini project paper” in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project

Student has to take up independent mini project on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study, which would supplement and complement the program assigned to each student.

Guidelines:

1. The HoD shall constitute a *Department Mini Project Evaluation Committee (DMPEC)*
2. *DMPEC* shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format and (iv) effective mini project oral presentation
3. There shall be only continuous Internal Evaluation (CIE) for miniproject
4. The CIE for mini project is as follows:

Assessment	Weightage
Mini Project Supervisor Assessment	15%
Working model / process / software package / system developed	20%
Mini Project report	15%
Mini Project paper	10%
Video pitch	10%
<i>DMPEC Assessment: Oral presentation with PPT and viva-voce</i>	15%
SDG Alignment	5%
Research Alignment	10%
Total Weightage:	100%

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

- (f) **Mini Project Topic:** The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest
- (g) **Working Model:** Each student is requested to develop a working model / process / system on the chosen work and demonstrate before the *DMPEC* as per the dates specified by *DMPEC*
- (h) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DMPEC*
- (i) **Anti-Plagiarism Check:** The seminar report should clear plagiarism check as per the Anti-Plagiarism policy of the institute
- (j) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *DMPEC* as per the schedule notified by the department
- (k) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact
- (l) The student has to register for the Mini project as supplementary examination in the following cases:
 - vi) he/she is absent for oral presentation and viva-voce
 - vii) he/she fails to submit the report in prescribed format
 - viii) he/she fails to fulfill the requirements of Mini project evaluation as per specified guidelines
 - ix) The CoE shall send a list of students registered for supplementary to the HoD concerned
 - x) The DSEC, duly constituted by the HoD, shall conduct Mini project evaluation and send the award list to the CoE within the stipulated time

Course Articulation Matrix (CAM):				U24CS610 Mini Project										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS610.1	3	3	2	3	3	2	1	2	1	2	2	2	1
CO2	U24CS610.2	2	2	2	3	2	1	1	1	2	1	3	1	1
CO3	U24CS610.3	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	U24CS610.4	1	2	1	2	2	1	2	1	3	1	2	1	1
U24CS610		1.75	2	1.5	2.25	2.25	1.5	1.25	1.52	2.25	1.25	2.25	1.25	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system	SDG 9	Industry, Innovation and Infrastructure	Mini projects involve the design and development of innovative ECE solutions such as IoT systems, embedded systems, communication networks, VLSI applications, and intelligent

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
	leading to innovation & entrepreneurship			electronic devices. These activities promote technological innovation, entrepreneurship, and sustainable industrial infrastructure.
CO2	demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report	SDG 4	Quality Education	Literature review, problem analysis, technical documentation, and independent learning enhance research skills, critical thinking, and lifelong learning capabilities, thereby supporting quality technical education and knowledge creation.
CO3	make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project	SDG 11	Sustainable Cities and Communities	Presentation and discussion of ECE-based solutions for smart cities, intelligent transportation systems, environmental monitoring, public safety, healthcare technologies, and digital connectivity contribute to sustainable and inclusive community development.
CO4	write a “Mini project paper” in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project	SDG 12	Responsible Consumption and Production	Scientific reporting and dissemination of project outcomes promote responsible innovation, ethical publication practices, efficient utilization of resources, and sustainable technology development.

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. Tech (Vocational) in CSE)

(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 CSE: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24CS611X	Cloud computing Essentials	2	-	2	-	4	3
2	PCC	U24CS612X	Data Visualization with R programming	2	-	2	-	4	3
3	PCC	U24CS613X	Industrial IoT	2	-	2	-	4	3
4	PCC	U24CS614X	DevOps Development						
4	PCC	U24CS615X	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 B.Voc in CSE Degree.

Exit Option to Qualify B. Voc in CSE: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE616X	Data Visualization using R Language (NSIC Course)	-	-	6	-	6	3
2	SEC	U24SE617X	AMAZON Web Services (NSIC Course)	-	-	6	-	6	3
3	SEC	U24SE618X	Augmented & Virtual Reality (NSIC Course)	-	-	6	-	6	3
4	SEC	U24SE619X	CCNA: Enterprise networking, security & automation	-	-	6	-	6	3
5	SEC	U24SE620X	Block Chain Application Developer (NASSCOM Futureskills course)	-	-	6	-	6	3
6	SEC	U24SE621X	Any other course approved by BoS Chair and Dean AA	-	-	6	-	6	3

CLOUD COMPUTING ESSENTIALS			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS611X	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 Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: Explain cloud computing concepts, service models, deployment models, and virtualization CO2: Create and manage virtual machines, cloud storage, and compute resources using cloud platforms CO3: Apply cloud services for deploying web applications and managing databases CO4: Explain cloud security, monitoring, backup, and cost optimization techniques CO5: Implement cloud infrastructure using virtualization tools CO6: Implement cloud storage, networking, and compute services CO7: Deploy simple applications using cloud platforms CO8: Implement cloud security, monitoring, and resource management			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Introduction to Cloud Computing: Evolution of Computing, Distributed Computing, Utility Computing, Grid Computing, Cloud Computing Definition and Characteristics, Advantages and Challenges, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Community), Major Cloud Providers (AWS, Microsoft Azure, Google Cloud Platform).			
UNIT-II		4 Hrs	
Virtualization Fundamentals: Hypervisors (Type-I and Type-II), Virtual Machines, Virtual Machine Lifecycle, Containers and Docker Basics, Virtual Networking, Virtual Storage, Resource Allocation.			
UNIT-III		4 Hrs	
Cloud Services: Identity and Access Management (IAM), Virtual Private Cloud (VPC) Concepts, DNS Services, Cloud Databases (SQL and NoSQL), Serverless Computing, Cloud Functions, Introduction to Kubernetes and Container Orchestration.			
UNIT-IV		4 Hrs	
Cloud Security and Management: Security Principles, Authentication and Authorization, Encryption, Backup and Disaster Recovery, Monitoring and Logging Services, Cost Management, Cloud Billing Concepts, Green Cloud Computing, Emerging Trends in Cloud Computing.			
LABORATORY COMPONENT			
List of Experiments			
21. Install VMware/VirtualBox and create a virtual machine with Linux operating system.			
22. Configure networking between host and virtual machine.			
23. Create and manage cloud storage using Google Drive/OneDrive/AWS S3 equivalent.			

24. Launch and configure a virtual machine instance on AWS Academy/Azure/Google Cloud.
25. Create users, roles, and permissions using Identity and Access Management (IAM).
26. Deploy a static website using cloud object storage.
27. Create and connect to a cloud database service.
28. Install Docker and execute basic container operations.
29. Deploy a simple web application using Docker containers.
30. Monitor cloud resources, configure backups, and estimate cloud service costs.
<u>Textbook(s):</u> 1. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, Mastering Cloud Computing , McGraw-Hill Education, First Edition.
<u>Reference Book(S):</u> 3.Kai Hwang, Geoffrey Fox, Jack Dongarra, Distributed and Cloud Computing , Morgan Kaufmann.
<u>Laboratory Manual (for laboratory component):</u> 2.Cloud Computing laboratory manual and Record Book Department of CSE

Course Articulation Matrix (CAM):								U24CS611X Cloud Computing Essentials					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
U24CS611X.1	1	1	1	1	-	-	-	-	1	-	-	1	1
U24CS611X.2	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS611X.3	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS611X.4	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS611X.5	2	2	2	1	-	-	-	-	1	-	-	2	2
U24CS611X.6	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS611X.7	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS611X.8	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS611X	1.87	1.87	1.87	1	-	-	-	-	1	-	2	1.87	1.62
3 – HIGH, 2 – MEDIUM, 1 - LOW													

DATA VISUALIZATION WITH R PROGRAMMING			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS612X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: Explain the fundamentals of R programming and data visualization techniques.			
CO2: Import, manipulate, summarize, and transform datasets using R.			
CO3: Develop data visualizations using base R graphics and the ggplot2 package.			
CO4: Analyze and communicate insights using advanced visualization techniques and interactive dashboards.			
CO5: Implement R programs using vectors, matrices, lists, data frames, and functions.			
CO6: Perform data preprocessing and exploratory data analysis (EDA) using R.			
CO7: Develop statistical and business visualizations using ggplot2.			
CO8: Build interactive visualizations and dashboards for effective data presentation.			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Introduction to R Programming: Introduction to Data Visualization, Installation of R and RStudio, Features of R, R Environment, Variables, Data Types, Operators, Control Statements, Loops, Functions			
UNIT-II		4 Hrs	
Data Import and Manipulation: Reading CSV, Excel, and Text Files, Writing Data Files, Data Cleaning, Missing Values, Data Transformation, Data Aggregation, Sorting, Filtering, Merging Datasets			
UNIT-III		4 Hrs	
Data Visualization using Base R: Line Charts, Bar Charts, Pie Charts, Histograms, Box Plots, Scatter Plots, Density Plots, Customizing Graphs, Visualization using ggplot2, Grammar of Graphics, Layers, Themes, Labels, Colours, Faceting, Multiple Plot Types			
UNIT-IV		4 Hrs	
Advanced Visualization: Time Series Visualization, Geographic Maps, Heat Maps, Bubble Charts, Interactive Charts using Plotly, Dashboard Development using Shiny, Data Storytelling, Best Practices in Data Visualization			
LABORATORY COMPONENT			
1. Install R and RStudio and execute basic R programs using variables, operators, and control statements.			
2. Develop programs using vectors, matrices, lists, factors, and data frames.			
3. Import CSV and Excel datasets and perform data preprocessing.			
4. Perform data manipulation using sorting, filtering, aggregation, and merging operations.			
5. Compute descriptive statistics and perform exploratory data analysis on datasets.			
6. Develop visualizations using Base R graphics (line chart, bar chart, histogram, pie chart, scatter plot, box plot).			
7. Create professional visualizations using the ggplot2 package.			
8. Customize charts using themes, colours, labels, legends, and faceting in ggplot2.			

9. Develop interactive visualizations using the Plotly package. 10. Design a simple interactive dashboard using Shiny to visualize real-world datasets.
Textbook(s): 1. Kieran Healy, Data Visualization: A Practical Introduction , Princeton University Press, 2nd Edition.
Reference Book(S): 1. Hadley Wickham, ggplot2: Elegant Graphics for Data Analysis , Springer, 3rd Edition.
Laboratory Manual (for laboratory component): <i>3.R Programming laboratory manual and Record Book</i> Department of CSE

Course Articulation Matrix (CAM):								U24CS612X Cloud Computing Essentials					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
U24CS612X.1	1	1	1	1	-	-	-	-	1	-	-	1	1
U24CS612X.2	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS612X.3	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS612X.4	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS612X.5	2	2	2	1	-	-	-	-	1	-	-	2	2
U24CS612X.6	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS612X.7	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS612X.8	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS612X	1.87	1.87	1.87	1	-	-	-	-	1	-	2	1.87	1.62
3 - HIGH, 2 - MEDIUM, 1 - LOW													

INDUSTRIAL IOT			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS613X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: Explain the concepts, architecture, and applications of Industrial Internet of Things			
CO2:Develop IIoT systems using sensors, actuators, microcontrollers, and communication protocols			
CO3: Apply cloud and edge computing technologies for industrial data acquisition, monitoring, and automation			
CO4: Explain industrial security, predictive maintenance, and smart manufacturing applications of IIoT			
CO5: Implement sensor interfacing and industrial device communication			
CO6: Develop IIoT applications using microcontroller platforms and cloud services			
CO7: Analyze industrial data for monitoring and automation using IoT dashboards			
CO8: Implement secure IIoT applications for industrial environments			
THEORY COMPONENT			
UNIT-I			4 Hrs
Introduction to Industrial IoT: Evolution of IoT, IoT vs IIoT, Characteristics of IIoT, Industrial Automation, Cyber-Physical Systems (CPS), Industry 4.0, IIoT Architecture, Components of IIoT, Industrial Applications			
UNIT-II			4 Hrs
IIoT Devices and Communication: Sensors and Actuators, Microcontrollers (Arduino, ESP32), Embedded Systems, RFID, Wireless Sensor Networks, Industrial Communication Protocols (MQTT, CoAP, Modbus, OPC-UA), Industrial Gateways			
UNIT-III			4 Hrs
Cloud and Edge Computing for IIoT: Cloud Platforms for IoT, Edge Computing, Data Acquisition, Data Storage, Real-Time Monitoring, IoT Dashboards, Industrial Data Analytics, Predictive Maintenance, Smart Manufacturing, Digital Twin Concepts			
UNIT-IV			4 Hrs
IIoT Security and Applications: Security Challenges in IIoT, Authentication and Authorization, Data Encryption, Secure Communication, Industrial Network Security, Smart Factory, Smart Grid, Intelligent Transportation Systems, Precision Agriculture, Future Trends in IIoT			
LABORATORY COMPONENT			
11. Study Arduino IDE/ESP32 development environment and interface digital input/output devices.			
12. Interface temperature, humidity, light, and motion sensors with Arduino/ESP32.			
13. Develop programs for controlling LEDs, relays, and motors using microcontrollers.			

14. Read sensor data and display it on Serial Monitor/LCD/OLED display.
15. Establish communication between IoT devices using Wi-Fi and MQTT protocol.
16. Upload sensor data to cloud platforms such as ThingSpeak, Blynk, or AWS IoT Core.
17. Develop an IoT dashboard for monitoring real-time industrial sensor data.
18. Implement a smart industrial monitoring system with threshold-based alerts.
19. Develop a predictive maintenance application using sensor data visualization.
20. Implement secure communication between IoT devices and cloud using authentication mechanisms.

Textbook(s):

2. Arshdeep Bahga and Vijay Madisetti, **Internet of Things - A Hands-on Approach**, Universities Press, First Edition

Reference Book(S):

2. Raj Kamal, **Internet of Things: Architecture and Design Principles**, McGraw-Hill Education.

Laboratory Manual (for laboratory component):

4. *Internet of Things laboratory manual and Record Book* Department of CSE

Course Articulation Matrix (CAM):								U24CS613X Cloud Computing Essentials					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
U24CS613X.1	1	1	1	1	-	-	-	-	1	-	-	1	1
U24CS613X.2	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS613X.3	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS613X.4	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS613X.5	2	2	2	1	-	-	-	-	1	-	-	2	2
U24CS613X.6	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS613X.7	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS613X.8	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS613X	1.87	1.87	1.87	1	-	-	-	-	1	-	2	1.87	1.62
3 - HIGH, 2 - MEDIUM, 1 - LOW													

DEV OPS DEVELOPMENT			
Class: B.Tech. I Yr- (Exit Course)		Branch: CSE	
Course Code:	U24CS614X	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 Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1:Explain DevOps principles, practices, culture, and the software development lifecycle			
CO2: Apply version control, continuous integration, and continuous delivery tools in software development			
CO3: Develop containerized applications and automate deployment using DevOps tools			
CO4: Implement infrastructure automation, monitoring, and cloud-based DevOps practices			
CO5: Implement source code management using Git and GitHub			
CO6: Develop CI/CD pipelines using Jenkins and DevOps automation tools			
CO7: Deploy applications using Docker containers and container orchestration			
CO8: Implement infrastructure automation, monitoring, and cloud deployment using DevOps practices			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Introduction to DevOps: Software Development Life Cycle (SDLC), Traditional Development vs DevOps, DevOps Principles, DevOps Culture, Agile Methodology, Continuous Integration (CI), Continuous Delivery (CD), Continuous Deployment, DevOps Lifecycle, Introduction to DevSecOps			
UNIT-II		4 Hrs	
Version Control and Build Automation: Git Fundamentals, Git Repository, Branching, Merging, Pull Requests, GitHub Workflow, Build Automation Concepts, Maven Basics, Dependency Management, Jenkins Architecture, Creating Build Jobs, Automated Testing			
UNIT-III		4 Hrs	
Infrastructure Automation and Monitoring: Infrastructure as Code (IaC), Ansible Basics, Configuration Management, Continuous Monitoring, Logging, Prometheus, Grafana, DevOps Security Best Practices, CI/CD Pipeline Design, Emerging Trends in DevOps and MLOps			
UNIT-IV		4 Hrs	
Containerization and Cloud Deployment: Docker Architecture, Docker Images, Containers, Dockerfile, Docker Compose, Container Registry, Kubernetes Fundamentals, Pods, Services, Deployments, Scaling Applications, Introduction to Cloud-based DevOps			
LABORATORY COMPONENT			
21. Install Git and configure a local repository; perform basic Git operations.			
22. Create and manage repositories using GitHub, including branching,			

merging, and pull requests. 23. Install and configure Jenkins; create a simple CI build job. 24. Automate software build and testing using Jenkins. 25. Install Docker and perform container operations such as creating, running, stopping, and removing containers. 26. Create Docker images using Dockerfiles and manage multi-container applications using Docker Compose. 27. Deploy a containerized application on Kubernetes using Pods and Deployments. 28. Automate server configuration and software installation using Ansible playbooks. 29. Configure monitoring dashboards using Prometheus and Grafana. 30. Build and demonstrate a complete CI/CD pipeline by integrating GitHub, Jenkins, Docker, and Kubernetes.
Textbook(s): 3. Gene Kim, Jez Humble, Patrick Debois, and John Willis, The DevOps Handbook , Addison-Wesley Professional, 2nd Edition
Reference Book(S): 3. Jez Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation , Addison-Wesley
Laboratory Manual (for laboratory component): 5. Devops laboratory manual and Record Book Department of CSE

Course Articulation Matrix (CAM):								U24CS614X Cloud Computing Essentials					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
U24CS614X.1	1	1	1	1	-	-	-	-	1	-	-	1	1
U24CS614X.2	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS614X.3	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS614X.4	2	2	2	1	-	-	-	-	1	-	2	2	1
U24CS614X.5	2	2	2	1	-	-	-	-	1	-	-	2	2
U24CS614X.6	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS614X.7	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS614X.8	2	2	2	1	-	-	-	-	1	-	2	2	2
U24CS614X	1.87	1.87	1.87	1	-	-	-	-	1	-	2	1.87	1.62
3 - HIGH, 2 - MEDIUM, 1 - LOW													

URR24: SYLLABI FOR VII & VIII SEMESTERS of B. TECH COMPUTER SCIENCE & ENGINEERING w.e.f. A.Y. 2024-25

VII SEMESTER

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OPEC	U24OE701X	Open Elective -SDG	2	1	-	3	3
2	PEC	U24CS702	Program Elective - II/ MOOCs-II	2	1	-	3	3
3	PCC	U24CS703	Cloud Computing	2	1	-	3	3
4	PCC	U24CS704	Generative AI	2	1	-	3	3
5	PCC	U24CS705	Data Science Essentials	2	1	-	3	3
6	PCC	U24CS706	Cloud Computing Laboratory	-	-	2	2	1
7	PCC	U24CS707	Data Science Laboratory	-	-	2	2	1
8	ELC	U24CS708	Internship Evaluation*	-	-	2	2	1
9	ELC	U24CS709	Major Project, Phase-1 / Industrial Internship - 1	-	-	8	8	4
Total:				10	5	14	29	22
Additional Learning@: Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	26

Pool - XIX		
Sustainable Development Goals Basket (OE - SDGB)		
S. No.	Course Code	Course Title
1.	U24OE701A	Sustainable Waste Management and Circular Economy (Offered by CE Dept.)
2.	U24OE701K	Embedded System for Sustainable Innovation (Offered by ECE Dept.)
3.	U24OE701O	AI Ethics (Offered by CSE(AI&ML) Dept.)
4.	U24OE701S	Software Testing and Quality Assurance (Offered by IT Dept.)
5.	U24OE701W	Network Automation (Offered by CSN Dept.)
6.	U24OE701	Any other course approved by BoS Chair and Dean AA

SUSTAINABLE WASTE MANAGEMENT AND CIRCULAR ECONOMY			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24OE701A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total No of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: appraise the concept of waste management CO2 : analyze activities associated with the management of hazardous wastes CO3: apply the concept of circular economy and conduct relevant research CO4: create business models for sustainable development using complex aspects of circular economy.			
UNIT-I			9 Hrs
Waste management: Introduction, context and overview of waste management, waste landscape in India, hierarchy of waste management, sources of waste and waste streams, challenges and opportunities in waste management. Strategies for Waste management: Need for National Waste Management Strategies (NWMS), Concepts and principles, objectives, goals and targets, policy tools for waste management, process of developing NWMS, implementation of NWMS, roles and responsibilities of various sectors, supporting initiatives of public and private domains, international recommendations and mandates.			
UNIT-II			9 Hrs
Elements of Hazardous waste management: Hazardous waste definition, sources, identification and classification, Collection, handling, storage and transport, Hazardous waste management rules and regulations, treatment technologies, Hazardous waste disposal, Hazardous waste landfills- Site selections, design and operation. Hazardous waste reduction, recycling and reuse, remediation of hazardous waste contaminated sites. Management of different Hazardous waste: Sources, Production, collection, segregation, treatment and disposal of hazardous wastes - plastic waste -biomedical waste- E-waste-nuclear waste- Global and Indian Context, Hazardous Waste Management Practices – Health and environmental effects, recycling, energy production, landfilling, other applications.			
UNIT-III			9 Hrs
Introduction to Circular Economy: Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs Circular Economy.			

Characteristics of Circular Economy: Material recovery, waste reduction, reducing negative externalities, explaining butterfly diagram, concept of loops.	
UNIT-IV	9 Hrs
Circular design, innovation and Assessment: Zero waste- Waste Management in context of Circular Economy, Circular design, Research and innovation, Life Cycle Assessment (LCA), Circular Business Models Case Studies and Legal policy framework Business models, Solid Waste Management / Wastewater, Plastics: A case study, EPR: polluters pay principle, Industrial symbiosis/ Eco-parks, Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG	
<u>Textbook(s):</u> - Guidelines For National Waste Management Strategies: Moving from Challenges to Opportunities—UNEP-United Nations Institute for Training and Research-2013-ISBN: 978-92-807-3333-4 - Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel, CRC Press, 2014, 2nd Edition. - Integrated Solid Waste Management, Engineering Principles and Management Issues, Tchobanoglous G, Theisen H and Vigil SA, McGraw Hill Education, 2014, Indian Edition	
<u>Reference Book(S):</u> - Guidelines For National Waste Management Strategies: Moving from Challenges to Opportunities—UNEP-United Nations Institute for Training and Research-2013-ISBN: 978-92-807-3333-4 - National Waste Management Strategy 2020- Minister of Forestry, Fisheries and the Environment, Republic of South Africa <i>Circular Economy: A Credit Point Course</i>, Proposed by International Council for Circular Economy (ICCE) New Delhi, In Collaboration with All India Council for Technical Education (AICTE) New Delhi. - The Circular Economy A User's Guide Walter R Stahel Routledge; 1st Edition (24 June 2019) - Circular Economy: (Re) Emerging Movement Shalini Goyal Bhalla Invincible Publisher - The Circular Economy Handbook: Realizing The Circular Advantage Peter Lacy, Jessica Long, Wesley Spindler Palgrave Macmillan UK - Waste to Wealth: The Circular Economy Advantage Peter Lacy, Jakob Rutqvist Palgrave Macmillan	
<u>Web and Video link(s):</u> https://nptel.ac.in/courses/105105160 NPTEL Course on Integrated Waste Management for a Smart City (Municipal Solid Waste, C&D Waste, E-Waste, NWMS, Waste Hierarchy, Policy Tools, Composting, Landfilling) by Prof. Brajesh Kumar Dubey, IIT Kharagpur. https://nptel.ac.in/courses/105105169 NPTEL Course on Electronic Waste Management – Issues and Challenges (E-Waste Generation, Biomedical, Plastic & Hazardous Waste Rules, Recycling, Landfill Design, Remediation) by Prof. Brajesh Kumar Dubey, IIT Kharagpur. https://nptel.ac.in/courses/105103205 NPTEL Course on Municipal Solid Waste Management (Circular Economy Principles, Material Recovery, LCA, Butterfly Diagram, Waste Reduction & Loop Strategies) by IIT Guwahati. https://onlinecourses.nptel.ac.in/noc25_ce122/preview NPTEL Course on Integrated Waste Management for a Smart City – 2025 Edition (Circular Business Models, EPR, Industrial Symbiosis, ESG, Zero-Waste Strategies, India CE Policy Framework) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.	

Course Articulation Matrix (CAM):			U24OE701A -SUSTAINABLE WASTE MANAGEMENT AND CIRCULAR ECONOMY											
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE701A.1	2	1	1	1	-	1	1	1	-	1	1	2	1
CO2	U24OE701A.2	2	1	1	1	-	1	1	1	1	1	1	2	1
CO3	U24OE701A.3	2	2	2	1	-	1	1	1	1	1	1	2	1
CO4	U24OE701A.4	2	1	1	1	2	1	1	1	1	1	1	2	1
U24OE701A		2	1.25	1.25	1	2	1	1	1	1	1	1	2	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	appraise the concept of waste management	SDG 12	Responsible Consumption and Production	Appraising the waste management hierarchy, National Waste Management Strategies (NWMS), and policy tools for controlling waste streams directly promotes responsible consumption, sustainable production patterns, and significant reduction of waste generation across municipal, industrial, and hazardous waste sectors.
CO2	analyze activities associated with the management of hazardous wastes	SDG 11	Sustainable Cities and Communities	Analyzing collection, handling, treatment, landfill design, and regulatory compliance for hazardous wastes – including plastic, biomedical, e-waste, and nuclear waste – safeguards human health and environmental quality, contributing to the development of safe, resilient, and environmentally sustainable urban and industrial communities.
CO3	apply the concept of circular economy and conduct relevant research	SDG 9	Industry, Innovation and Infrastructure	Applying circular economy principles – material recovery, waste reduction, LCA, butterfly diagram, and loop strategies – and conducting innovation-driven research fosters sustainable industrial practices that decouple economic growth from resource depletion, supporting resilient and environmentally responsible industrial infrastructure.
CO4	create business models for sustainable development using complex aspects of circular economy.	SDG 9	Industry, Innovation and Infrastructure	Creating circular business models – incorporating EPR, industrial symbiosis, eco-parks, zero-waste strategies, ESG frameworks, and India-specific CE policy goals – drives innovation-led, resource-efficient industry and contributes to inclusive, sustainable economic growth aligned with SDG 9 and the global circular economy agenda.

EMBEDDED SYSTEMS FOR SUSTAINABLE INNOVATION			
Class: B. Tech. VII- Semester		Branch: Common to all	
Course Code:	U24OE701K	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : explain the fundamentals of embedded systems and sustainability concepts. CO2 : analyze sensors, actuators, and low-power embedded technologies used in sustainable applications. CO3 : apply embedded hardware and software concepts to develop smart monitoring and control systems. CO4 : evaluate embedded system solutions for sustainable applications in energy, agriculture, environment, and healthcare sectors..			
UNIT-I			9 Hrs
Fundamentals of Embedded Systems and Sustainability: Introduction to embedded systems, characteristics of embedded systems, embedded hardware and software, microcontrollers and their applications, sensors and actuators, real-time systems, introduction to sustainable development, Sustainable Development Goals (SDGs), role of embedded systems in sustainable innovation, challenges in sustainable system design.			
			9 Hrs
Low-Power Embedded Technologies: Low-power microcontrollers, energy-efficient design principles, battery-powered embedded systems, renewable energy-powered embedded devices, sensor interfacing techniques, environmental sensors, smart sensing systems, wireless communication basics, Bluetooth Low Energy (BLE), ZigBee, LoRa overview, data acquisition systems.			
UNIT-III			9 Hrs
Embedded System Design for Smart Applications: Embedded software development process, embedded C programming concepts, interrupt handling, timers and counters, interfacing sensors and actuators, real-time monitoring systems, smart control systems, introduction to IoT-enabled embedded systems, testing and validation of embedded applications.			
UNIT-IV			9 Hrs
Sustainable Embedded Applications: Smart energy management systems, renewable energy monitoring, smart agriculture systems, environmental monitoring systems, water quality monitoring, healthcare monitoring devices, intelligent transportation systems, smart city applications, future trends in sustainable embedded technologies.			
Textbook(s):			
1. Raj Kamal, <i>Embedded Systems: Architecture, Programming and Design</i> , 3rd Edition, McGraw Hill Education, 2017.			

2. K. V. Shibu, *Introduction to Embedded Systems*. McGraw Hill Education, 2009.
3. David T. Allen and David R. Shonnard, *Sustainable Engineering: Concepts, Design and Case Studies*, Prentice Hall, 2011.

Reference Book(s):

1. Embedded System Design – Frank Vahid, Wiley.
2. Internet of Things: A Hands-On Approach – Arshdeep Bahga & Vijay Madiseti.
3. Building Wireless Sensor Networks – Robert Faludi.

Course Articulation Matrix (CAM):				U24EC701K: Embedded Systems For Sustainable Innovation										
	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24EC701K.1	3	2	1	1	2	1	2	-	-	-	-	2	2
CO2	U24EC701K.2	2	2	3	2	3	2	3	-	-	-	-	2	2
CO3	U24EC701K.3	2	2	3	3	3	2	2	-	-	-	-	2	2
CO4	U24EC701K.4	1	2	2	3	3	3	3	-	-	-	-	2	2
U24EC701K		2	2	2.25	2.25	2.75	2	2.5	-	-	-	-	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Explain the fundamentals of embedded systems and sustainability concepts.	SDG4	Quality Education	Promotes knowledge and awareness of sustainable technologies and embedded system fundamentals, supporting quality technical education.
CO2	Analyze sensors, actuators, and low-power embedded technologies used in sustainable applications.	SDG7	Affordable and Clean Energy	Encourages the development of energy-efficient embedded solutions and low-power technologies that contribute to clean and sustainable energy utilization.
CO3	Apply embedded hardware and software concepts to develop smart monitoring and control systems.	SDG9	Industry, Innovation and Infrastructure	Supports innovation and sustainable industrial development through the design of intelligent embedded and automation systems.
CO4	Evaluate embedded system solutions for sustainable applications in energy, agriculture, environment, and healthcare sectors.	SDG11	Sustainable Cities and Communities	Contributes to the development of smart cities and sustainable communities through intelligent monitoring, resource management, and environmentally responsible technologies.

AI ETHICS			
Class: B. Tech.		Branch: CSE(AI & ML)	
Course Code:	U24OE701O	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : apply the fundamental concepts of artificial intelligence to explain key ethical issues, approaches, and the significance of AI ethics in modern society CO2 : analyze ethical issues in AI through the perspectives of policy, regulation, philosophy of technology, and real-world case studies CO3 : apply ethical frameworks and methods in applied ethics to identify, interpret, and evaluate ethical challenges arising from AI systems CO4 : analyze human values, intelligence, and human nature in the context of AI systems, and assess the boundaries between humans and intelligent machines			
UNIT-I			9 Hrs
Introduction: What is Artificial Intelligence, Why AI Ethics is so exciting?, Bottom-Up and Top-Down approaches to AI Ethics, The boundaries and limitations of ethics, Developing ethical autonomy The Rise of AI Ethics: Ethical questions in AI currently receiving attention, Same or different? What's special about AI Ethics? Common themes and varieties of questions in AI Ethics, Ethical questions in AI currently receiving attention			
UNIT-II			9 Hrs
AI Policy and Regulatory Standards: AI Ethics, Law, Policy, Regulation, Ethics Guidance Case Study - An indigenous AI report AI, Philosophy of Technology, and Ethics: Comparing AI to humans, Case Study - Attributing agency to humans and to AI, A brief introduction to the philosophy of technology, Technology and attitudes towards nature, The implicit values of technology, communication through new technologies			
UNIT-III			9 Hrs
Methods in Applied Ethics: A simple account of methods in Applied Ethics, The challenges from AI for methodology in Applied Ethics, Common assumptions about the nature of ethics and their influence on methodology in Applied Ethics Methodology in Applied Ethics: The stories we tell, Introduction to ethical narratives in AI, Stories about AI systems			
UNIT-IV			9 Hrs
Humans and Intelligent Machines - Underlying Values: The nature and value of intelligence, Values underlying the use of data Human Nature: Self, Reason, Boundaries, Philosophical perspectives - The Divided Self			

and notions of the Higher Self, Reason or Emotion?, The boundaries of Human nature, Boundaries and limits, Is human nature Perfectible?, Myths and origin stories about human nature

Textbook(s):

1. P. Boddington, *AI Ethics*, 1st edition, Cham, Switzerland: Springer International Publishing, 2017. (Chapter 1 to 5)

Reference Book(s):

1. P. Boddington, *Artificial Intelligence: Foundations, Theory, and Algorithms*, Cham, Switzerland: Springer Nature, 2023.
2. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th edition, Hoboken, NJ, USA: Pearson, 2021.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs132; NPTEL Video Lecture on *Responsible & Safe AI Systems* by Prof. Ponnurangam Kumaraguru, Prof. Balaraman Ravindran, Prof. Arun Rajkumar | IIIT Hyderabad, IIT Madras

Course Articulation Matrix (CAM):				U24OE701O: AI ETHICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE701O.1	2	2	2	2	1	1	1	1	1	-	2	2	1
CO2	U24OE701O.2	2	2	3	2	1	1	1	1	1	-	2	3	1
CO3	U24OE701O.3	2	2	2	2	1	1	1	1	1	-	2	3	1
CO4	U24OE701O.4	2	2	3	3	1	1	1	1	1	-	2	3	1
U24OE701O		2	2	2.5	2.25	1	1	1	1	1	-	2	2.75	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	understand and apply the fundamental concepts of artificial intelligence to explain key ethical issues, approaches, and the significance of AI ethics in modern society	SDG4	Quality Education	AI ethics improves critical thinking and awareness about responsible technology use, strengthening quality education and informed learning in emerging technologies.
CO2	analyze ethical issues in AI through the perspectives of policy, regulation, philosophy of technology, and real-world case studies	SDG16	Peace, Justice and Strong Institutions	Studying AI governance, law, and policy supports ethical decision-making, transparency, and responsible institutional frameworks for trustworthy AI systems.
CO3	apply ethical frameworks and methods in applied ethics to identify, interpret, and evaluate ethical challenges arising from AI systems	SDG9	Industry, Innovation and Infrastructure	Ethical analysis methods help design safer and more responsible AI systems, promoting innovation with accountability in technological development.

CO4	analyze human values, intelligence, and human nature in the context of AI systems, and assess the boundaries between humans and intelligent machines	SDG3	Good Health and Well-being	Understanding human-centered AI and value alignment supports safer AI applications in healthcare, psychology, and human well-being systems.

SOFTWARE TESTING AND QUALITY ASSURANCE			
Class: B. Tech. VII – Semester		Branch: All Branches	
Course Code:	U24OE701S	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
<i>After completion of this course, the students should be able to,</i>			
CO1: apply software testing techniques such as unit testing, mutation testing, debugging, and data flow testing to identify and prevent defects in software systems			
CO2: analyze control flow graphs, integration testing approaches, and system testing categories to evaluate the effectiveness of software testing processes			
CO3: apply functional testing methods and system test planning techniques to design effective test cases and automate system testing activities			
CO4: analyze software quality assurance principles, quality standards, metrics, and reliability models to assess software quality and reliability			
UNIT-I			9 Hrs
Overview of Software Testing: Software Quality, Role of testing, testing approaches			
Unit Testing: Concept of Unit Testing, Defect Prevention, Mutation Testing, Debugging, Unit Testing in eXtreme Programming			
Data Flow Testing: Data Flow Anomaly, Data Flow Graph, Data Flow Testing Criteria, Feasible Paths and Test Selection Criteria, Comparison of Testing Techniques.			
UNIT-II			9 Hrs
Control Flow Testing: Control Flow Graph, Paths in a Control Flow Graph, All-Path Coverage Criterion, Statement Coverage Criterion, Branch Coverage Criterion, Examples of Test Data Selection			
System Integration Testing: System Integration Techniques, Types of Interfaces and Interface errors, Software and Hardware Integration, Off the shelf component testing, Built-in Testing			
System Test Categories: Basic Tests, Functionality Tests, Robustness Tests, Interoperability Tests, Performance Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Documentation Tests			
UNIT-III			9 Hrs
Functional Testing: Equivalence Class Partitioning Boundary value Analysis, Decision Tables, Random Testing, Error guessing, Category Partition			
System Test Design and Planning: Test Design Factors, Requirement Identification, Characteristics of Testable Requirements, Test Design Preparedness Metrics, Test Case Design Effectiveness			
System Test Planning, Automation: Structure of a System Test Plan, Beta Testing, System Test Automation			
UNIT-IV			9 Hrs
Software Quality Assurance: Five views of Software Quality, McCall's Software Quality Factors, Quality Criteria, Relationship between Quality factors and Criteria, Components of SQA, Software Quality Standards and their requirements, Software Quality Metrics, Software Reliability Models			

Textbook(s):

1. Kshirasagar Naik and, Priyadarshi Tripathy, *Software Testing and Quality Assurance: Theory and Practice*, A John Wiley & Sons, Inc., Publication, 2008

Reference Book(s):

1. Naresh Chauhan, *Software Testing: Principles and Practices*, India : Oxford University Press, 2010
2. Daniel Galin, *Software Quality Assurance: From Theory to Implementation*, Pearson Education, 2003

Web and Video link(s):

<https://nptel.ac.in/courses/106101163> NPTEL Video Lecture on Software Testing, Prof. Meenakshi D'souza, Professor of CSE, IIT Bangalore

Course Articulation Matrix (CAM):					U24OE701S SOFTWARE TESTING AND QUALITY ASSURANCE									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE701S.1	2	2	1	1	-	-	1	-	1	2	-	1	1
CO2	U24OE701S.2	2	2	1	1	-	-	1	-	1	2	-	1	1
CO3	U24OE701S.3	2	2	1	1	-	-	1	-	1	2	-	1	1
CO4	U24OE701S.4	2	2	1	1	-	-	1	-	1	2	-	1	1
U24OE701S		2	2	1	1	-	-	1	-	1	2	-	1	1

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply software testing techniques such as unit testing, mutation testing, debugging, and data flow testing to identify and prevent defects in software systems	SDG 9	Industry, Innovation and Infrastructure	Testing techniques improve software reliability and support the development of robust digital infrastructure and innovative software systems
CO2	analyze control flow graphs, integration testing approaches, and system testing categories to evaluate the effectiveness of software testing processes	SDG 9	Industry, Innovation and Infrastructure	Integration and system testing ensure dependable software solutions for industrial and technological applications
CO3	apply functional testing methods and system test planning techniques to design effective test cases and automate system testing activities	SDG 8	Decent Work and Economic Growth	Automated and efficient testing practices enhance software productivity, reduce development costs, and improve organizational efficiency
CO4	analyze software quality assurance principles, quality standards, metrics, and reliability models to assess software quality and reliability	SDG 12	Responsible Consumption and Production	Quality assurance promotes efficient use of resources, reduces software failures and rework, and supports sustainable software development practices

NETWORK AUTOMATION			
Class: B. Tech. VII – Semester		Branch: CSE (Networks)	
Course Code:	U24OE701W	Credits:	3
Hours/Week (L-T-P- E):	3-0-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : examine linux distributions for network automation and programmability CO2 : create python scripts and modules to automate networks CO3 : develop data models with YAML, XML, JSON, YANG to exchange data between network devices CO4 : design automated networks using network API's and analyze networks using automation tools			
UNIT-I			9 Hrs
Network industry trends: The rise of Software Defined Networking, Open Flow. Technologies and trends in SDN: Open Flow, Network Functions Virtualization, Virtual Switching, Network Virtualization, Device APIs, Network Automation, Bare metal Switching, Data center network fabrics, SD-WAN, controller networking Network Automation: Why Network Automation, Network Automation tasks, Evolving management plane from SNMP to device APIs, Network Automation in SDN Era LINUX: Examining Linux in Network Automation context, Linux distributions. Networking in Linux			
UNIT-II			9 Hrs
PYTHON IN A NETWORK CONTEXT: Should Network Engineers learn to code, Using python interactive interpreter, Data Types, Understanding Containment, Loops, Using python Functions, Working with files PYTHON PROGRAMMING: Creating python programs, Understanding shebang, migrating code from python interpreter to python script, working with python modules, passing arguments into python script PACKAGES: Using pip and installing python packages			
UNIT-III			9 Hrs
DATA FORMATS: Introduction to Data format, Types of data DATA MODELS: YAML: Reviewing YAML basics, working with YAML in python, Data Models in YAML. XML: Reviewing XML Basics, Using XSD for Data Models, transforming XML with XSLT. JSON: Reviewing JSON Basics, working with JSON in python, Using JSON schema for Data Models. YANG: overview, taking a deeper dive into YANG NETWORK CONFIGURATION TEMPLATES: Rise of modern template languages, Value of templates in network automation JINJA: Jinja for network configuration templates, Dynamically inserting data, Rendering a Jinja template, Conditions and loops, Jinja filters, Template creation			
UNIT-IV			9 Hrs
NETWORK APIs: HTTP-Based APIs: restful, non-restful. NETCONF: overview, protocol stack Exploring Network APIs: HTTP-Based APIs: cURL, Postman			

AUTOMATING USING NETWORK APIs: Using python requests Library, CISCO-NX API, Using python ncclient library. Using netmiko
AUTOMATION TOOLS: Reviewing Automation tools, ANSIBLE - Overview, Understanding how Ansible works, SALT - Overview, Architecture, STACKSTORM - Event-Driven automation, concepts, Architecture
Textbook(s): [1] Jasen Edelman, Scott.S Lowe & Matt Oswalt, <i>Network Programmability and Automation</i> , O'REILLY publishers, February 2018 First Edition (<i>Chapters: 1,2,3,4,5,6,7</i>)
Reference Book(S): [1] Abhishek Ratan, <i>Practical Network Automation</i> , Packt publishers, 2018 Second Edition
Web and Video link(s): https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs66 ; NPTEL Video Lecture on Edge Computing by Prof. Rajiv Misra, IIT patna.

Course Articulation Matrix (CAM):				U24OE701W: NETWORK AUTOMATION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE701W.1	2	2	2	1	2	-	-	1	1	1	-	2	2
CO2	U24OE701W.2	2	2	2	2	1	-	-	1	1	1	-	2	2
CO3	U24OE701W.3	2	2	3	3	2	-	-	1	1	1	-	2	2
CO4	U24OE701W.4	2	3	2	3	3	-	-	1	1	1	-	2	2
U24OE701W		2	2.25	2.25	2.2	2	-	-	1	1	1	-	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Explain the concepts, architecture, and applications of edge, fog, and cloud computing in distributed and IoT environments.	SDG 9	Industry, Innovation and Infrastructure	Linux-based network automation supports modern digital infrastructure, scalable networking, and innovative IT operations used in smart industries and communication systems.
CO2	Analyze the role of edge and fog computing in data processing, low-latency communication, and real-time IoT applications.	SDG 4	Quality Education	Developing programming and automation skills enhances technical competency, digital literacy, and industry-relevant education aligned with modern engineering practices.
		SDG 8	Decent Work and Economic Growth	Automation skills improve employability in networking, cloud computing, DevOps, and IT sectors, contributing to economic productivity and skilled workforce development.
CO3	Implement edge and fog computing	SDG 9	Industry, Innovation	Standardized data models improve interoperability,

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	solutions using modern tools, platforms, and APIs for distributed infrastructures.		and Infrastructure	reliability, and efficiency of communication infrastructure and intelligent network systems.
		SDG 12	Responsible Consumption and Production	Efficient network automation and optimized data exchange reduce manual configuration errors, unnecessary resource usage, and operational wastage in IT environments.
CO4	Design and evaluate IoT-based applications integrating edge, fog, and cloud computing technologies for efficient resource management and data analytics.	SDG 9	Industry, Innovation and Infrastructure	API-driven automation and intelligent network management enable resilient, scalable, and innovative digital infrastructure for enterprises and smart services.
		SDG 11	Sustainable Cities and Communities	Automated and reliable communication networks support smart city infrastructure, digital public services, and efficient urban connectivity systems.

AGENTIC AI			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code:	U24CS702A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: apply the concepts, architectures, and characteristics of intelligent autonomous agents and multi-agent systems to design a solution for a real-world problem. CO2: design reflective and collaborative AI agents using reasoning, monitoring, communication, and coordinator-worker-delegator (CWD) approaches. CO3: develop efficient agentic workflows using system prompts, memory architecture, context management, and workflow optimization techniques. CO4: implement intelligent AI applications using Large Language Models, Retrieval-Augmented Generation (RAG), and Agentic AI frameworks such as LangChain, LangGraph, and LangSmith.			
UNIT-I			9 Hrs
Introduction to Agentic AI: Introduction to Agentic AI, Traditional AI Vs Agentic AI and Generative AI, Capabilities of Agentic AI, Benefits and Agentic AI Use Cases. Autonomous and Intelligent Agents: Autonomous Agents, Reviewing Intelligent Agents and their Characteristics. Agent Architectures: Exploring the Architecture of Agentic Systems, Deliberative Architectures, Reactive Architectures, Hybrid Architectures. Multi-Agent Systems: Definition and Characteristics of MAS, Interaction Mechanisms in MASs.			
UNIT-II			9 Hrs
Reflection and Reasoning in Agents: Reflection in Agents, Implementing Reflective Capabilities, Traditional Reasoning, Meta-Reasoning with AI Agents and CrewAI Framework. Agent Monitoring and Learning: Performance Monitoring, Self-Explanations and Transparency with AI Agents, Learning and Refinement with AI Agents. Collaborative Agent Design: Understanding the Coordinator-Worker-Delegator (CWD) Model, Designing Agents with Role Assignments. Agent Communication and Coordination: Communication and Collaboration Between Agents, Implementing the CWD Approach in Generative AI Systems.			

UNIT-III	9 Hrs
Agentic System Design: Effective Agentic System Design Techniques, Focused System Prompts and Instructions for Agents. Environment Modeling and Integration: State Spaces and Environment Modeling, Integration and Interaction Patterns. Monitoring and Memory Management: Monitoring and Adaptation, Agent Memory Architecture and Context Management. Agentic Workflows: Sequential and Parallel Processing in Agentic Workflows, Workflow Optimization.	
UNIT-IV	9 Hrs
Large Language Models for Agentic AI: Introduction to Large Language Models. Retrieval-Augmented Generation: Retrieval-Augmented Generation (RAG) Model. Agentic AI Frameworks: LangChain – Modular Agent Design, RAG Integration. Agent Orchestration and Deployment: LangGraph – Low-Level Orchestration Framework for Building, Managing and Deploying Stateful Agents, LangSmith.	
Textbook(s): 1. Anjanava Biswas, Wrick Talukdar and Matthew R Scott, <i>Building Agentic AI Systems: Create intelligent, autonomous AI agents that can reason, plan, and adapt</i>, Packt Publication, 2025.	
Reference Book(S): 1. Stuart Russell, Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i>, 4th Edition, Pearson, 2021. 2. Yoav Shoham, Kevin Leyton-Brown, <i>Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations</i>, 1st Edition, Cambridge University Press, 2009.	
Web and Video link(s):	

Course Articulation Matrix (CAM):				U24CS702A : AGENTIC AI										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS702A.1	3	2	1	1	2	1	-	-	1	1	1	3	2
CO2	U24CS702A.2	3	3	2	2	2	1	-	-	2	2	1	3	3
CO3	U24CS702A.3	2	3	3	2	3	1	-	-	2	2	2	3	3
CO4	U24CS702A.4	2	2	3	2	3	1	-	-	1	2	2	3	3
U24 CS702A		3	3	2	2	3	1	-	-	2	2	2	3	3
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply image pre-processing techniques	SDG3	Good Health and Well-being	Image pre-processing enhances medical images (MRI, CT, X-ray) by reducing noise and improving contrast, enabling accurate diagnosis and early disease detection.
CO2	Apply frequency domain filtering, restoration and reconstruction techniques	SDG9	Industry, Innovation and Infrastructure	Frequency domain filtering and restoration techniques improve image quality in industrial and satellite imaging systems, supporting reliable infrastructure monitoring and innovation.
CO3	Apply morphological processing and segmentation techniques	SDG11	Sustainable Cities and Communities	Image segmentation and morphological analysis enable applications like traffic analysis, surveillance, and urban monitoring, contributing to safer and smarter cities.
CO4	Apply feature extraction and classification techniques	SDG9	Industry, Innovation and Infrastructure	Feature extraction and classification form the backbone of AI-driven systems such as autonomous vehicles, industrial automation, and smart analytics, fostering technological innovation.

BIG DATA ANALYTICS			
Class: B. Tech. VI – Semester		Branch: CSE	
Course Code:	U24CS702B	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: apply the fundamental concepts of big data platforms, analytics, and NoSQL technologies for managing and processing large-scale digital data			
CO2: develop and optimize distributed data processing applications using Apache Hadoop, MapReduce, HDFS, YARN, and MongoDB			
CO3: analyze and implement distributed database and data warehousing solutions using Cassandra and Hive for large-scale data storage and analytics.			
CO4: apply Pig and Jasper Reports for big data transformation, analysis, visualization, and reporting applications			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction to Digital & Big Data: Types of digital data, Classification of digital data, Characteristics of data, Evolution of big data, Definition of big data, Challenges with big data, 3V’s of Big data, Non definitional traits of Big Data - Business intelligence Vs Big Data - Data warehouse and hadoop environment, Coexistence			
Big Data Analytics: Classification of analytics, Data science, Terminologies in big data, CAP Theorem, BASE concept, Few top analytics tools			
The Big Data Technology Landscape: NoSQL (Not Only SQL), Hadoop			
UNIT-II			9 Hrs
Introduction to Hadoop: History of hadoop, Hadoop overview, RDBMS vs hadoop, Distributed computing challenges, Use case of hadoop, Hadoop distributors, Hadoop distributed file system(HDFS), Processing data with hadoop, Managing resources and applications with hadoop YARN (Yet Another Resource Negotiator), Interacting with hadoop ecosystem			
Map Reduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting and Compression			
Mongo DB: Terms used in RDBMS and mongoDB, Data types in mongoDB, mongoDB query language			
UNIT-III			9 Hrs
Introduction to Cassandra: Features of Cassandra, CQL data types, CQLSH, Keyspaces, CRUD (Create, Read, Update, and Delete) operations, Collections, Using a counter, Time to live (TTL), Alter commands, Import and export, Querying system tables			

Introduction to Hive: Hive architecture, Hive data types, Hive file format, Hive query language (HQL), RCFile implementation, SerDe, User defined function (UDF)	
UNIT-IV	9 Hrs
Introduction to pig: Pig on hadoop, Use case for pig-ETL processing, Data types in pig, Running pig, Execution modes of pig, HDFS commands, Relational operators, Eval function, Complex data types, Pigg bank, User defined functions (UDF), Parameter substitution, Diagnostic operator, Word count example using pig, Pig vs hive Introduction to Jasper Reports: Connecting to mongoDB NoSQL database, Connecting to cassandra NoSQL database Case Study: Global innovation network and analysis (GINA)	
Textbook(s):	
1. Seema Acharya and Subhashini Chellappan, <i>Big Data Analytics</i> , Wiley India Pvt. Ltd., 2 nd edition, 2019, New Delhi. (Chapters 1 to 11)	
Reference Book(S):	
1. John Wiley, <i>Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data</i> , EMC Education Services, 1 st edition, 2015, United States: Indianapolis. 2. DT Editorial Services, <i>BIG DATA, Black Book</i> , DreamTech Press, 1 st edition, 2016, New Delhi. 3. Russell Bradberry, Eric Blow, <i>Practical Cassandra: A Developers Approach</i> , Pearson Education, 1 st edition, 2014, New York. 4. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, <i>Big Data for Dummies</i> , John Wiley & Sons, Inc., 1 st edition, 2013, New York. 5. Kyle Banker, <i>MongoDB in Action</i> , Manning Publications Company, 1 st edition, 2012, George Town. 6. Tom White, <i>Hadoop: The Definitive Guide</i> , O'Reilly Publications, 4th edition, 2011, New York.	
Web and Video link(s):	
https://onlinecourses.nptel.ac.in/noc25_cs131/preview ; NPTEL Video Lecture on Big Data Computing by Prof. Rajiv Misra, Professor of CSE, IIT Patna.	

Course Articulation Matrix (CAM):				U24CS702B: BIG DATA ANALYTICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS702.1	2	2	1	1	-	-	1	1	1	-	1	2	1
CO2	U24CS702.2	2	2	2	1	-	-	1	1	1	-	1	2	1
CO3	U24CS702.3	2	2	2	2	-	-	1	1	1	-	2	2	1
CO4	U24CS702.4	2	2	2	2	-	-	1	1	1	-	2	2	2
U24CS702		2	2	1.75	1.5	-	-	1	1	1	-	1.5	2	1.25
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the fundamental concepts of big data platforms, analytics, and NoSQL technologies for	SDG9	Industry, Innovation and Infrastructure	Big data platforms form the backbone of modern digital infrastructure, enabling scalable data processing and supporting innovation in industries

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	managing and processing large-scale digital data			through efficient data management systems.
CO2	develop and optimize distributed data processing applications using Apache Hadoop, MapReduce, HDFS, YARN, and MongoDB	SDG8	Decent Work and Economic Growth	Efficient use of big data tools enhances productivity, supports data-driven decision making in enterprises, and contributes to economic growth and employment in IT and data industries.
CO3	analyze and implement distributed database and data warehousing solutions using Cassandra and Hive for large-scale data storage and analytics	SDG9	Industry, Innovation and Infrastructure	Distributed databases and data warehousing tools enable large-scale analytics, supporting industrial applications such as cloud computing, business intelligence, and big data-driven innovations.
CO4	apply Pig and Jasper Reports for big data transformation, analysis, visualization, and reporting applications	SDG4	Quality Education	Data analytics tools like Pig and reporting tools like Jasper support knowledge extraction, data visualization, and learning systems, contributing to improved education and informed decision-making.

HIGH PERFORMANCE COMPUTING ALGORITHMS			
Class: B. Tech. VII- Semester		Branch: CSE	
Course Code:	U24CS702C	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1:	Understand High Performance Computing (HPC) system architectures and various computational models.		
CO2:	Understand parallel computing architectures, paradigms, and scalability concepts, and apply OpenMP-based shared-memory programming techniques to develop, analyze, and optimize efficient parallel applications.		
CO3:	Understand the various programming frameworks like MPI, OpenMP and CUDA		
CO4:	Learn basics of CUDA programming.		
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction to High Performance Computing: Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments.			
Modern Processors: Stored-Program Computer Architecture, General-Purpose cache-based Microprocessor Architecture, Memory Hierarchies, Multicore processors, Multithreaded processors, Vector processors.			
UNIT-II			9 Hrs
Parallel computers: Taxonomy of parallel computing paradigms, Shared-memory computers, Distributed-memory computers, Hierarchical (hybrid) systems, Networks. Basics of parallelization: Need for Parallelism, Parallel scalability			
Shared-memory parallel programming with OpenMP: Introduction to OpenMP, Profiling OpenMP programs, Performance pitfalls, Case study: OpenMP-parallel Jacobi algorithm.			
UNIT-III			9 Hrs
Distributed-memory parallel programming with MPI: Message passing, Introduction to MPI, MPI performance tools, Communication parameters, Synchronization, serialization, contention, Reducing communication overhead. Case study: Parallel sparse matrix-vector multiply.			
UNIT-IV			9 Hrs
CUDA: Understanding the CUDA computing model and the API using nvcc compiler, Introduction to modern supercomputing architectures featuring NVIDIA processors. CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory			
Textbook(s):			

1. D. B. Kirk and W. W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 4th ed. Cambridge, MA, USA: Morgan Kaufmann, 2022 2. G. Hager and G. Wellein, Introduction to High Performance Computing for Scientists and Engineers. Boca Raton, FL, USA: CRC Press, 2010. 3. A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to Parallel Computing, 2nd ed. Boston, MA, USA: Addison-Wesley, 2003.
Reference Book(S): 1. Grama, A., Gupta, A., Karypis, G., & Kumar, V., Introduction to Parallel Computing, 2nd ed., Addison-Wesley, 2003. 2. Prabhu, C. S. R., Grid and Cluster Computing, PHI Learning, 2008.
Web and Video link(s): ps://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs55

Course Articulation Matrix (CAM):			U24CS702C HIGH PERFORMANCE COMPUTING ALGORITHMS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	U24CS702C.1	3	2	2	2	-	-	-	-	-	-	2	-	2	2
CO2	U24CS702C.2	3	3	-	2		2				-	2	3	2	-
CO3	U24CS702C.3	-	-	3	3	2	3	-	---	-	-	2	2	2	2
CO4	U24CS702C.4	-	3	3	-	2	-	-	-	-	-	2	-	-	2
U24CS702C		1.5	2.5	2.5	2.5	1	1				-	2	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW															

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Understand High Performance Computing (HPC) system architectures and various computational models.	SDG9	Industry, Innovation and Infrastructure	Understanding high-performance computing architectures provides the foundational technical infrastructure necessary to drive scientific innovation. It enables industries to build advanced computational capabilities for complex data processing and research.
CO2	Understand parallel computing architectures, paradigms, and scalability concepts, and apply OpenMP-based shared-memory programming techniques to develop, analyze, and optimize efficient parallel applications.	SDG 8	Decent Work and Economic Growth	Developing and optimizing parallel applications using OpenMP upgrades technological capabilities for higher economic productivity. This specialization prepares the workforce for high-value tech roles, fostering economic growth and employment.
CO3	Understand the various programming frameworks like MPI,	SDG 4	Quality Education	Learning multiple advanced computing frameworks equips students with highly

	OpenMP and CUDA			specialized, industry-relevant technical skills. This directly improves access to quality technical education and boosts future employment readiness.
CO4	Learn basics of CUDA programming.	SDG9	Industry, Innovation and Infrastructure	Mastering basic CUDA programming builds essential skills for GPU-accelerated computing, which drives modern artificial intelligence innovations. This specialized knowledge directly upgrades the technological capabilities of industrial and research sectors.

CYBER SECURITY ESSENTIALS			
Class: B.Tech. VII-Semester		Branch: CSE	
Course Code:	U24CS702D	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Objectives (LOs):			
<i>After completion of this course, the students should be able to,</i>			
CO1:	Understand basic cryptographic techniques for securing information and analyze cyber threats using concepts such as proxies, tunneling, and fraud techniques		
CO2:	Develop skills in identifying and exploiting vulnerabilities, including shellcode, buffer overflows, SQL injection, and web exploit tools.		
CO3:	Demonstrate knowledge of malicious code, its types (worms, viruses), and countermeasures against evasion, privilege escalation, and information theft.		
CO4:	Analyze defense and analysis techniques, including memory forensics, honeypots, and intrusion detection systems, for proactive cybersecurity measures.		
UNIT-I			9 Hrs
Cyber Security Fundamentals: Network and Security Concepts- Information Assurance Fundamentals, Basic Cryptography, Symmetric Encryption, Public Key Encryption, The Domain Name System (DNS), Firewalls, Virtualization, Radio-Frequency Identification Microsoft Windows Security Principles: Windows Tokens, Window Messaging, Windows Program, The Windows firewalls			
UNIT-II			9 Hrs
Attacker Techniques and Motivations: How Hackers Cover Their Tracks (Antiforensics) How and Why Attackers Use Proxies, Types of Proxies, Detecting the Use of Proxies, Tunneling Techniques, Phishing, Smishing, Vishing, and Mobile Malicious Code, Rogue Antivirus, Click Fraud, Threat Infrastructure - Botnets, Fast-Flux, Advanced Fast-Flux			
UNIT-III			9 Hrs
Exploitation: Techniques to Gain a Foothold, Misdirection- Shellcode, Integer Overflow Vulnerabilities, Stack-Based Buffer Overflows, Format String Vulnerabilities, SQL Injection, Malicious PDF Files, Race Conditions, Web Exploit Tools, DoS Conditions, Brute Force and Dictionary Attacks, Misdirection, Reconnaissance, and Disruption Methods: Cross-Site Scripting (XSS), Social Engineering, WarXing, DNS Amplification Attacks			
UNIT-IV			9 Hrs
Malicious Code: Self-Replicating Malicious Code- Worms, Viruses. Evading Detection and Elevating Privileges- Obfuscation, Virtual Machine Obfuscation, Persistent Software Techniques, Rootkits, Spyware, Attacks against Privileged User Accounts and Escalation of Privileges, Token Kidnapping, Virtual Machine Detection. Stealing Information and Exploitation- Form Grabbing, DLL Injection, Browser Helper Objects.			

Defense and Analysis Techniques: Memory Forensics, Honeypots, Malicious Code Naming, Automated Malicious Code Analysis Systems

Textbook(s):

1. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials", CRC Press, Taylor & Francis Group, 2011

Reference Book(s):

1. Mayank Bhusan, Rajkumar Singh Rathore, Aatif Jamshed, "Fundamental of Cyber Security (Principles, Theory and Practices) BPB Publications 2018.

Web and Video link(s):

<https://nptel.ac.in/courses/106106248> Cyber Security and Privacy by Prof. Saji K Mathew, IIT Madras,

Course Articulation Matrix (CAM):				U24CS 702D CYBER SECURITY ESSENTIALS											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	U24CS702D.1	2	2	2	2	1	1	-	1	1	1	-	2	2	2
CO2	U24CS702D.2	2	2	2	2	1	1	-	1	1	1	-	2	2	2
CO3	U24CS702D.3	2	2	2	2	1	1	-	1	1	1	-	2	2	2
CO4	U24CS702D.4	2	2	2	2	1	1	-	1	1	1	-	2	2	2
U24CS702D		2	2	2	2	-	-	-	1	1	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW															

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Understand basic cryptographic techniques for securing information and analyze cyber threats using concepts such as proxies, tunneling, and fraud techniques	SDG 4	Quality Education	It focuses on building strong foundational knowledge in securing information systems. Enhances students' technical and analytical skills in the digital security domain. This aligns with skill-based and outcome-based education principles. The knowledge gained improves students' readiness for real-world cybersecurity challenges. It contributes to employability in fields like ethical hacking, network security, and data protection.
CO2	Develop skills in identifying and exploiting vulnerabilities, including shellcode, buffer overflows, SQL injection, and web exploit tools.	SDG 9	Industry, Innovation and Infrastructure	Focuses on developing skills to identify and exploit system vulnerabilities, which are essential for strengthening cybersecurity frameworks. Techniques such as buffer overflows, SQL injection, and exploit analysis help in uncovering weaknesses in software and network systems. This knowledge enables the design and development of secure, robust, and attack-resistant applications, thereby contributing to resilient digital infrastructure. Furthermore, it supports

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				innovation in cybersecurity practices and tools, which are critical for safe technological advancement.
CO3	Demonstrate knowledge of malicious code, its types (worms, viruses), and countermeasures against evasion, privilege escalation, and information theft.	SDG 9	Industry, Innovation and Infrastructure Justification	Focuses on understanding malicious code such as worms and viruses, along with techniques to prevent cyber threats like privilege escalation and information theft. These cybersecurity measures are essential for protecting digital infrastructure and ensuring secure communication systems. Emphasizes building resilient and reliable technological infrastructure, where security plays a critical role. By preventing attacks and maintaining system integrity, such knowledge supports the safe operation of industries and digital services.
CO4	Analyze defense and analysis techniques, including memory forensics, honeypots for proactive cybersecurity measures.	SDG 9	Industry, Innovation and Infrastructure	Emphasizes advanced cybersecurity techniques such as intrusion detection systems, honeypots, and memory forensics. These techniques are essential for safeguarding modern digital and communication infrastructure. Focuses on building resilient, secure, and reliable technological systems. Cyber defense mechanisms help in early detection and prevention of cyber threats. This ensures the stability and continuous operation of critical IT and network systems. The use of proactive security measures supports innovation by creating a safe digital environment.

EDGE & FOG COMPUTING			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code:	U24CS702E	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : understand the foundations of fog and edge computing networks and different architectures CO2 : design fog and edge computing-based systems and applications using reference architectures CO3 : understand and apply data collection, analysis, decision making and learning methodologies over the edge for different applications CO4 : apply optimization techniques for edge and fog computing			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Foundations: Introduction – Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges, Addressing the challenges in Federating Edge Resources, Introduction, The Networking Challenge, The Management Challenge, Miscellaneous Challenges.			
UNIT-II		9 Hrs	
Middleware: Middleware for Fog and Edge Computing: Introduction, Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures, System Model, Proposed Architecture, Lightweight Container Middleware for Edge Cloud Architectures, Clusters for Lightweight Edge Clouds, Architecture Management – Storage and Orchestration, IoT Integration, Security Management for Edge Cloud Architectures, Data Management in Fog Computing, Fog Data Management.			
UNIT-III		9 Hrs	
Predictive Analysis: Predictive Analysis to Support Fog Application Deployment, Introduction, Motivating Example: Smart Building, Predictive Analysis with FogTorchII, Using Machine Learning for Protecting the Security and Privacy of Internet of Things (IoT) Systems, Introduction, Background, Survey of ML Techniques for Defending IoT Devices, Machine Learning in Fog Computing.			

UNIT-IV	9 Hrs
Applications: Fog Computing Realization for Big Data Analytics, Introduction, Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation, Case Studies, Exploiting Fog Computing in Health Monitoring, Introduction, An Architecture of a Health Monitoring IoT-Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, System Implementation, Case Studies, Experimental Results, and Evaluation.	
Textbook(s): 1. Rajkumar Buyya, Satish Narayana Srirama, <i>Fog and Edge Computing: Principles and Paradigms</i>, 1st edition, Wiley, 2019	
Reference Book(s): 1. Javid Taheri, Shuiguang Deng, <i>Edge Computing: Models, technologies and applications</i>, IET, 2020 2. Xin Sun and Amin Vahdat, <i>Edge Computing: A Primer</i>, CRC Press, 2019 3. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani and M. Niranjanamurthy, <i>Edge Computing Fundamentals, Advances and Applications</i>, CRC Press, 2022	
Web and Video link(s): https://nptel.ac.in/courses/106104449 ; NPTEL Video Lecture on Edge Computing by Prof. Rajiv Misra, Professor of CSE, IIT Kanpur	

Course Articulation Matrix (CAM):				U24CS702E: EDGE & FOG COMPUTING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS702E.1	2	1	-	-	1	-	-	-	-	-	1	1	1
CO2	U24CS702E.2	2	2	1	1	1	-	-	-	1	1	1	2	2
CO3	U24CS702E.3	2	2	2	1	2	-	-	1	1	-	2	2	2
CO4	U24CS702E.4	2	2	2	1	2	-	-	1	-	2	2	2	2
U24CS702E		2	1.75	1.6	1	1.5	-	-	1	1	0.75	1.5	1.75	1.75
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	understand the foundations of fog and edge computing networks and different architectures	SDG9	Industry, Innovation and Infrastructure	fog and edge computing technologies strengthen modern digital infrastructure and support innovative computing solutions. Understanding these architectures helps in building reliable and scalable smart systems for industries and society
CO2	design fog and edge computing based systems and applications using reference architectures	SDG9	Industry, Innovation and Infrastructure	designing edge and fog-based applications promotes industrial innovation and development of intelligent infrastructure. These systems improve efficiency, connectivity, and real-time service delivery in smart environments.
CO3	understand and apply data collection, analysis, decision making and learning methodologies over the edge for different applications	SDG11	Sustainable Cities and Communities	edge-based data analysis and intelligent decision-making support advanced learning technologies and smart city applications. These methodologies enable efficient resource utilization, automation, and data-driven solutions for sustainable communities.
CO4	apply optimization techniques for edge and fog computing	SDG12	Responsible Consumption and Production	optimization techniques reduce energy consumption, latency, and resource wastage in distributed computing systems. Efficient utilization of computational resources contributes to sustainable and energy-aware technology solutions.

CLOUD COMPUTING			
Class: B. Tech. VII- Semester		Branch: CSE	
Course Code:	U24CS703	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : design enterprise-level applications in hosted cloud environments using Software as a Service (SaaS) model.			
CO2 : analyze virtual cloud resources for deploying and executing applications using virtual machines.			
CO3 : apply cloud service models such as SaaS, PaaS and IaaS using cloud platforms including Microsoft Azure, Google App Engine and Amazon Web Services.			
CO4 : apply cloud economics, security mechanisms and resource management techniques to mitigate risks and support further study and research in cloud computing.			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Principles of Parallel and Distributed Computing: Eras of computing, parallel vs distributed computing, elements of parallel computing, elements of distributed computing, technologies for distributed computing.			
Introduction: Cloud computing at a glance, historical developments, building cloud computing environment, computing platforms and technologies.			
UNIT-II		9 Hrs	
Cloud Computing Architecture: Introduction, cloud reference model, types of cloud, economics of cloud, open challenges.			
Virtualization: Introduction, characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud computing, pros and cons of virtualization, technology examples.			
UNIT-III		9 Hrs	
Data Intensive Computing: Introduction, data intensive computing, technologies for data intensive computing.			
Cloud Platform in Industry: Amazon Web Services, Google App Engine, Microsoft Azure.			
Cloud Applications: Scientific applications - ECG analysis in the cloud, business and consumer applications - CRM and ERP.			
UNIT-IV		9 Hrs	
Advanced Topics in Cloud Computing: Federated clouds/InterCloud characterization and definition, cloud federation stack, aspects of interest, technologies for cloud federation.			
Cloud Security: Security top concern for cloud users, cloud security risks, privacy and privacy impact assessment, trust, cloud data encryption, security of database services, operating system security, virtual machine security, security of virtualization, security risks posed by shared images, security risks posed by a management operating system, mobile devices and cloud security.			
Textbook(s):			
1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, <i>Mastering Cloud Computing</i> , McGraw			

Hill Education, 2nd edition, 2024, New Delhi. (Chapters 1 to 4 and 8 to 11)

2. Dan C. Marinescu, *Cloud Computing Theory and Practice*, Elsevier, 2nd edition, 2018, Cambridge. (Chapter 11)

Reference Book(S):

1. Dr. Kumar Saurabh, *Cloud Computing: Architecting Next-Gen Transformation Paradigms*, Wiley India Private Limited, 4th edition, 2018, New Delhi.
2. Barrie Sosinsky, *Cloud Computing Bible*, Wiley Publications, 1st edition, 2011, Indiana.
3. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, *Cloud Computing: A Practical Approach*, McGraw Hill, 1st edition, 2010, New York.

Web and Video link(s):
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs55
 NPTEL Video Lecture on Cloud Computing by Prof. Soumya Kanti Ghosh, Professor of CSE, IIT Kharagpur.

Course Articulation Matrix (CAM):					U24CS703: CLOUD COMPUTING									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS703.1	2	2	2	1	2	-	-	1	1	1	-	2	1
CO2	U24CS703.2	2	2	2	1	2	-	1	1	1	1	-	2	1
CO3	U24CS703.3	2	2	2	2	2	1	-	1	1	1	-	2	1
CO4	U24CS703.4	2	2	2	2	2	1	-	1	1	1	-	2	1
U24CS703		2	2	2	1.5	2	1	1	1	1	1	-	2	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO	CO Statement The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	design enterprise-level applications in hosted cloud environments using Software as a Service (SaaS) model	SDG9	Industry, Innovation and Infrastructure	SaaS-based enterprise applications support scalable digital infrastructure and promote innovation by enabling organizations to deploy cloud-hosted solutions efficiently.
CO2	analyze virtual cloud resources for deploying and executing applications using virtual machines	SDG9	Industry, Innovation and Infrastructure	Virtual machines and cloud resources form the foundation of modern IT infrastructure, enabling flexible, scalable and reliable application deployment.
CO3	apply cloud service models such as SaaS, PaaS and IaaS using cloud platforms including Microsoft Azure, Google App Engine and Amazon Web Services	SDG8	Decent Work and Economic Growth	Cloud service models and platforms support digital transformation, improve productivity, create cloud-based employment opportunities and contribute to economic growth.
CO4	apply cloud economics, security mechanisms and resource management techniques to mitigate risks and support further study and research in cloud computing	SDG4	Quality Education	Cloud economics, security and resource management strengthen students' technical knowledge and research readiness, supporting lifelong learning and advanced study in cloud computing.

GENERATIVE AI			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code:	U24CS704	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: apply Generative AI foundations, deep learning techniques, computer vision architectures and generative image models for solving image generation.			
CO2: design and optimize prompts using transformer architectures, ChatGPT and prompt engineering techniques for text generation and conversational AI applications.			
CO3: develop intelligent AI applications using LangChain, retrieval augmented generation (RAG), LLMOps methodologies for efficient deployment and management of large language models.			
CO4: analyze enterprise applications of Generative AI, evaluate responsible AI, sustainability, business strategies, risks, challenges and emerging advancements in Generative AI systems.			
UNIT-I			9 Hrs
GenAI Foundation: Basic mathematics of artificial intelligence, Deep learning, Model performance metrics, Introduction to generative AI, Generative AI use cases GenAI for Images: Introduction to computer vision, Computer vision architectures, Convolution neural networks, Representation learning, Autoencoders and variational autoencoders			
UNIT-II			9 Hrs
GenAI for Text: Natural language processing, Sequence-to-Sequence models, Recurrent neural networks, Long-Short term memory networks, Transformer architecture, NLP examples. ChatGPT: Introduction to OpenAI, OpenAI image models, OpenAI whisper, OpenAI playground, OpenAI Fine-Tuning, ChatGPT plugins, ChatGPT enterprise, Prompt engineering, Build your prompt playground.			
UNIT-III			9 Hrs
Large Language Model Frameworks: Introduction to LangChain, Chain, Prompt template, Memory, Document loaders, Vector stores, Agents, Retrieval augmented generation, Property graph creation of medical research journal. Large Language Model Operations: Introduction to LLMOps, Data preparation, Model training and Fine-Tuning, Performance benchmarking, AI alignment, Experimentation, Model serving, Inference optimization, Large language model security, Monitoring and feedback			
UNIT-IV			9 Hrs
Generative AI for the Enterprise: GenAI for enterprise, Enterprise use cases of GenAI, GenAI vendors, AI risks and challenges, Responsible AI Advances and Sustainability in Generative AI: Advances of GenAI, Business, Technology, Regulations, GenAI business strategy, GenAI sustainability			

Textbook(s):

1. Karthikeyan Sabesan, Sivagamisundari and Nilip Dutta, *Generative AI for Everyone: Deep Learning, NLP, and LLMs for Creative and Practical Applications*, BPB Publications, 1st Edition, 2025, New Delhi. (Chapters 2 to 10)

Reference Book(S):

1. Dr. Priyanka Singh and Hariom Singh, *Generative AI Essentials: Unlocking Creativity and Innovation with Generative AI*, BPB Publications, 1st Edition, 2025, New Delhi.
2. Valentina Alto, *Modern Generative AI with ChatGPT and OpenAI Models*, Packt Publishing Ltd., 1st Edition, 2023, Birmingham.
3. Ben Auffarth, *Generative AI with LangChain – Build Large Language Model (LLM) apps with Python, ChatGPT, and Other LLMs*, Packt Publishing Ltd., 1st Edition, 2023, Birmingham.
4. Jay Alamar and Maarten Grootendorst, *Hands-On Large Language Models*, O'Reilly Media, 1st Edition, 2024, Sebastopol.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc25_cs137/preview; NPTEL Video Lecture on Programming with Generative AI by Prof. Viraj Kumar, Professor of Computer Science, IISc Bangalore.

Course Articulation Matrix (CAM):				U24CS704 : GENERATIVE AI										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS704.1	2	2	2	2	2	-	-	1	1	-	1	2	2
CO2	U24CS704.2	2	2	2	2	2	-	-	1	1	-	1	2	2
CO3	U24CS704.3	2	2	2	2	2	-	-	1	1	-	2	2	2
CO4	U24CS704.4	2	2	1	2	1	-	2	2	1	1	2	2	1
U24CS704		2	2	1.75	2	1.75	-	2	1.25	1	1	1.5	2	1.75
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply Generative AI foundations, deep learning techniques, computer vision architectures and generative image models for solving image generation and transformation tasks.	SDG9	Industry, Innovation and Infrastructure	Generative AI and computer vision technologies foster innovation in image synthesis, design automation, healthcare imaging and intelligent industrial applications, contributing to advanced digital infrastructure and technological development.
CO2	design and optimize prompts using transformer architectures, ChatGPT and prompt engineering techniques for text generation and conversational AI applications.	SDG4	Quality Education	Transformer architectures, ChatGPT and prompt engineering techniques support personalized learning, intelligent tutoring systems, AI-assisted content generation and interactive conversational platforms, thereby enhancing accessibility and quality of education.

CO3	develop intelligent AI applications using LangChain, retrieval augmented generation (RAG), LLMOps methodologies for efficient deployment and management of large language models.	SDG8	Decent Work and Economic Growth	Advanced AI applications improve workplace productivity, intelligent automation, knowledge management, and decision support systems, promoting digital transformation and economic growth across industries.
CO4	analyze enterprise applications of Generative AI, evaluate responsible AI, sustainability, business strategies, risks, challenges and emerging advancements in Generative AI systems.	SDG11	Sustainable Cities and Communities	Generative AI technologies support smart city initiatives, intelligent urban services, digital governance, sustainable resource management, and AI-driven decision-making systems. Responsible AI and sustainability practices contribute to the development of inclusive, resilient and sustainable communities.

DATA SCIENCE ESSENTIALS			
Class: B.Tech. VII –Semester		Branch: CSE	
Course Code:	U24CS705	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-3	CIE:	60 %
Total Number of Teaching Hours:	36Hrs	ESE:	40 %
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: explain the fundamental concepts of data science, statistical inference, probability distributions, and data types. CO2: apply R programming constructs and basic statistical techniques for data analysis. CO3: demonstrate the use of R data structures for data manipulation and preprocessing. CO4: develop R functions and perform data visualization and regression analysis using statistical models.			
UNIT-I			9Hrs
Definition of Data Science- Big data and data science hype – and getting past the hype - Datafication - Current landscape of perspectives - Statistical inference - Populations and samples - Statistical modeling, probability distributions, fitting a model – Over fitting. Types of Data: Attributes and Measurement, Attribute, The type of an attribute, The different types of attributes, Describing attributes by the number of values, Asymmetric attributes, Binary attribute, Nominal attributes, Ordinal attributes, Numeric attributes, Discrete versus Continuous attributes. Basics of R: Introduction, R-Environment setup, Programming with R, Basic data types			
UNIT-II			9Hrs
Conditionals and Control Flow: Relational operators, Relational operators and Vectors, Logical operators, Logical operators and Vectors, Conditional statements. Iterative Programming in R: Introduction, While loop, For loop, Looping over list. Basic Statistical Descriptions of Data: Measuring the central tendency: Mean, Median, Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard deviation, and Interquartile Range, Graphic displays of basic statistical descriptions of data.			
UNIT-III			9Hrs
Vectors: Creating and naming vectors, Vector arithmetic, Vector sub setting. Matrices: Creating and naming matrices, Matrix sub setting, Arrays, Class. Factors and Data Frames: Introduction to factors: Factor levels, Summarizing a factor, Ordered factors, Comparing ordered factors, Introduction to data frame, Sub setting of data frames, Extending data frames, Sorting data frames. Lists: Introduction, Creating a list, Acessing list elements, Manipulating list elements, Merging lists, Converting lists to vectors			

UNIT-IV	9Hrs
Functions in R: Introduction, Writing a function in R, Nested functions, Function scoping, Recursion, Loading an R package, Mathematical functions in R. Charts and Graphs: Introduction, Pie chart: Chart legend, Bar chart, Box plot, Histogram, Line graph, Multiple lines in line graph, Scatter plot. Regression: Linear regression analysis, Multiple linear regression	
Text Book(s): 1. Cathy O'Neil and Rachel Schutt Doing, <i>Data Science, Straight Talk from The Frontline</i>, O'Reilly, 1st edition, 2014, Canada. 2. K.G Srinivasa, G.M Siddesh, Chetan Shetty, B.J Sowmya, <i>Statistical programming in R</i>, Oxford University Press, 1st edition, 2017, Noida.	
Reference Book(s): 1. Brain S. Everitt, Torsten Hothorn, <i>A Handbook of Statistical Analyses Using R</i>, Capman&Hall, 2nd edition, 2014, London. 2. Peter Dalgaard, <i>Introductory statistics with R</i>, Springer, 2nd edition, 2008, New Delhi. 3. Paul Teetor, "R Cookbook", O'Reilly, 1st edition, 2011, Canada. 4. Jiawei Han, Micheline Kamber and Jian Pei. <i>Data Mining: Concepts and Techniques</i>, The Morgan Kaufmann Series in Data Management Systems, 3rd edition, 2012, New York.	
Web and Video link(s): https://onlinecourses.nptel.ac.in/noc26_cs65/preview NPTEL Video Lecture on "Data Science for Engineers" by Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan, IIT Madras	

Course Articulation Matrix (CAM):				U24CS705- DATA SCIENCE ESSENTIALS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS705.1	2	2	2	1	2	-	1	-	1	-	2	2	2
CO2	U24CS705.2	2	2	2	1	2	-	1	-	1	-	2	2	2
CO3	U24CS705.3	2	2	2	2	3	-	1	-	1	-	2	2	2
CO4	U24CS705.4	2	2	2	2	3	-	1	-	1	-	2	2	2
U24CS705		2	2	2	1.5	2.5	-	1	-	1	-	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO1	Explain the fundamental concepts of Data Science, statistical inference, probability distributions, and data types.	SDG 4	Quality Education	Understanding data science fundamentals enhances analytical thinking, statistical literacy, and technical knowledge.

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO2	Apply R programming constructs and basic statistical techniques for data analysis.	SDG 9	Industry, Innovation and Infrastructure	R programming and statistical analysis support innovation, data-driven decision making, and modern digital infrastructure.
CO3	Demonstrate the use of R data structures for data manipulation and preprocessing.	SDG 8	Decent Work and Economic Growth	Data preprocessing and management skills improve productivity and prepare students for data-oriented careers.
CO4	Develop R functions and perform data visualization and regression analysis using statistical models.	SDG 11	Sustainable Cities and Communities	Data visualization and predictive modeling assist in analyzing real-world problems and supporting sustainable community planning.

CLOUD COMPUTING LABORATORY			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code:	U24CS706	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : develop cloud applications and deploy using Storage as a Service (STaaS) CO2 : design applications on instantiated VMs of different configuration over different hypervisors CO3 : analyze the functioning of components in cloud platform, technologies and applications in industry CO4 : apply automate security policies for applications in cloud			
THEORY COMPONENT			
Experiment-1 (UNIT-I)			
1. Create a storage account and a hosted service component. 2. Deploying an application using platform management portal.			
Experiment-2 (UNIT-I)			
3. Create a word document of your class time table and store on the cloud with docx and pdf format. 4. Write a program to generate 'n' even numbers and deploy in cloud. 5. Write a program to display nth largest number from the given list and deploy in cloud.			
Experiment-3 (UNIT-I)			
6. Write a program to validate user, create a database login (username, password) and deploy in cloud. 7. Write a program to validate user, create a database to store user info and deploy in cloud.			
Experiment-4 (UNIT-II)			
8. Find procedure to run the virtual machine of different configuration, check how many virtual machines can be utilized at particular time.			
Experiment-5 (UNIT-II)			
9. Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.			
Experiment-6 (UNIT-II)			
10. Create your own Virtual Private Cloud (VPC). 11. Create public and private subnet.			
Experiment-7 (UNIT-III)			
12. Create Public Routing Table, associate subnet and add routing rules. 13. Create Private Routing Table, associate subnet and add routing rules.			

Experiment-8 (UNIT-III)
14. Install a 'C' compiler in the virtual machine and execute sample programs
Experiment-9 (UNIT-III)
15. Show the virtual machine migration based on the certain condition from one node to the other.
Experiment-10 (UNIT-IV)
16. Using PowerShell manage an application in cloud.
Experiment-11 (UNIT-IV)
17. Using Visual Studio deploy an application in cloud.
Experiment-12 (UNIT-IV)
18. Securing an application in cloud.
19. Debugging an application in cloud.
Textbook(s):
1. Rafael C. Gonzalez, Richard E. Woods, <i>Digital Image Processing</i> , Pearson, 4 th edition, 2018, New York. (Chapters 1 to 3, 9 to 12)
Reference Book(S):
1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, <i>Mastering Cloud Computing</i> , McGraw Hill, 1st edition, 2013, New Delhi
2. Dan C. Marinescu, <i>Cloud Computing: Theory and Practice</i> , Elsevier, 2nd edition, 2018, Cambridge.
3. Dr. Kumar Saurabh, <i>Cloud Computing: Architecting Next-Gen Transformation Paradigms</i> , Wiley India Private Limited, 4th edition, 2012, New Delhi.
Web and Video link(s):
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs55
Laboratory Manual (for laboratory component):
1. <i>Cloud Computing Laboratory Manual</i> , Department of CSE, KITSW

Course Articulation Matrix (CAM):				U24CS706 : CLOUD COMPUTING LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS706.1	2	2	2	1	2	-	-	1	1	1	1	2	1
CO2	U24CS706.2	2	2	2	2	2	-	-	1	1	1	1	2	1
CO3	U24CS706.3	2	2	2	2	2	-	-	1	2	1	1	2	1
CO4	U24CS706.4	2	2	2	2	2	-	-	1	1	1	1	2	1
U24CS706		2	2	2	2	2	-	-	1	1.25	1	1	2	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Develop cloud applications and deploy them using Storage as a Service (STaaS).	SDG9	Industry, Innovation and Infrastructure	Development and deployment of cloud applications using STaaS supports scalable digital infrastructure, efficient data storage, and innovation in cloud-based services.
CO2	Design applications on instantiated VMs of different configurations over different hypervisors.	SDG9	Industry, Innovation and Infrastructure	Designing applications on virtual machines and hypervisors enables flexible computing infrastructure, virtualization-based innovation, and efficient cloud resource utilization.
CO3	Analyze the functioning of components in cloud platforms, technologies, and applications in industry.	SDG8	Decent Work and Economic Growth	Understanding cloud platforms and industry applications helps students contribute to digital transformation, productivity improvement, and technology-driven economic growth.
CO4	Apply automated security policies for applications in cloud.	SDG16	Peace, Justice and Strong Institutions	Applying automated security policies strengthens cloud application security, data protection, and secure digital governance, supporting trustworthy digital systems.

DATA SCIENCE LABORATORY			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code: U24CS707	U24CS707	Credits:	1
Hours/Week (L-T-P-E):	0-0-2-2	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> <i>(based on psychomotor skills acquired from laboratory component)</i>			
CO1: apply R programming basics to write and execute simple programs. CO2: create and manipulate data structures such as vectors, matrices, arrays, lists, and data frames in R programming. CO3: apply functions and control statements to solve data analysis problems using R programming. CO4: perform data visualization and regression analysis to interpret data using R programming			
THEORY COMPONENT			
Experiment-1 (UNIT-I)			
1. Download and install R-Programming environment and install basic packages using install.packages () command in R			
Experiment-2 (UNIT-I)			
1. Develop R programs using variables, constants, data types, operators, and expressions. 2. Demonstrate arithmetic, relational, and logical operations through simple applications.			
Experiment-3 (UNIT-I)			
1. Create sample datasets and perform basic statistical analysis. 2. Identify different types of data (nominal, ordinal, discrete, continuous) and compute measures such as mean, median, and probability distributions.			
Experiment-4 (UNIT-II)			
1. Write R programs using conditional constructs such as if, if-else, and nested if statements to solve decision-making problems.			
Experiment-5 (UNIT-II)			
1. Implement for loops, while loops, and list iteration techniques to perform repetitive computations such as factorial calculation, series generation, and data processing.			
Experiment-6 (UNIT-II)			
1. Compute measures of central tendency and dispersion including mean, median, mode, variance, standard deviation, quartiles, and interquartile range. Represent the results using suitable graphical techniques.			
Experiment-7 (UNIT-III)			
1. Create vectors and matrices, perform arithmetic operations, indexing, and subsetting.			

2. Analyze the behavior of vectorized operations in R.
Experiment-8 (UNIT-III)
1. Create and manipulate arrays, factors, ordered factors, and data frames.
2. Perform sorting, filtering, and data organization operations on structured datasets.
Experiment-9 (UNIT-III)
1. Create named and unnamed lists, access and modify list elements, merge lists, and convert lists into vectors or data frames.
Experiment-10 (UNIT-IV)
1. Develop user-defined functions to perform mathematical and statistical computations.
2. Demonstrate nested functions, recursion, and function scoping concepts.
Experiment-11 (UNIT-IV)
1. Create and interpret Pie Charts, Bar Charts, Histograms, Box Plots, Line Graphs, Multiple Line Graphs, and Scatter Plots using real-world datasets.
Experiment-12 (UNIT-IV)
1. Implement Simple Linear Regression and Multiple Linear Regression using suitable datasets.
2. Analyze and interpret regression results.
<u>Text Book(s):</u>
1. Cathy O’Neil and Rachel Schutt Doing, <i>Data Science, Straight Talk from The Frontline</i> , O’Reilly, 1 st edition, 2014, Canada.
2. K.G Srinivasa, G.M Siddesh, Chetan Shetty, B.J Sowmya, <i>Statistical programming in R</i> , Oxford University Press, 1 st edition, 2017, Noida.
<u>Reference Book(s):</u>
1. Brain S. Everitt, Torsten Hothorn, <i>A Handbook of Statistical Analyses Using R</i> , Capman&Hall, 2 nd edition, 2014, London.
2. Peter Dalgaard, <i>Introductory statistics with R</i> , Springer, 2 nd edition, 2008, New Delhi.
3. Paul Teetor, “R Cookbook”, O’Reilly, 1 st edition, 2011, Canada.
4. Jiawei Han, Micheline Kamber and Jian Pei. <i>Data Mining: Concepts and Techniques</i> , The Morgan Kaufmann Series in Data Management Systems, 3 rd edition, 2012, New York.
<u>Web and Video link(s):</u>
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs07 NPTEL Video Lecture on Exploratory Data Analysis for Data Science with R software by Prof. Shalabh, IIT Kharagpur.
<u>Laboratory Manual (for laboratory component):</u>
1. <i>Data Science Laboratory Manual</i> , Department of CSE, KITSW

Course Articulation Matrix (CAM):				U24CS707: Data Science Essentials Laboratory										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS707.1	2	2	2	1	2	1	1	1	1	-	2	2	2
CO2	U24CS707.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24CS707.3	3	3	3	3	3	1	1	1	1	-	2	2	3
CO4	U24CS707.4	2	2	2	2	3	1	1	1	1	-	2	2	3
U24CS707		2.25	2.25	2.25	2	2.5	1	1	1	1	-	2	2	2.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply R programming basics to write and execute simple programs	SDG4	Quality Education	Learning the fundamentals of R programming develops computational thinking, programming literacy, and analytical skills, which are essential for modern education and lifelong learning in data-driven environments.
CO2	create and manipulate data structures such as vectors, matrices, arrays, lists, and data frames in R programming.	SDG9	Industry, Innovation and Infrastructure	Efficient handling of data structures forms the foundation for data management, analytics, and software development, enabling innovation and supporting technology-driven industrial applications.
CO3	apply functions and control statements to solve data analysis problems using R programming.	SDG8	Decent Work and Economic Growth	Problem-solving and automation skills gained through programming improve workforce readiness, productivity, and data-driven decision-making, which contribute to economic growth and professional competency.
CO4	perform data visualization and regression analysis to interpret data using R programming	SDG11	Sustainable Cities and Communities	Data visualization and statistical analysis enable evidence-based decision-making, effective communication of insights, and collaboration among stakeholders to address societal, environmental, and economic challenges.

INTERNSHIP EVALUATION			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code:	U24CS708	Credits:	6
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	100%
Total Number of Teaching Hours:	-	ESE:	
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to, (based on cognitive skills acquired from theory component)</i>			
CO1: Demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience CO2: Apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems CO3: Exhibit professional skills including communication, teamwork, leadership, and lifelong learning CO4: Prepare internship reports and effectively communicate internship outcomes through presentations and viva-voce			
Mandatory Internships: 1. The internships provide exposure to the real-world, get a feel for the work environment and how a professional workplace operates. 2. During the internship, students will experience a real-life engineering workplace and understand how their engineering and professional knowledge, skills, and qualities (KSQs) can be utilized in industry. 3. Students can learn, more importantly, how to apply the KSQs they have acquired during an internship to their future workplaces. 4. Students will also be able to demonstrate functioning engineering knowledge, both new & existing, and identify areas of further development for their future careers. 5. Internships give the student an opportunity to bridge theory and practice 6. Internships also provide students with the soft skills needed at workplace and leadership positions. 7. The internship guidelines are governed by the rules stipulated in the Institute's Internship Policy-2020 document. 8. The students shall have to undergo 6-8 weeks of mandatory internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs, IIITs& NITs. 9. HoD, along with Prof i/c internships, shall address students (of 2 nd , 4 th and 6 th semesters) during last week of even semester of every academic year on the following a. creating awareness on mandatory 6-8 weeks internship by every student b. creating awareness on COs of internships c. KSQs the students would acquire doing internships d. expected internship outcomes			

- e. available internship options, and organizations offering internships
 - f. progressively completing 6-8 weeks internship by the end of 6th semester summer, starting from 2nd semester summer break.
 - g. internship evaluation in 7th semester
 - h. internship report submission and oral presentation (through PPT) by student
10. Students undergoing the internship shall be required to submit their details to the department internship coordinators of the respective branches. He will coordinate all the internship activities of the students of that department.
 11. Students have to submit a signed undertaking to the department internship coordinator for demonstrating honesty, integrity, professionalism and regular attendance at work place to add value to the organization where the internship is allotted. Students also have to uphold the professional image of our institute.
 12. In case, a student is found to violate the internship rules and regulations, the student will have to produce a valid reason for the violation of internship rules. Without a valid reason, the student will be debarred from taking part in subsequent placement activities of the institute.
 13. The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of one week internship at every stage.
 14. The internship evaluation shall be done in the VII semester of study and hence the students shall complete the prescribed period of internship before start of VII semester (from end of II semester to commencement of VII semester).
 15. The student learning assessment process (SLAP): The SLAP in internships shall include feedback from internship supervisor, submission of internship report on the complete internship and PPT presentation.
 16. Internship Log Book: The activity journaling in a log book is very important for a successful internship.
 - a. The internship supervisor identifies the work goals at the beginning of the internship
 - b. Student has to maintain internship log book, where in the activities undertaken during internship and timely submission at periodic intervals are to be documented.
 - c. At the conclusion of the internship, the supervisor shall specifically comment, in the internship log book, on whether the student met each of the work goals and to give evidence which describes the quality of work. For student, this also serves as a self- assessment.
 - d. Internship log book (*with due signatures of the internship supervisor*) shall be considered for evaluation during presentation, i.e., number of planned meetings with internship supervisor and number attended by student
 17. Meeting Cadence:
 - i. **Regular meetings with internship supervisor:** Regular meetings with the internship supervisor to discuss work goals and review the status of activities undertaken are very essential. Student shall participate in discussions and take notes.
 - ii. **Meeting Frequency:** The meeting cadence, i.e., *meeting frequency* shall be

fixed in consultation with the internship supervisor and accordingly student has to participate in discussions and take notes. Take signatures of internship supervisor as per the planned cadence in the internship log book.

18. The internship evaluation shall be done by **department internship evaluation committee (DIEC)** based on the submitted report by student and oral presentation.
19. There shall be only Continuous Internal Evaluation (CIE) for internship evaluation.
20. CIE for the Internship evaluation in VII semester shall be as below:

Internship evaluation	Weightage
A. Internship Supervisor's Assessment (i) Feedback from the internship supervisor - on completion of internship assignment/work (20%) (ii) Feedback from the internship supervisor - on quality of work in internship assignment/work (10%) (iii) Feedback from the internship supervisor - internship log book (10%) (iv) Feedback from the internship supervisor - on attendance, punctuality and work hours (10%) (For the case of 6-8 week internship done in more than one spell, it will be the average of all the internship supervisors' assessments)	50
B. DIEC Assessment (i) Internship duration (8 /12 weeks) (6/8 weeks online via NPTEL and 2/4 weeks offline) (10% / 10%) (ii) Internship Report (20%) (iii) Oral Presentation (with PPT) and viva voce (10%) (iv) SDG (5%) (v) Research Orientation (5%)	50
Total Weightage:	100

Note: It is mandatory for the student to appear for oral presentation (with PPT) and viva voce to qualify for course evaluation

- (a) **Internship Report:** Each student is required to submit a well-documented internship report (both *soft copy and softbound hard copy*) as per format specified by DIEC. In case of completing the 6-8 weeks internship in more than one organization, the student shall be required to prepare separate softbound internship reports signed by the internship supervisor (s) along with the seal(s) of the organization(s). The student shall submit two final softbound internship reports along with a soft copy, keeping all the certificate(s) issued by the internship supervisor(s) and all the individual internship reports cleared by the respective internship supervisor. Chapter 1 of the final internship report shall clearly describe the following, indicating an overall summary.
 - (i) **Internship(s) attended:** A table with name & address of organization, organization's vision and mission, internship weeks attended, internship period (exact dates attended), internship supervisor, head of the section and head of the organization.
 - (ii) **Duties/tasks during internship(s):** Table describing name & address of organization, and the duties/tasks undertaken during internships. This indicates what opportunities and learning experiences

- the interns got to get hands-on experience on a wide range of KSQs of a professional engineer.
- (iii) **Tangible outcomes of internship:** These are the lessons learnt from internship experience. The students have to describe in their own words what they learnt from the internship experience. The student has to describe what specific KSQs are acquired by him, with reference to the expected internship COs, after successful completion of internship(s). Finally, a table depicting systematic mapping of what they have learnt and the expected internship COs is to be shown.
 - (iv) **Student feedback on internship:** To gather information on whether the internship was useful and gave practical experience in the chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*) with closed and open questions shall be kept in the report.
 - (v) **Pictures at the worksite:** Student has to keep, in the report, his working pictures at the worksite, discussing with the internship supervisor, the creative project he is working on, or an event he is attending for work, group photo of the team/section/department he worked with.
- (b) **Anti-Plagiarism Check:** The internship report should clear the plagiarism check as per the Anti-Plagiarism policy-2020 of the institute.
- (c) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the DIEC as per the schedule notified by the department. The presentation shall compulsorily have slides on the points mentioned in (a)(i)-(v)
 - (d) It is mandatory for every student to *appear for oral presentation(with PPT) and viva-voce*, to qualify for internship evaluation
 - (e) A student shall register for supplementary examination for the internship evaluation in the following cases:
 - (i) absent for oral presentation and viva-voce
 - (ii) fails to submit the internship report in prescribed format
 - (iii) fails to fulfill the requirements of internship evaluation as per specified guidelines
 - (f) **Supplementary examination for internship evaluation**
 - (i) The CoE shall send the list of students registered for supplementary examination to the HoD concerned.
 - (ii) The DIEC, duly constituted by the HoD, shall conduct the internship evaluation supplementary exam and send the award list to the CoE within the stipulated time.

Course Articulation Matrix (CAM):		U24CS708: INTERNSHIP EVALUATION												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS708.1	1	-	-	-	-	-	1	3	-	-	-	-	-
CO2	U24CS708.2	3	2	1	1	3	-	1	-	-	-	-	2	2
CO3	U24CS708.3	-	-	-	-	-	-	1	1	3	3	2	-	-
CO4	U24CS708.4	-	-	-	-	-	-	1	-	1	3	-	-	-
U24CS708		2	2	1	1	3	-	1	2	2	3	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	Demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience	SDG 4	Quality Education	Industrial internship provides experiential learning in ECE domains such as Embedded Systems, IoT, VLSI, Communication Systems, Signal Processing, Artificial Intelligence, and Semiconductor Technologies. Students acquire practical skills, industry exposure, professional networking opportunities, and lifelong learning abilities, thereby strengthening quality technical education and employability.
CO2	Apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems	SDG 11	Sustainable Cities and Communities	Effective communication and collaboration are essential for multidisciplinary ECE projects such as smart city infrastructure, intelligent transportation systems, public safety networks, and digital communication platforms that contribute to sustainable and connected communities.
CO3	Exhibit professional skills including communication, teamwork, leadership, and lifelong learning	SDG 9	Industry, Innovation and Infrastructure	Application of ECE concepts to industrial problems through communication networks, embedded systems, IoT, VLSI, robotics, AI-enabled systems, and automation technologies promotes innovation, industrial modernization, and sustainable infrastructure development.
CO4	Prepare internship reports and effectively communicate internship	SDG 12	Responsible Consumption and Production	Professional ethics, quality assurance, responsible technology deployment, resource optimization, and sustainable engineering practices in ECE industries encourage responsible production, efficient use of resources,

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
	outcomes through presentations and viva-voce			and continuous improvement.

MAJOR PROJECT PHASE 1			
Class: B. Tech. VII – Semester		Branch: CSE	
Course Code:	U24CS709	Credits:	1
Hours/Week (L-T-P- E):	0-0-8-8	CIE:	100%
Total Number of Teaching Hours:	-	ESE:	

Course Learning Outcomes (COs):

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

- CO1: review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real- world complex engineering problems (**Technical skills**)
- CO2: design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (**Problem solving and critical thinking skills**)
- CO3: apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (**Ethics and teamwork**)
- CO4: collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (**Communication skills and life-long learning**)

1. Final Year Major Project work represents the culmination of study towards the B. Tech degree. *Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems.* The **student learning assessment process** (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project work.
2. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
3. **Team work:** Major project work is a team work.
 - (i) The students of a project team shall work together to achieve a common objective.
 - (ii) Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of a team having knowledge diversity, gender diversity, social and cultural diversity among its members.
4. **Two phases:** Major project work shall be carried out in two phases. Nearly 50 - 75% of the proposed work to be completed in 7th semester as *Phase-I* and the remaining work to be continued and completed in 8th semester as *Phase-II*.

5. Every student is expected to put approximately **72 hours of work** into the major project *phase-I* course over the 12 weeks of 7th semester.

6. Major project work Phase-I: 7th semester

- (i) The HoD shall constitute the *department project evaluation committee (DPEC)* with following composition

<i>Department project evaluation committee (DPEC)</i>	
HoD	Chairman
Senior Faculty	Convener
Coordinator(s)	Section-wise coordinator(s) <i>One coordinator for each section</i>
Three Faculty members	Section-wise faculty members <i>Three faculty members for each section representing various specializations will be covered including the coordinator's and Convener</i>

- (ii) Major project allotment to students during last working week of 6th semester:

- First / Second week of 6th Semester:** The process shall be initiated during the first / second week of 6th semester by collecting project titles from the department faculty research groups, on offering innovative ideas/solutions for engineering problems.
- MSE-I period of 6th Semester - Notifying project titles:** The finalized project titles shall be notified to students during the MSE-I period of 6th semester and student teams shall be allowed to exercise their options on titles that interest them.
- Last working week of 6th Semester - Allotment of titles and supervisors to project teams:** The project title allotment to major project teams shall be completed before the last day of instruction of 6th semester
- 6th semester summer break - Literature review:** This 6th semester schedule enables students to complete literature review, preliminary simulations / investigations / experimentation during 6th semester summer break and *start the work from day-one in 7th semester*
- Registration Presentation - Notifying the tentative dates:** The major project teams are expected to give registration presentation during second / third week from the commencement of 7th semester. The tentative dates for conducting the registration presentation shall be notified at the time of releasing the circular on allotted project title and project supervisors, as indicated in (c) above. This enables student teams to plan the work accordingly during summer break, to complete the literature review, preliminary simulations / investigations and get ready for informative, confident and comfortable presentations on their project work.

- (iii) The convener DPEC shall notify, during MSE-I period of 6th semester, the list of implementable project titles offered by the faculty of different research groups of the department

- Project titles shall come with the following details to be made available to students on dept webpage and notice boards, facilitating students to select problems that interest them.
 - abstract
 - deliverables / outcomes
 - knowledge and skills required to complete the project
 - resources required

- v. one of the deliverables shall be writing a technical paper out of the major project work done for submission to a reputed non-predatory conference/non-paid peer reviewed journal
- (iv) The major project teams, finalized by the convener DPEC, shall be allowed to exercise their options on the titles that interest them from the notified list
- (v) **Project supervisor allotment:** The convener DPEC shall allot, during the last week of 6th semester, the faculty supervisors to all project teams
 - (a) The project supervisors shall
 - i. **define project objectives and expected deliverables**
 - ii. **help the students plan their project work and timeline**
 - iii. **provide enough resources for successful project completion**
- (vi) The faculty supervisors are expected to provide guidance to project teams on
 - (a) *Knowledge, skills and qualities (KSQ) to be acquired* to propose solutions to the identified real-world problems
 - (b) *Problem analysis* - to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
 - (c) *Applying engineering knowledge* - to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
 - (d) *Design/development of solutions* - to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental Considerations
 - (e) *Conduct investigations of complex problems* - to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
 - (f) *Modern tool usage* - to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
 - (g) *The Engineering and the world* - to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
 - (h) *Ethics* - to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice
 - (i) *Individual and team work* - to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
 - (j) *Communication* - to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
 - (k) *Project management and finance* - to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
 - (l) *Life-long learning* - to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
- (vii) The project supervisors are also expected to continuously emphasize and guide

students on

(a) **Meeting Cadence:**

- i. **Regular meetings with supervisor:** Short and frequent meetings increase a team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.
- ii. **Meeting Frequency: Semi-weekly cadence**, i.e., the meeting frequency shall be **twice a week**. Due weightage will be given to meeting cadence and considered for evaluation during presentations, i.e., number of planned meetings and number attended by students

(b) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

- i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).
- ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.
- iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.
- iv. Log books are to be shown during all presentations and will be graded along with the project.
- v. At the conclusion of the project work *phase-I*, the supervisor shall specifically comment, in the project log book, on whether the project team met each of the project work *phase-I* goals and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(c) **Following project timeline:** completing the tasks as planned in project timeline

(d) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, which can be specially acquired by participating in major project work

(e) **Writing down whatever is done and making notes of whatever is read.** Writing down the procedures/models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, *difficulties faced and how they were fixed* are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well-documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on.

This information will be needed for the bibliography in your project report. On the other hand, documenting a report *on the spur of the moment* would end up copying things from other sources resulting in a plagiarized document.

(f) **Good and sufficient literature review:** Literature review is a description and analysis of information related to the topic of project work. Reading

good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

- (g) Completing nearly 50 - 75% of the proposed work during phase-I
 - (h) Right conduct of research to promote academic integrity, honesty and time management
 - (i) Preparing a well-documented report in proper format, covering the progress made during Phase-I
 - (j) Consequences of plagiarism and use of anti-plagiarism software to detect plagiarism in documents
 - (k) Submission of major project phase-I report within acceptable plagiarism levels, as per the *Anti-plagiarism policy-2020 of our institute*.
 - (l) **Video pitch:** Capturing short videos, photos, screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the work done during *phase-I*.
 - (m) **Project Paper:** Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained, and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.
 - (n) **Project poster:** At the end of phase-II, the project teams shall have to present their project in the form of posters, at the time of demonstration of complete prototype / working model / software package / system developed.
- (viii) **Phase - I evaluation:** There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components
- (a) **Registration Presentation** (*during second / third week of 7th semester*): The Registration Presentation shall include a brief report and presentation focusing the identified problem, objective(s), literature review, identifying research gap in the literature, implementation of existing methods, proposed solution, and expected outcome(s).
 - i. The registration presentation shall invariably include the **project plan timeline** with actual start and finish dates- monthly/weekly project milestones/ timeline prepared in MS Excel or any other project management tool.
 - ii. **Project timeline - Weekly project milestones:** It's a compact and creative way to present a project plan. Identify the project intermediate goals and related tasks for completing each of those goals. Categorize tasks for each week. In the project timeline use different colors to the tasks for each week. Horizontal timeline layouts shall be preferred or any other layout of team's choice.
 - iii. Project teams shall create and present the following during registration presentation
 - 1. Complete project timeline
 - 2. Phase-I project timeline
 - 3. Phase-II project timeline
 - iv. During every presentation, project teams shall compulsorily show the following as part of their presentation
 - 1. The slides on project timeline and
 - 2. A table showing targeted tasks as per timeline and status - whether tasks accomplished?
 - v. **Project log book:** Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of*

- project supervisor)* during presentations
- (b) **Progress Presentation-I** (*during penultimate week of 7th semester*): At the end of first stage (7th semester), student teams shall be required present, before the DPEC, the progress made during phase-I and submit a well-documented report of work done for evaluation to the project coordinator
- Following project timeline:** The project timeline shall be meticulously followed and the tasks shall be completed as planned in the project timeline.
 - Project teams shall compulsorily show the following as part of their progress presentation-I
 - The slides on project timeline and*
 - A table showing targeted tasks as per timeline and whether tasks are accomplished?*
 - Project log book:** Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*)
- (c) **CIE schedule:** The convener DPEC shall release the complete schedule of CIE before start of 7th semester well in advance, so that student teams will complete the scheduled works and get ready with an informative, confident, and comfortable presentation for registration and progress presentations.

(ix) CIE for the Major project work Phase-I shall be as given below:

Major project work Phase-I Assessment (<i>7th semester</i>)	Weightage
A. Supervisor Assessment	20%
B. DPEC Assessment (i) <i>Registration Presentation (10%)</i> (ii) <i>Progress Presentation-I (20%)</i> (iii) <i>Project progress*: Part of working model/ process/software package/system developed (30%)</i> (iii) <i>Well-documented Progress Report on Phase-I work (10%)</i> (iv) <i>Video pitch on Phase-I (10%)</i>	80%
Total Weightage	100 %

* *Students are advised to complete major part of the project in phase-I only*

- (a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system, on the chosen work. The progress made in this shall be demonstrated during progress presentation-I at the end of *phase-I* and the completed working model/ process/software package/system before the DPEC as per the dates specified by DPEC at the end of *phase-II*.
- (b) **Progress Report on phase-I:** Every project team shall be required to submit a well-documented progress report on dissertation phase-I as per format specified by DPEC.
- Tangible outcomes of phase-I in Conclusions - Chapter:** These are the lessons learnt from doing a project work. The students have to describe in their own words what they learnt from the *phase-I* project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of *phase-I* work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be presented in the conclusions chapter of *phase-I* report

- (c) **Video pitch on *phase-I*:** Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I*. The project team shall present the produced video pitch during progress presentation-I. The produced video pitch should
 - a. be 3 to 5-minute-long video (no longer than 5 minutes)
 - b. be concise and to the point, on the problem and proposed solution
 - c. show project timeline and sample page of log book
 - d. highlight the progress made at various stages during *phase-I* project implementation with the help of short videos/photos / screenshots on experiments conducted, simulations carried out, part of prototype/ working model/process / software package/system being under development as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project
 - e. discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts*.
 - f. emphasize key points about *business idea, potential market for the proposed solution*
- (x) It is mandatory for
 - (a) every student of the team to *appear for oral presentation and viva-voce*, as part of progress presentation -I to qualify for course evaluation
 - (b) every project team to *submit a well-documented progress report on major project work phase-I*, as part of progress presentation -I to qualify for course evaluation
 - (c) every project team to create and present a good video pitch on major project work *phase-I*, as part of progress presentation -I to qualify for course evaluation
- (xi) A student shall register for supplementary examination for the Major project work *phase-I* in the following cases:
 - (a) He/she is absent for oral presentation and viva-voce as part of progress presentation-I
 - (b) The project team fails to submit the progress report on *Phase-I* in prescribed format
 - (c) The project team fails to submit the video pitch on the progress made during the *phase-I* period.
 - (d) he/she fails to fulfill the requirements of Major project work *phase-I* evaluation as per specified guidelines
- (xii) Supplementary examination for Major project work *phase-I*
 - (a) The CoE shall send the list of students registered for supplementary examination to the HoDs concerned
 - (b) The DPEC, duly constituted by the HoD, shall conduct Major Project Phase I supplementary exam and send the award list to the CoE within the stipulated time

Course Articulation Matrix (CAM):				U24CS709: MAJOR PROJECT PHASE I										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS709.1	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	U24CS709.2	3	3	3	2	3	3	2	1	1	2	2	2	1
CO3	U24CS709.3	1	1	1	1	1	2	3	3	2	3	1	2	1
CO4	U24CS709.4	1	1	1	2	2	1	2	1	3	1	3	2	2
U24CS709		2	2	1.75	2	2	1.75	2	1.5	1.75	175	2	2	1.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)	SDG 9	Industry, Innovation and Infrastructure	Research gap identification, problem formulation, and development of innovative engineering solutions promote technological advancement, industrial innovation, and sustainable infrastructure development in ECE domains such as communication systems, IoT, VLSI, AI, and embedded systems.
CO2	design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)	SDG 12	Responsible Consumption and Production	Engineering design considering resource optimization, environmental impact, sustainability, and efficient utilization of technology promotes responsible production and sustainable engineering practices.
CO3	Apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical	SDG 11	Sustainable Cities and Communities	Effective teamwork, ethical engineering practices, leadership, and multidisciplinary collaboration facilitate the

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
	responsibilities as an individual and as a member or leader of a multidisciplinary team.			development of sustainable technological solutions that improve societal well-being and community infrastructure.
		SDG3	Good Health and Well-Being	ECE projects related to biomedical instrumentation, healthcare IoT, telemedicine, wearable sensors, and assistive technologies contribute to improved healthcare services and quality of life.
CO4	Collate results, compare prototype performance with specifications, communicate findings through reports, posters, technical papers, presentations, and video pitches; engage in self-directed and lifelong learning.	SDG 4	Quality Education	Technical communication, dissemination of knowledge, professional documentation, and lifelong learning foster continuous education, skill enhancement, and knowledge sharing among engineering professionals.

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	PEC	U24CS801	Program Elective - III / MOOCs-III	2	1	-	3	3
2	PEC	U24CS802	Program Elective - IV / MOOCs-IV	2	1	-	3	3
3	IKSC	U24IK803B	Universal Human Values-II	2	-	-	2	2
4	ELC	U24CS804	Major Project, Phase - 2 / Industrial Internship - 2	-	-	12	12	6
Total:				6	2	12	20	14
Additional Learning [@] : Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	18

RESPONSIBLE AI			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS801A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1: understand AI technologies, ethics, societal impacts, and risks, and apply responsible AI governance to build trustworthy, human-centered, and socially beneficial systems. CO2: analyse and apply ethical, legal, fairness, and accountability principles in Artificial Intelligence systems to ensure transparent, non-discriminatory, and responsible AI deployment. CO3: ensure responsible AI governance by applying data protection, accountability, transparency, regulatory compliance, and ethical practices across AI systems in all industries. CO4: apply ethical, legal, and governance principles for responsible use of Artificial Intelligence in healthcare, neurotechnology, security, and armed conflict to ensure human rights, safety, and accountability.			
UNIT-I			9 Hrs
Foundations of Responsible AI: Artificial Intelligence: Key Technologies and Opportunities, Automating Supervision of AI Delegates, Artificial Moral Agents: Conceptual Issues and Ethical Controversy, Risk Imposition by Artificial Agents: The Moral Proxy Problem, Artificial Intelligence and Its Integration into the Human Lifeworld. Current and future approaches to AI governance: Artificial Intelligence and the Past, Present, and Future of Democracy, The New Regulation of the European Union on Artificial Intelligence: Fuzzy Ethics Diffuse into Domestic Law and Sideline International Law, Fostering the Common Good: An Adaptive Approach Regulating High-Risk AI-Driven Products and Services.			
UNIT-II			9 Hrs
Responsible AI liability schemes: Liability for Artificial Intelligence: The Need to Address Both Safety Risks and Fundamental Rights Risks, forward to the Past: A Critical Evaluation of the European Approach to Artificial Intelligence in Private International Law. Fairness and non-discrimination in AI systems: Differences That Make a Difference: Computational Profiling and Fairness to Individuals, Discriminatory AI and the Law: Legal Standards for Algorithmic Profiling.			
UNIT-III			9 Hrs
Responsible data governance : Artificial Intelligence and the Right to Data Protection, Artificial Intelligence as a Challenge for Data Protection Law: And Vice Versa, Data Governance and Trust: Lessons from South Korean Experiences Coping with COVID-19 Responsible corporate governance of AI systems: From Corporate Governance to Algorithm Governance: Artificial Intelligence as a Challenge for Corporations and Their Executives, Autonomation and Antitrust: On the Construal of the Cartel Prohibition in the Light of Algorithmic Collusion, Artificial Intelligence in Financial Services: New Risks and the Need for More Regulation?			
UNIT-IV			9 Hrs
Responsible ai healthcare and neurotechnology governance: Medical AI: Key Elements at the International Level , “Hey Siri, How Am I Doing?”: Legal Challenges for Artificial Intelligence Alter Egos in Healthcare, ‘Neurorights’: A Human Rights-Based Approach for			

Governing Neurotechnologies, AI-Supported Brain-Computer Interfaces and the Emergence of 'Cyberbilities'

Responsible AI for security applications and in armed conflict: Artificial Intelligence, Law, and National Security, Morally Repugnant Weaponry? Ethical Responses to the Prospect of Autonomous Weapons, On 'Responsible AI' in War: Exploring Preconditions for Respecting International Law in Armed Conflict.

Textbook(s):

2. Silja Voenekey, Philipp Kellmeyer, Oliver Mueller, Wolfram Burgard, *The Cambridge Handbook of Responsible Artificial Intelligence: Interdisciplinary Perspectives*, Cambridge University Press, 2022.

Reference Book(S):

3. Virginia Dignum, *Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way*, Springer Nature, 2019.
4. Christoph Molnar, *Interpretable Machine Learning*, Lulu Publication, 1st Edition, 2019.
5. Mark Coeckelbergh, *AI Ethics*, MIT Press, 2020.
6. Stuart Russell, *Human Compatible: Artificial Intelligence and the Problem of Control*, Viking Publications, 2019.
7. Lu, Q., Zhu, L., Whittle, J., & Xu, X., *Responsible AI: Best Practices for Creating Trustworthy AI Systems*, Addison Wesley Professional, 2023.

Web and Video link(s):

<https://nptel.ac.in/courses/106106472>; NPTEL Video Lecture on NOC: Responsible & Safe AI Systems by Prof. Ponnurangam Kumaraguru, Prof. Balaraman Ravindran, Prof. Arun Rajkumar, Professor of IIITH & IITM.

Course Articulation Matrix (CAM):				U24CS801A: RESPONSIBLE AI										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801A.1	3	2	2	2	1	3	3	2	2	1	1	2	2
CO2	U24CS801A.2	2	3	2	2	1	3	3	2	2	1	1	2	2
CO3	U24CS801A.3	2	2	2	2	2	3	3	2	2	2	2	2	2
CO4	U24CS801A.4	2	2	3	2	2	3	3	2	2	1	1	2	2
U24CS801A		2.25	2.25	2.25	2	1.5	3	3	2	2	1.25	1.25	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	understand AI technologies, ethics, societal impacts, and risks, and apply responsible AI governance to build trustworthy, human-centered, and socially beneficial systems.	SDG16	Peace, Justice and Strong Institutions	as it focuses on responsible AI governance, ethical decision-making, regulatory frameworks (e.g., EU AI Act), risk accountability, and the integration of AI into democratic and societal institutions to ensure transparent, fair, and trustworthy AI systems..
CO2	analyse and apply ethical, legal, fairness, and	SDG10	Reduced Inequalities	by addressing fairness, accountability, transparency, and non-discrimination

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	accountability principles in Artificial Intelligence systems to ensure transparent, non-discriminatory, and responsible AI deployment.			in Artificial Intelligence systems to ensure inclusive and equitable digital technologies.
CO3	ensure responsible AI governance by applying data protection, accountability, transparency, regulatory compliance, and ethical practices across AI systems in all industries.	SDG9	Industry, Innovation and Infrastructure	by promoting responsible AI governance, secure data infrastructures, ethical digital innovation, and regulatory frameworks necessary for sustainable industrial and technological development.
CO4	apply ethical, legal, and governance principles for responsible use of Artificial Intelligence in healthcare, neurotechnology, security, and armed conflict to ensure human rights, safety, and accountability.	SDG3	Good Health and well being	(Good Health and Well-Being) due to its emphasis on responsible AI in healthcare, neurotechnology governance, medical ethics, and human-centered AI systems. It also partially supports SDG 9 (Industry, Innovation and Infrastructure) through innovation in AI and neurotechnologies, and SDG 16 through ethical AI governance and international law in security applications.

SOCIAL NETWORK ANALYSIS			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS801B	Credits:	3
Hours/Week (L-T-P- E):	3-0-0-3	CIE:	40%
Total Number of Teaching Hours:	36 Hrs	ESE:	60%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : Identify networks in graph-theoretic language and identify sources and boundaries of network data CO2 : apply clustering algorithms to detect groups in proximity data and analyze testable hypothesis at the dyadic, monadic and whole-network level CO3 : analyze directed & undirected networks and evaluate measures of transitivity, reciprocity & clustering CO4 : interpret sampling methods and block models for both regular and structural equivalence			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction: Network essentials, Types of relations, Goals of analysis, Network variables as explanatory variables, Network variables as outcome variables Mathematical Foundations: Introduction, Graphs, Paths and components, Adjacency matrices, Ways and modes, Matrix products Research Design: Introduction, Experiments and field studies, Whole-network and personal-network research designs, Sources of network data, Types of nodes and types of ties, Actor attributes, Sampling and bounding, Sources of data reliability and validity issues, Ethical considerations			
UNIT-II			9 Hrs
Multivariate Techniques Used in Network Analysis: Introduction, Multidimensional scaling, Correspondence analysis, Hierarchical clustering Visualization: Introduction, Layout, Embedding node attributes, Node filtering, Ego networks, Embedding tie characteristics, Visualizing network change, Exporting visualizations, Closing comments Testing Hypotheses: Introduction, Permutation tests, Dyadic hypotheses, Mixed dyadic-monadic hypotheses, Node-level hypotheses, Whole-network hypotheses, Exponential random graph models, Stochastic actor-oriented models (SAOMs)			
UNIT-III			9 Hrs
Characterizing Whole Networks: Introduction, Cohesion, Reciprocity, Transitivity and the clustering coefficient, Triad census, Centralization and core-periphery indices Centrality: Introduction, Basic concept, Undirected, non-valued networks, Directed, non-			

valued networks, Valued networks, Negative tie networks

Subgroups: Introduction, Cliques, Girvan–Newman algorithm, Factions and modularity optimization, Directed and valued data, Computational considerations, Performing a cohesive subgraph analysis, Supplementary material

UNIT-IV

9 Hrs

Equivalence: Introduction, Structural equivalence, Profile similarity, Block models, The direct method, Regular equivalence, The REGE algorithm, Core–periphery models

Analyzing Two-mode Data: Introduction, Converting to one-mode data, converting valued two-mode matrices to one-mode, Bipartite networks, Cohesive subgroups and community detection, Core–periphery models, Equivalence

Large Networks: Introduction, Reducing the size of problem, Choosing appropriate methods, Sampling, Small-world and scale-free networks

Textbook(s):

1. phen P Borgatti, Martin G Everett, Jeffrey C Johnson, Analyzing Social Networks, 2nd ed. Melbourne: Sage publications, 2018.

Reference Book(S):

1. Stanley Wasserman, Katherine Faust, Social Network Analysis: Methods And Applications, New York: Cambridge University Press, 1999
2. Derek.L.Hansen, BenShneiderman, Marc A. Smith, Analyzing social media networks with NodeXL, Burlington: Elsevier Publication, 2019.
3. KsimTsvetovat, Alexander Kouznetsov, Social Network Analysis for Startups, California: O'Reilly Media publications, 2011
4. BorkoFurht, Handbook of Social Network Technologies and Applications, New York: Springer publications, 2010.

Web and Research Paper(s):

Research papers (Journals/conference papers) relevant to the course content will be posted by the course faculty in CourseWeb page.

Course Articulation Matrix (CAM):				U24CS801B: SOCIAL NETWORK ANALYSIS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801B.1	2	2	3	2	1	-	-	1	1	1	-	1	2
CO2	U24CS801B.2	1	2	2	1	1	-	-	1	1	1	-	1	2
CO3	U24CS801B.3	2	2	2	2	1	-	-	1	1	1	-	1	2
CO4	U24CS801B.4	2	2	2	2	-	-	-	1	1	1	-	1	2
U24CS801B		1.7 5	2	2	1.7 5	1	-	-	1	1	1	-	1	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the fundamental concepts of network analysis, graph theory,	SDG9	Industry, Innovation and	Network analysis concepts and graph-based models support the development of intelligent digital

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	and network variables for analyzing relationships and interactions in social and information networks		Infrastructure	infrastructure, communication systems, and data-driven innovations in modern industries and research domains.
CO2	analyze and design research methodologies for network data collection, sampling, validation, and ethical analysis in social and organizational networks	SDG16	Peace, Justice and Strong Institutions	Ethical and reliable network research methods promote transparency, responsible data usage, and informed institutional decision-making, contributing to accountable and inclusive systems.
CO3	apply multivariate techniques, visualization methods, and hypothesis testing models for interpreting complex network structures and relationships	SDG4	Quality Education	Advanced visualization and analytical techniques enhance knowledge discovery, critical thinking, and data interpretation skills, supporting modern education and research practices.
CO4	evaluate network structures using centrality, cohesion, subgroup detection, equivalence models, and large-scale network analysis techniques	SDG9	Industry, Innovation and Infrastructure	Large-scale network analysis and community detection methods are essential for optimizing communication networks, social platforms, transportation systems, and other infrastructure-based applications.

MLOPS ENGINEERING			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS801C	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : explain MLOps fundamentals, machine learning systems design, and machine learning lifecycle CO2 : analyze data engineering workflows, feature engineering processes and model development practices CO3 : apply continuous integration, continuous delivery, testing and automation techniques for ML systems CO4 : implement model deployment, monitoring, governance and operational best practices for production ML applications			
UNIT-I			9 Hrs
Introduction to MLOps and Machine Learning Systems: Introduction to MLOps, Machine learning engineering lifecycle, Principles of MLOps, Designing machine learning systems, Machine learning project lifecycle, Product management for AI and ML systems, Team roles and responsibilities in MLOps, Data science process, Machine learning workflow, Challenges in operationalizing machine learning systems			
UNIT-II			9 Hrs
Data Engineering and Model Development: Data engineering for machine learning, Data ingestion and data pipelines, Data preparation and preprocessing, Feature engineering fundamentals, Data quality and validation, Exploratory data analysis, Model training workflows, Experiment tracking, Reproducibility in machine learning, Managing datasets and model artifacts			
UNIT-III			9 Hrs
Continuous Integration and Continuous Delivery for Machine Learning: Version control for machine learning projects, Continuous integration concepts, Automated testing for machine learning systems, Build automation, Continuous delivery pipelines, Infrastructure as Code, Containerization fundamentals, Workflow orchestration, Automation strategies for machine learning operations			
UNIT-IV			9 Hrs
Model Deployment, Monitoring and Operations: Model deployment strategies, Batch and real-time inference systems, Cloud-based machine learning deployment, Model serving architectures, Monitoring machine learning systems, Performance monitoring and drift detection, Logging and observability, Model governance and compliance, Security considerations in MLOps, Scaling and maintaining production machine learning systems			
<u>Text book(s):</u> 2. Noah Gift and Alfredo Deza, Practical MLOps: Operationalizing Machine Learning Models, O'Reilly Media, First Edition, 2021. (All Units)			
<u>Reference book(S):</u> 1. Mark Treveil et al., Introducing MLOps: How to Scale Machine Learning in the Enterprise, O'Reilly Media, 2020. 2. Emmanuel Ameisen, Building Machine Learning Powered Applications, O'Reilly Media, 2020.			

Course Articulation Matrix (CAM):				U24CS801C: MLOps Engineering										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801C.1	2	2	2	2	2	1	1	-	1	1	1	2	2
CO2	U24CS801C.2	2	2	2	2	2	-	-	-	-	-	1	2	2
CO3	U24CS801C.3	2	2	3	3	2	-	-	-	-	-	1	2	2
CO4	U24CS801C.4	2	2	3	3	2	1	1	-	1	1	1	2	2
U24CS801C		2	2	2.5	2.5	2	1	1	-	1	1	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	explain MLOps fundamentals, machine learning systems design, and machine learning lifecycle	SDG3	Good Health and Well-being	Enables the development, deployment, and management of reliable machine learning systems for healthcare applications, thereby improving disease prediction, diagnosis, and overall healthcare.
CO2	analyze data engineering workflows, feature engineering processes and model development practices	SDG9	Industry, Innovation and Infrastructure	Fostering skills in data-driven innovation, scalable machine learning infrastructure, and advanced analytics, which contribute to the development of sustainable industrial systems and technological advancement.
CO3	apply continuous integration, continuous delivery, testing and automation techniques for ML systems	SDG9	Industry, Innovation and Infrastructure	promotes automated, scalable, and reliable machine learning deployment practices, thereby strengthening technological innovation and sustainable digital infrastructure es.
CO4	implement model deployment, monitoring, governance and operational best practices for production ML applications	SDG9	Industry, Innovation and Infrastructure	Enables the development of robust, scalable, and well-governed machine learning systems, thereby promoting innovation, resilient digital infrastructure, and sustainable industrial practices.

DIGITAL FORENSICS

Class: B. Tech. VIII- Semester		Branch: CSE	
Course Code:	U24CS801D	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%

Course Learning Outcomes (COs)

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

CO1 : analyze concepts of cybercrimes and identify cyber offenses

CO2 : analyze vulnerabilities in mobile and wireless devices

CO3 : apply Indian IT Act and cyber laws

CO4 : Use digital forensic techniques and digital evidence techniques in investigations

THEORY COMPONENT

UNIT-I	9 Hrs
Introduction to Cybercrime: Introduction, Cybercrime and information security, Who are Cybercriminals, Classifications of Cybercrimes, Cybercrime – legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, global perspective on cybercrimes. Cyber offenses: How criminals plan attacks, Social engineering, Cyber stalking, Cyber café and cybercrimes, Botnets, Attack vectors, Cloud computing. Case Study: A Comprehensive Digital Forensic Case Study on Mirai Botnet Servers.	
UNIT-II	9 Hrs
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds, Security challenges posed by mobile devices, Registry settings, Authentication service security. Mobile attacks and organizational measures: Security implications for organizations, Organizational policies, Mobile computing era, Laptops. Case Study: Mobile malware – Cabassous /FluBot.	
UNIT-III	9 Hrs
Cybercrimes and Cybersecurity: Legal Perspectives Introduction, Cybercrime legal landscape around the world, Need of cyber laws, Indian IT Act, Challenges to Indian law, Digital signatures, Amendments to IT Act, Cybercrime and punishment, Technology and students. Case Study: Conviction of PARK JIN HYOK in Brambul Worm attack.	
UNIT-IV	9 Hrs
Introduction to Digital Forensics and Digital Evidence: Need for Digital Forensics, Rules of Digital Forensics, Types of Digital Forensics, Ethical issues, Digital investigations, Digital evidence, Characteristics of evidence, Evidence handling challenges. Case Study: Post-retrieval search hit clustering to improve information retrieval effectiveness.	

Textbook(s):

1. Adam Tilmar Jakobsen, Practical Cyber Intelligence: A Hands-on Guide to Digital Forensics, Hoboken, New Jersey: Wiley, 2024 (Unit-II, III, IV).
2. Meenal Dhal et al., Handbook of Digital Forensics and Cyber Crime, New Delhi: Springer, 2024 (Unit-I, II, III, IV).

Reference Book(S):

1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, New York: CRC Press T & F Group, 2011.
2. Chwan-Hwa (John) Wu, J. David Irwin, Introduction to Cyber Security, New York: CRC Press T & F Group, 2013.
3. Thomas A. Johnson, Cyber Security Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, Missouri: CRC Press T & F Group, 2015.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_lw01/preview?utm_source=chatgpt.com

NPTEL Video Lecture on Internet Crimes and Cyber Security, NALSAR University of Law

Prof. K.V.K. Santhy Prof. B Md Irfan

Course Articulation Matrix (CAM):					U24CS801D: DIGITAL FORENSICS									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801D.1	1	2	1	2	1	-	-	1	1	1	-	1	2
CO2	U24CS801D.2	2	3	2	2	2	-	-	1	1	1	-	2	2
CO3	U24CS801D.3	2	2	2	2	1	-	-	1	1	1	-	1	2
CO4	U24CS801D.4	2	2	1	3	2	-	-	1	1	1	-	2	2
U24CS801D		1.75	2.25	1.5	2.25	1.5	-	-	1	1	1	-	1.5	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO	CO Statement The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	analyze concepts of cybercrimes and identify cyber offenses	SDG-8	Decent Work & Economic Growth	Digital Forensics is identified in the department SDG framework under employability, professional cybersecurity skills and economic growth.
CO2	analyze vulnerabilities in mobile and wireless devices	SDG-9	Industry, Innovation & Infrastructure	Mobile and wireless security contributes to resilient digital infrastructure and technological innovation.
CO3	apply Indian IT Act and cyber laws	SDG-8	Decent Work & Economic Growth	Cyber law and ethical practices support secure workplaces and professional standards.
CO4	use digital forensic techniques and digital evidence techniques in investigations	SDG-8	Decent Work & Economic Growth	Digital forensic investigation skills improve workforce readiness and support cybersecurity industries.

INDUSTRIAL IoT			
Class: B. Tech. VIII- Semester		Branch: CSE	
Course Code:	U24CS801E	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : apply the fundamental concepts of Industry 4.0, Industrial IoT systems, business models, and reference architectures for industrial automation and smart manufacturing applications			
CO2 : analyze IIoT reference architectures and enabling technologies such as cloud, fog, edge, big data, augmented reality, virtual reality, machine learning, and artificial intelligence for industrial systems			
CO3 : examine industrial data acquisition and data transmission systems using sensors, actuators, PLC, DCS, SCADA, industrial gateways, and industrial connectivity mechanisms			
CO4 : apply IIoT analytics, machine learning, data science, and application architectures for solving real-world industrial use cases such as predictive maintenance, healthcare, traffic control, smart irrigation, and smart factories			
THEORY COMPONENT			
UNIT-I			9 Hrs
Industry 4.0: Introduction, design requirements, drivers, sustainability assessment, smart business perspective, cyber security, impact of Industry 4.0.			
Industrial Internet of Things: Introduction, industrial internet systems, industrial sensing, industrial processes			
IIoT Benefits and Industrial Applications: Cyber-physical systems, key IIoT technologies, opportunities and benefits of IIoT, Business model of IoT and IIoT, smart manufacturing, smart factories, digital and human workforce, logistics and industrial automation.			
UNIT-II			9 Hrs
IIoT Reference Architecture: Reference architecture of IoT and IIoT, Industrial Internet Reference Architecture, IIRA, RAMI 4.0			
IIoT System Characteristics: Key performance indicators, industrial internet viewpoints, three-tier IIoT topology, key system characteristics, Cloud computing, fog computing, edge computing			
Analytics and Intelligent Technologies: Big data and advanced analytics, augmented reality, virtual reality, role of machine learning and artificial intelligence in IIoT- Integrating ANN and IoT for Predictive Maintenance in Industries.			
UNIT-III			9 Hrs
Industrial Data Acquisition: Distributed Control System, Programmable Logic Controller, SCADA, industrial sensors and actuators.			
Industrial Data Transmission: Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Controller Area Network			
Industrial Connectivity and Integration: DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and Lora WAN, Recent and upcoming technologies in industrial automation,			

Industrial gateways, industrial connectivity, protocol conversion, industrial device integration.	
UNIT-IV	9 Hrs
IIoT Analytics: Necessity of analytics, data management, advanced analytics, real-time data processing. Machine Learning and Predictive Analytics in Industry: Applications of machine learning in industry, data science in industry, deep learning and its applications in industry, predictive analytics, anomaly detection, quality control and inventory management. IIoT Applications and Case Studies: Manufacturing industry, automotive industry, mining industry, smart traffic control system	
Textbook(s): 1. Sudip Misra, Chandan Roy, Anandarup Mukherjee, <i>Introduction to Industrial Internet of Things and Industry 4.0</i>, CRC Press, Taylor & Francis Group, 1st edition, 2021, Boca Raton. (Chapters 2 to 17) 2. A. Suresh, Malarvizhi Nandagopal, Pethuru Raj, E. A. Neeba, Jenn-Wei Lin, <i>Industrial IoT Application Architecture and Use Cases</i>, CRC Press / Auerbach Publications, Taylor & Francis Group, 1st edition, 2020, Boca Raton. (Chapters 1, 2, 3, 5, 7, 8, 9 and 10)	
Reference Book(S): 1. Alasdair Gilchrist, <i>Industry 4.0: The Industrial Internet of Things</i>, Apress, 1st edition, 2017, New York. 2. Zaigham Mahmood, <i>The Internet of Things in the Industrial Sector: Security and Device Connectivity, Smart Environments and Industry 4.0</i>, Springer, 1st edition, 2019, Cham. 3. Sabina Jeschke, Christian Brecher, Houbing Song and Danda B. Rawat, <i>Industrial Internet of Things: Cybermanufacturing Systems</i>, Springer, 1st edition, 2017, Cham. 4. Pethuru Raj and Anupama C. Raman, <i>The Internet of Things: Enabling Technologies, Platforms, and Use Cases</i>, CRC Press, 1st edition, 2017, Boca Raton.	
Web and Video link(s): https://www.nptel.ac.in/courses/106105195 NPTEL Video Lecture on Introduction to Industry 4.0 and Industrial Internet of Things, IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc26_cs38/preview NPTEL Course Preview on Introduction to Industry 4.0 and Industrial Internet of Things.	

Course Articulation Matrix (CAM):					U24CS801E: INDUSTRIAL IoT									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801E.1	2	1	1	1	1	1	2	1	1	1	1	2	1
CO2	U24CS801E.2	2	2	2	1	2	1	1	1	1	1	1	2	2
CO3	U24CS801E.3	2	2	2	2	2	1	1	1	1	1	1	2	2
CO4	U24CS801E.4	2	2	2	2	2	1	2	1	1	2	2	2	2
U24CS801E		2	1.75	1.75	1.5	1.75	1	1.5	1	1	1.25	1.25	2	1.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO-SDG Alignment Matrix				
CO	CO Statement The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the fundamental concepts of Industry 4.0, Industrial IoT systems, business models, and reference architectures for industrial automation and smart manufacturing applications	SDG9	Industry, Innovation and Infrastructure	Industry 4.0 and IIoT concepts strengthen industrial infrastructure and innovation by supporting connected, intelligent, and scalable manufacturing systems.
CO2	analyze IIoT reference architectures and enabling technologies such as cloud, fog, edge, big data, AR/VR, ML and AI for industrial systems	SDG9	Industry, Innovation and Infrastructure	Reference architectures and enabling technologies support digital industrial transformation and promote intelligent infrastructure development.
CO3	examine industrial data acquisition and data transmission systems using sensors, actuators, PLC, DCS, SCADA, industrial gateways, and industrial connectivity mechanisms	SDG8	Decent Work and Economic Growth	Industrial automation and data acquisition improve productivity, operational efficiency, and technology-driven employment opportunities in industries.
CO4	apply IIoT analytics, machine learning, data science, and application architectures for solving industrial use cases such as predictive maintenance, healthcare, traffic control, smart irrigation, and smart factories	SDG11	Sustainable Cities and Communities	IIoT applications such as smart traffic, smart irrigation, healthcare monitoring, and predictive maintenance contribute to sustainable, safe, and efficient communities and industries.

ROBOTIC PROCESS AUTOMATION			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS802A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 :	understand and develop automation workflows using UiPath studio with task recording and advanced UI interactions.		
CO2 :	implement workflow sequencing, control flow, loops, data manipulation, variables, collections, data tables, and file operations using UiPath Studio.		
CO3 :	apply control handling, OCR techniques, event handling, and plugins/extensions such as Terminal, SAP, and Citrix automation using UiPath Studio.		
CO4 :	implement assistant bots, event triggers, exception handling, debugging, logging, and error reporting techniques using UiPath Studio.		
THEORY COMPONENT			
UNIT-I			9 Hrs
What is Robotic Process Automation? Scope and techniques of automation. Robotic process automation, About UiPath Record and Play UiPath Stack- UiPath Stack, Downloading and installing UiPath studio Learning UiPath studio, Task recorder, Step-by-Step examples using the recorder.			
UNIT-II			9 Hrs
Sequence, Flowchart, and Control Flow Sequencing the workflow- Activities, Control Flow, various types of loops and decision making Data Manipulation: Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management File operation with step-by-step example, CSV/Excel to data table and vice versa.			
UNIT-III			9 Hrs
Taking Control of the Controls Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer Handling events, revisit recorder, Screen Scraping When to use OCR, Types of OCR available, How to use OCR, Avoiding Typical Failure Points. Tame that Application with Plugins and Extensions: Terminal Plugin, SAP Automation, Java Plug-in, Citrix automation.			
UNIT-IV			9 Hrs
Handling User Events and Assistant Bots .What are Assistant bots? Monitoring system event triggers-Monitoring image and element triggers, Launching an assistant bot on a keyboard event Exception Handling, Debugging, and Logging-Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting			
Textbook:			
1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing			

Reference Book(s):

1. Tom Taulli, *The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems*, 2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A press
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.
3. Richard Murdoch, "Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.
4. Srikanth Merianda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.

Web and Video link(s):

<https://www.shiksha.com/college/iit-kanpur-indian-institute-of-technology-25116/course-online-introduction-to-robotic-process-automation-using-uipath-1196003>

Course Articulation Matrix (CAM):				U24CS802A : ROBOTIC PROCESS AUTOMATION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS802A.1	2	2	2	1	3	2	1	1	1	1	2	2	2
CO2	U24CS802A.2	1	2	3	1	3	2	1	1	1	1	2	3	3
CO3	U24CS802A.3	1	2	3	1	3	2	1	1	1	1	2	3	3
CO4	U24CS802A.4	1	2	3	1	3	2	1	3	1	1	2	3	3
U24CS802A		1.25	2	2.75	1	3	2	1	1.5	1	1	2	2.75	2.75
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	understand RPA concepts and develop automation workflows using UiPath studio with task recording and advanced UI interactions.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	Understanding RPA concepts and developing automation workflows using UiPath Studio with task recording and advanced UI interactions is involved in automating repetitive business processes, integrating digital technologies into organizational

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				workflows, improving operational efficiency and accuracy, reducing manual effort, and enabling intelligent, scalable, and sustainable automation solutions across industries and public services.
CO2	implement workflow sequencing, control flow, loops, data manipulation, variables, collections, data tables, and file operations using UiPath Studio.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	implementing workflow sequencing, control flow, loops, data manipulation, variables, collections, data tables, and file operations using UiPath Studio, thereby supporting quality technical education, improving workplace productivity through automation, and promoting innovative digital process management.
CO3	apply control handling, OCR techniques, event handling, and plugins/extensions such as Terminal, SAP, and Citrix automation using UiPath Studio.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	Applying control handling, OCR techniques, event handling, and plugins/extensions such as Terminal, SAP, and Citrix automation using UiPath Studio develops advanced automation and digital integration skills, enhances productivity and employability, promotes innovative enterprise automation solutions, and supports efficient, intelligent, and sustainable digital operations.
CO4	implement assistant bots, event triggers, exception handling, debugging, logging, and error reporting techniques using	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	implementing assistant bots, event triggers, exception handling, debugging, logging, and error reporting in UiPath Studio to develop automation skills, improve

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
	UiPath Studio.			process efficiency, and enable reliable and intelligent business automation solutions.

SOCIAL NETWORK ANALYSIS			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS801B	Credits:	3
Hours/Week (L-T-P- E):	3-0-0-3	CIE:	40%
Total Number of Teaching Hours:	36 Hrs	ESE:	60%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : Identify networks in graph-theoretic language and identify sources and boundaries of network data CO2 : apply clustering algorithms to detect groups in proximity data and analyze testable hypothesis at the dyadic, monadic and whole-network level CO3 : analyze directed & undirected networks and evaluate measures of transitivity, reciprocity & clustering CO4 : interpret sampling methods and block models for both regular and structural equivalence			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction: Network essentials, Types of relations, Goals of analysis, Network variables as explanatory variables, Network variables as outcome variables Mathematical Foundations: Introduction, Graphs, Paths and components, Adjacency matrices, Ways and modes, Matrix products Research Design: Introduction, Experiments and field studies, Whole-network and personal-network research designs, Sources of network data, Types of nodes and types of ties, Actor attributes, Sampling and bounding, Sources of data reliability and validity issues, Ethical considerations			
UNIT-II			9 Hrs
Multivariate Techniques Used in Network Analysis: Introduction, Multidimensional scaling, Correspondence analysis, Hierarchical clustering Visualization: Introduction, Layout, Embedding node attributes, Node filtering, Ego networks, Embedding tie characteristics, Visualizing network change, Exporting visualizations, Closing comments Testing Hypotheses: Introduction, Permutation tests, Dyadic hypotheses, Mixed dyadic-monadic hypotheses, Node-level hypotheses, Whole-network hypotheses, Exponential random graph models, Stochastic actor-oriented models (SAOMs)			
UNIT-III			9 Hrs
Characterizing Whole Networks: Introduction, Cohesion, Reciprocity, Transitivity and the clustering coefficient, Triad census, Centralization and core-periphery indices			

Centrality: Introduction, Basic concept, Undirected, non-valued networks, Directed, non-valued networks, Valued networks, Negative tie networks

Subgroups: Introduction, Cliques, Girvan-Newman algorithm, Factions and modularity optimization, Directed and valued data, Computational considerations, Performing a cohesive subgraph analysis, Supplementary material

UNIT-IV

9 Hrs

Equivalence: Introduction, Structural equivalence, Profile similarity, Block models, The direct method, Regular equivalence, The REGE algorithm, Core-periphery models

Analyzing Two-mode Data: Introduction, Converting to one-mode data, converting valued two-mode matrices to one-mode, Bipartite networks, Cohesive subgroups and community detection, Core-periphery models, Equivalence

Large Networks: Introduction, Reducing the size of problem, Choosing appropriate methods, Sampling, Small-world and scale-free networks

Textbook(s):

- phen P Borgatti, Martin G Everett, Jeffrey C Johnson, Analyzing Social Networks, 2nd ed. Melbourne: Sage publications, 2018.

Reference Book(S):

- Stanley Wasserman, Katherine Faust, Social Network Analysis: Methods And Applications, New York: Cambridge University Press, 1999
- Derek.L.Hansen, BenShneiderman, Marc A. Smith, Analyzing social media networks with NodeXL, Burlington: Elsevier Publication, 2019.
- KsimTsvetovat, Alexander Kouznetsov, Social Network Analysis for Startups, California: O'Reilly Media publications, 2011
- BorkoFurht, Handbook of Social Network Technologies and Applications, New York: Springer publications, 2010.

Web and Research Paper(s):

Research papers (Journals/conference papers) relevant to the course content will be posted by the course faculty in CourseWeb page.

Course Articulation Matrix (CAM):				U24CS801B: SOCIAL NETWORK ANALYSIS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801B.1	2	2	3	2	1	-	-	1	1	1	-	1	2
CO2	U24CS801B.2	1	2	2	1	1	-	-	1	1	1	-	1	2
CO3	U24CS801B.3	2	2	2	2	1	-	-	1	1	1	-	1	2
CO4	U24CS801B.4	2	2	2	2	-	-	-	1	1	1	-	1	2
U24CS801B		1.7 5	2	2	1.7 5	1	-	-	1	1	1	-	1	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the fundamental concepts of network analysis, graph theory, and network variables for analyzing relationships and interactions in social and information networks	SDG9	Industry, Innovation and Infrastructure	Network analysis concepts and graph-based models support the development of intelligent digital infrastructure, communication systems, and data-driven innovations in modern industries and research domains.
CO2	analyze and design research methodologies for network data collection, sampling, validation, and ethical analysis in social and organizational networks	SDG16	Peace, Justice and Strong Institutions	Ethical and reliable network research methods promote transparency, responsible data usage, and informed institutional decision-making, contributing to accountable and inclusive systems.
CO3	apply multivariate techniques, visualization methods, and hypothesis testing models for interpreting complex network structures and relationships	SDG4	Quality Education	Advanced visualization and analytical techniques enhance knowledge discovery, critical thinking, and data interpretation skills, supporting modern education and research practices.
CO4	evaluate network structures using centrality, cohesion, subgroup detection, equivalence models, and large-scale network analysis techniques	SDG9	Industry, Innovation and Infrastructure	Large-scale network analysis and community detection methods are essential for optimizing communication networks, social platforms, transportation systems, and other infrastructure-based applications.

MLOPS ENGINEERING			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS801C	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
<i>After completion of this course, the students should be able to,</i>			
CO1 :	explain MLOps fundamentals, machine learning systems design, and machine learning lifecycle		
CO2 :	analyze data engineering workflows, feature engineering processes and model development practices		
CO3 :	apply continuous integration, continuous delivery, testing and automation techniques for ML systems		
CO4 :	implement model deployment, monitoring, governance and operational best practices for production ML applications		
UNIT-I			9 Hrs
Introduction to MLOps and Machine Learning Systems: Introduction to MLOps, Machine learning engineering lifecycle, Principles of MLOps, Designing machine learning systems, Machine learning project lifecycle, Product management for AI and ML systems, Team roles and responsibilities in MLOps, Data science process, Machine learning workflow, Challenges in operationalizing machine learning systems			
UNIT-II			9 Hrs
Data Engineering and Model Development: Data engineering for machine learning, Data ingestion and data pipelines, Data preparation and preprocessing, Feature engineering fundamentals, Data quality and validation, Exploratory data analysis, Model training workflows, Experiment tracking, Reproducibility in machine learning, Managing datasets and model artifacts			
UNIT-III			9 Hrs
Continuous Integration and Continuous Delivery for Machine Learning: Version control for machine learning projects, Continuous integration concepts, Automated testing for machine learning systems, Build automation, Continuous delivery pipelines, Infrastructure as Code, Containerization fundamentals, Workflow orchestration, Automation strategies for machine learning operations			
UNIT-IV			9 Hrs
Model Deployment, Monitoring and Operations: Model deployment strategies, Batch and real-time inference systems, Cloud-based machine learning deployment, Model serving architectures, Monitoring machine learning systems, Performance monitoring and drift detection, Logging and observability, Model governance and compliance, Security considerations in MLOps, Scaling and maintaining production machine learning systems			
Text book(s):			
3. Noah Gift and Alfredo Deza, Practical MLOps: Operationalizing Machine Learning Models, O'Reilly Media, First Edition, 2021. (All Units)			
Reference book(S):			
3. Mark Treveil et al., Introducing MLOps: How to Scale Machine Learning in the Enterprise, O'Reilly Media, 2020.			
4. Emmanuel Ameisen, Building Machine Learning Powered Applications, O'Reilly Media, 2020.			

Course Articulation Matrix (CAM):				U24CS801C: MLOps Engineering										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801C.1	2	2	2	2	2	1	1	-	1	1	1	2	2
CO2	U24CS801C.2	2	2	2	2	2	-	-	-	-	-	1	2	2
CO3	U24CS801C.3	2	2	3	3	2	-	-	-	-	-	1	2	2
CO4	U24CS801C.4	2	2	3	3	2	1	1	-	1	1	1	2	2
U24CS801C		2	2	2.5	2.5	2	1	1	-	1	1	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	explain MLOps fundamentals, machine learning systems design, and machine learning lifecycle	SDG3	Good Health and Well-being	Enables the development, deployment, and management of reliable machine learning systems for healthcare applications, thereby improving disease prediction, diagnosis, and overall healthcare.
CO2	analyze data engineering workflows, feature engineering processes and model development practices	SDG9	Industry, Innovation and Infrastructure	Fostering skills in data-driven innovation, scalable machine learning infrastructure, and advanced analytics, which contribute to the development of sustainable industrial systems and technological advancement.
CO3	apply continuous integration, continuous delivery, testing and automation techniques for ML systems	SDG9	Industry, Innovation and Infrastructure	promotes automated, scalable, and reliable machine learning deployment practices, thereby strengthening technological innovation and sustainable digital infrastructure es.
CO4	implement model deployment, monitoring, governance and operational best practices for production ML applications	SDG9	Industry, Innovation and Infrastructure	Enables the development of robust, scalable, and well-governed machine learning systems, thereby promoting innovation, resilient digital infrastructure, and sustainable industrial practices.

DIGITAL FORENSICS

Class: B. Tech. VIII- Semester		Branch: CSE	
Course Code:	U24CS801D	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%

Course Learning Outcomes (COs)

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

(based on cognitive skills acquired from theory component)

CO1 : analyze concepts of cybercrimes and identify cyber offenses

CO2 : analyze vulnerabilities in mobile and wireless devices

CO3 : apply Indian IT Act and cyber laws

CO4 : Use digital forensic techniques and digital evidence techniques in investigations

THEORY COMPONENT

UNIT-I	9 Hrs
Introduction to Cybercrime: Introduction, Cybercrime and information security, Who are Cybercriminals, Classifications of Cybercrimes, Cybercrime – legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, global perspective on cybercrimes. Cyber offenses: How criminals plan attacks, Social engineering, Cyber stalking, Cyber café and cybercrimes, Botnets, Attack vectors, Cloud computing. Case Study: A Comprehensive Digital Forensic Case Study on Mirai Botnet Servers.	
UNIT-II	9 Hrs
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds, Security challenges posed by mobile devices, Registry settings, Authentication service security. Mobile attacks and organizational measures: Security implications for organizations, Organizational policies, Mobile computing era, Laptops. Case Study: Mobile malware – Cabassous /FluBot.	
UNIT-III	9 Hrs
Cybercrimes and Cybersecurity: Legal Perspectives Introduction, Cybercrime legal landscape around the world, Need of cyber laws, Indian IT Act, Challenges to Indian law, Digital signatures, Amendments to IT Act, Cybercrime and punishment, Technology and students. Case Study: Conviction of PARK JIN HYOK in Brambul Worm attack.	
UNIT-IV	9 Hrs
Introduction to Digital Forensics and Digital Evidence: Need for Digital Forensics, Rules of Digital Forensics, Types of Digital Forensics, Ethical issues, Digital investigations, Digital evidence, Characteristics of evidence, Evidence handling challenges. Case Study: Post-retrieval search hit clustering to improve information retrieval effectiveness.	
Textbook(s): 1. Adam Tilmar Jakobsen, Practical Cyber Intelligence: A Hands-on Guide to Digital Forensics, Hoboken, New Jersey: Wiley, 2024 (Unit-II, III, IV). 2. Meenal Dhal et al., Handbook of Digital Forensics and Cyber Crime, New Delhi: Springer, 2024 (Unit-I, II, III, IV).	

Reference Book(S):

1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, New York: CRC Press T & F Group, 2011.
2. Chwan-Hwa (John) Wu, J. David Irwin, Introduction to Cyber Security, New York: CRC Press T & F Group, 2013.
3. Thomas A. Johnson, Cyber Security Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, Missouri: CRC Press T & F Group, 2015.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_lw01/preview?utm_source=chatgpt.com

NPTEL Video Lecture on Internet Crimes and Cyber Security, NALSAR University of Law

Prof. K.V.K. Santhy Prof. B Md Irfan

Course Articulation Matrix (CAM):					U24CS801D: DIGITAL FORENSICS									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801D.1	1	2	1	2	1	-	-	1	1	1	-	1	2
CO2	U24CS801D.2	2	3	2	2	2	-	-	1	1	1	-	2	2
CO3	U24CS801D.3	2	2	2	2	1	-	-	1	1	1	-	1	2
CO4	U24CS801D.4	2	2	1	3	2	-	-	1	1	1	-	2	2
U24CS801D		1.75	2.25	1.5	2.25	1.5	-	-	1	1	1	-	1.5	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO	CO Statement The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	analyze concepts of cybercrimes and identify cyber offenses	SDG-8	Decent Work & Economic Growth	Digital Forensics is identified in the department SDG framework under employability, professional cybersecurity skills and economic growth.
CO2	analyze vulnerabilities in mobile and wireless devices	SDG-9	Industry, Innovation & Infrastructure	Mobile and wireless security contributes to resilient digital infrastructure and technological innovation.
CO3	apply Indian IT Act and cyber laws	SDG-8	Decent Work & Economic Growth	Cyber law and ethical practices support secure workplaces and professional standards.
CO4	use digital forensic techniques and digital evidence techniques in investigations	SDG-8	Decent Work & Economic Growth	Digital forensic investigation skills improve workforce readiness and support cybersecurity industries.

INDUSTRIAL IoT			
Class: B. Tech. VIII- Semester		Branch: CSE	
Course Code:	U24CS801E	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : apply the fundamental concepts of Industry 4.0, Industrial IoT systems, business models, and reference architectures for industrial automation and smart manufacturing applications			
CO2 : analyze IIoT reference architectures and enabling technologies such as cloud, fog, edge, big data, augmented reality, virtual reality, machine learning, and artificial intelligence for industrial systems			
CO3 : examine industrial data acquisition and data transmission systems using sensors, actuators, PLC, DCS, SCADA, industrial gateways, and industrial connectivity mechanisms			
CO4 : apply IIoT analytics, machine learning, data science, and application architectures for solving real-world industrial use cases such as predictive maintenance, healthcare, traffic control, smart irrigation, and smart factories			
THEORY COMPONENT			
UNIT-I			9 Hrs
Industry 4.0: Introduction, design requirements, drivers, sustainability assessment, smart business perspective, cyber security, impact of Industry 4.0.			
Industrial Internet of Things: Introduction, industrial internet systems, industrial sensing, industrial processes			
IIoT Benefits and Industrial Applications: Cyber-physical systems, key IIoT technologies, opportunities and benefits of IIoT, Business model of IoT and IIoT, smart manufacturing, smart factories, digital and human workforce, logistics and industrial automation.			
UNIT-II			9 Hrs
IIoT Reference Architecture: Reference architecture of IoT and IIoT, Industrial Internet Reference Architecture, IIRA, RAMI 4.0			
IIoT System Characteristics: Key performance indicators, industrial internet viewpoints, three-tier IIoT topology, key system characteristics, Cloud computing, fog computing, edge computing			
Analytics and Intelligent Technologies: Big data and advanced analytics, augmented reality, virtual reality, role of machine learning and artificial intelligence in IIoT- Integrating ANN and IoT for Predictive Maintenance in Industries.			
UNIT-III			9 Hrs
Industrial Data Acquisition: Distributed Control System, Programmable Logic Controller, SCADA, industrial sensors and actuators.			
Industrial Data Transmission: Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Controller Area Network			

Industrial Connectivity and Integration: DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and Lora WAN, Recent and upcoming technologies in industrial automation, Industrial gateways, industrial connectivity, protocol conversion, industrial device integration.

UNIT-IV

9 Hrs

IIoT Analytics: Necessity of analytics, data management, advanced analytics, real-time data processing.

Machine Learning and Predictive Analytics in Industry: Applications of machine learning in industry, data science in industry, deep learning and its applications in industry, predictive analytics, anomaly detection, quality control and inventory management.

IIoT Applications and Case Studies: Manufacturing industry, automotive industry, mining industry, smart traffic control system

Textbook(s):

1. Sudip Misra, Chandan Roy, Anandarup Mukherjee, *Introduction to Industrial Internet of Things and Industry 4.0*, CRC Press, Taylor & Francis Group, 1st edition, 2021, Boca Raton. (Chapters 2 to 17)
2. A. Suresh, Malarvizhi Nandagopal, Pethuru Raj, E. A. Neeba, Jenn-Wei Lin, *Industrial IoT Application Architecture and Use Cases*, CRC Press / Auerbach Publications, Taylor & Francis Group, 1st edition, 2020, Boca Raton. (Chapters 1, 2, 3, 5, 7, 8, 9 and 10)

Reference Book(S):

1. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress, 1st edition, 2017, New York.
2. Zaigham Mahmood, *The Internet of Things in the Industrial Sector: Security and Device Connectivity, Smart Environments and Industry 4.0*, Springer, 1st edition, 2019, Cham.
3. Sabina Jeschke, Christian Brecher, Houbing Song and Danda B. Rawat, *Industrial Internet of Things: Cybermanufacturing Systems*, Springer, 1st edition, 2017, Cham.
4. Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 1st edition, 2017, Boca Raton.

Web and Video link(s):

<https://www.nptel.ac.in/courses/106105195>

NPTEL Video Lecture on Introduction to Industry 4.0 and Industrial Internet of Things, IIT Kharagpur.

https://onlinecourses.nptel.ac.in/noc26_cs38/preview

NPTEL Course Preview on Introduction to Industry 4.0 and Industrial Internet of Things.

Course Articulation Matrix (CAM):					U24CS801E: INDUSTRIAL IoT									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS801E.1	2	1	1	1	1	1	2	1	1	1	1	2	1
CO2	U24CS801E.2	2	2	2	1	2	1	1	1	1	1	1	2	2
CO3	U24CS801E.3	2	2	2	2	2	1	1	1	1	1	1	2	2
CO4	U24CS801E.4	2	2	2	2	2	1	2	1	1	2	2	2	2
U24CS801E		2	1.75	1.75	1.5	1.75	1	1.5	1	1	1.25	1.25	2	1.75
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	apply the fundamental concepts of Industry 4.0, Industrial IoT systems, business models, and reference architectures for industrial automation and smart manufacturing applications	SDG9	Industry, Innovation and Infrastructure	Industry 4.0 and IIoT concepts strengthen industrial infrastructure and innovation by supporting connected, intelligent, and scalable manufacturing systems.
CO2	analyze IIoT reference architectures and enabling technologies such as cloud, fog, edge, big data, AR/VR, ML and AI for industrial systems	SDG9	Industry, Innovation and Infrastructure	Reference architectures and enabling technologies support digital industrial transformation and promote intelligent infrastructure development.
CO3	examine industrial data acquisition and data transmission systems using sensors, actuators, PLC, DCS, SCADA, industrial gateways, and industrial connectivity mechanisms	SDG8	Decent Work and Economic Growth	Industrial automation and data acquisition improve productivity, operational efficiency, and technology-driven employment opportunities in industries.
CO4	apply IIoT analytics, machine learning, data science, and application architectures for solving industrial use cases such as predictive maintenance, healthcare, traffic control, smart irrigation, and smart factories	SDG11	Sustainable Cities and Communities	IIoT applications such as smart traffic, smart irrigation, healthcare monitoring, and predictive maintenance contribute to sustainable, safe, and efficient communities and industries.

ROBOTIC PROCESS AUTOMATION			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS802A	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : understand and develop automation workflows using UiPath studio with task recording and advanced UI interactions.			
CO2 : implement workflow sequencing, control flow, loops, data manipulation, variables, collections, data tables, and file operations using UiPath Studio.			
CO3 : apply control handling, OCR techniques, event handling, and plugins/extensions such as Terminal, SAP, and Citrix automation using UiPath Studio.			
CO4 : implement assistant bots, event triggers, exception handling, debugging, logging, and error reporting techniques using UiPath Studio.			
THEORY COMPONENT			
UNIT-I			9 Hrs
What is Robotic Process Automation? Scope and techniques of automation. Robotic process automation, About UiPath			
Record and Play UiPath Stack- UiPath Stack, Downloading and installing UiPath studio			
Learning UiPath studio, Task recorder, Step-by-Step examples using the recorder.			
UNIT-II			9 Hrs
Sequence, Flowchart, and Control Flow Sequencing the workflow- Activities, Control Flow, various types of loops and decision making			
Data Manipulation: Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management File operation with step-by-step example, CSV/Excel to data table and vice versa.			
UNIT-III			9 Hrs
Taking Control of the Controls Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer Handling events, revisit recorder, Screen Scraping When to use OCR, Types of OCR available, How to use OCR, Avoiding Typical Failure Points.			
Tame that Application with Plugins and Extensions: Terminal Plugin, SAP Automation, Java Plug-in, Citrix automation.			
UNIT-IV			9 Hrs
Handling User Events and Assistant Bots .What are Assistant bots? Monitoring system event triggers-Monitoring image and element triggers, Launching an assistant bot on a keyboard event			
Exception Handling, Debugging, and Logging-Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting			
Textbook:			
1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing			

Reference Book(s):

1. Tom Taulli, *The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems*, 2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A press
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.
3. Richard Murdoch, "Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.
4. Srikanth Merianda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.

Web and Video link(s):

<https://www.shiksha.com/college/iit-kanpur-indian-institute-of-technology-25116/course-online-introduction-to-robotic-process-automation-using-uipath-1196003>

Course Articulation Matrix (CAM):				U24CS802A : ROBOTIC PROCESS AUTOMATION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS802A.1	2	2	2	1	3	2	1	1	1	1	2	2	2
CO2	U24CS802A.2	1	2	3	1	3	2	1	1	1	1	2	3	3
CO3	U24CS802A.3	1	2	3	1	3	2	1	1	1	1	2	3	3
CO4	U24CS802A.4	1	2	3	1	3	2	1	3	1	1	2	3	3
U24CS802A		1.25	2	2.75	1	3	2	1	1.5	1	1	2	2.75	2.75
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	understand RPA concepts and develop automation workflows using UiPath studio with task recording and advanced UI interactions.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	Understanding RPA concepts and developing automation workflows using UiPath Studio with task recording and advanced UI interactions is involved in automating repetitive business processes, integrating digital technologies into organizational workflows, improving operational efficiency

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				and accuracy, reducing manual effort, and enabling intelligent, scalable, and sustainable automation solutions across industries and public services.
CO2	implement workflow sequencing, control flow, loops, data manipulation, variables, collections, data tables, and file operations using UiPath Studio.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	implementing workflow sequencing, control flow, loops, data manipulation, variables, collections, data tables, and file operations using UiPath Studio, thereby supporting quality technical education, improving workplace productivity through automation, and promoting innovative digital process management.
CO3	apply control handling, OCR techniques, event handling, and plugins/extensions such as Terminal, SAP, and Citrix automation using UiPath Studio.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	Applying control handling, OCR techniques, event handling, and plugins/extensions such as Terminal, SAP, and Citrix automation using UiPath Studio develops advanced automation and digital integration skills, enhances productivity and employability, promotes innovative enterprise automation solutions, and supports efficient, intelligent, and sustainable digital operations.
CO4	implement assistant bots, event triggers, exception handling, debugging, logging, and error reporting techniques using UiPath Studio.	SDG4, SDG8, SDG9, SDG11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	implementing assistant bots, event triggers, exception handling, debugging, logging, and error reporting in UiPath Studio to develop automation skills, improve process efficiency, and enable reliable and

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				intelligent business automation solutions.

DATA VISUALIZATION			
Class: B. Tech. VIII- Semester		Branch: CSE	
Course Code:	U24CS802B	Credits:	3
Hours/Week (L-T-P- C):	3-0-0-3	CIE:	40%
Total Number of Teaching Hours:	36 Hrs	ESE:	60%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: discern the advanced techniques of data visualization, types of data and data processing			
CO2: apply visualization techniques for representing the spatial and geospatial data			
CO3: apply visualization techniques for representing the time-oriented and unstructured data			
CO4: analyze text and document visualization techniques			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Data Visualization: Visualization functionalities, importance, The difference between visualization and computer graphics, The visualization process, The scatter plot			
Data Foundations: Types of data, Data preprocessing, Visualization foundations, The eight visual variables, Taxonomies			
UNIT-II		9 Hrs	
Visualization Techniques for Spatial Data: One-dimensional data, Two- dimensional data, Three-dimensional data, Visualizing volume data, Dynamic data			
Visualization Techniques for Geospatial Data: Visualizing geospatial data, Map projections, Visualization of point data, line data			
UNIT-III		9 Hrs	
Visualization Techniques for Time-Oriented Data: Introduction, Definitions, characterizing time-oriented data, Relating data and time, Visualizing time-oriented data, Categorization			
Visualization Techniques for Trees, Graphs, and Networks: Displaying hierarchical structures, Displaying arbitrary graphs, networks, Node-link graphs, Matrix representations for graphs			
UNIT-IV		9 Hrs	
Text and Document Visualization: Levels of text representations, The Vector space model, Single document and Document collection visualizations			
Image Visualization: Image Data Representation, Image Processing and Visualization, Basic Imaging Algorithms, Shape Representation and Analysis, Conclusion			
Visualization Systems: Systems based on data type, Systems based on analysis type, Toolkits, Libraries, Research directions in visualization			

Textbook(s):

ttthew O. Ward, Georges Grinstein, Daniel Keim , *Interactive Data Visualization: Foundations, Techniques, and Applications*, 2nd ed., Boca Raton: A K Peters/CRC Press, 2015.

exandru C. Telea , *Data Visualization: Principles and Practice* , 2nd ed., Boca Raton :CRC Press, 2015.

Reference Book(S):

Claus Wilke, *Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures*, 1st ed., Sebastopol: O'Reilly Media Inc, 2019.

Kristen Sosulski, *Data Visualization Made Simple Insights into Becoming Visual*, 2nd ed., Oxon: Routledge, 2015.

Ben Fry, *Visualizing Data*, 1st ed., Sebastopol, O'Reilly Media Inc, 2008.

Web and Video link(s):

<https://nptel.ac.in/courses/106106179> - NPTEL Course on Data Visualization.

Course Articulation Matrix (CAM):				U24CS802B- DATA VISUALIZATION												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	U24CS802B.1	1	3	2	3	1	-	-	1	1	1	-	2	1	2	2
CO2	U24CS802B.2	2	3	2	3	2	-	-	1	1	1	-	2	1	2	2
CO3	U24CS802B.3	2	3	2	3	2	-	-	1	1	1	-	2	1	2	2
CO4	U24CS802B.4	2	3	2	3	2	-	-	1	1	1	-	2	1	2	2
U24CS802B		1.75	3	2	3	1.75	-	-	1	1	1	-	2	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW																

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	discern the advanced techniques of data visualization, types of data and data processing	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	Understanding the advanced concepts of data and visualization contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO2	apply visualization techniques for representing the spatial and geospatial data	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	Application of visualization techniques for representing the spatial and geospatial data contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.
CO3	apply visualization techniques for representing the time-oriented and unstructured data	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	apply visualization techniques for representing the time-oriented and unstructured data contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.
CO4	analyze text and document visualization techniques	SDG4, SDG8, SDG9	Quality Education. Decent Work and Economic Growth. Industry, Innovation and Infrastructure	Analyzing the text and document visualization techniques contributes in ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, and builds resilient infrastructure in promoting inclusive and sustainable industrialization fostering innovation, and also, helps in building scalable, innovative, and resilient digital infrastructure.

AUGMENTED AND VIRTUAL REALITY			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS802C	Credits:	3
Hours/Week (L-T-P- E):	3-0-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : Make use of the components of VR, to interact with input & output devices CO2 : Apply modeling techniques to prepare object position, object behavior and collision detection in VR CO3 : Design VR apps using various tools like Java-3D,WorldTool-Kit and Haptic General open source tool kit CO4 : Analyze augmented reality & mixed reality, challenges and visualization techniques			
THEORY COMPONENT			
UNIT-I			9 Hrs
Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, MovementCapture, Video-basedInput, 3DMenus&3DScanneretc .Output--Visual/ Auditory/HapticDevices.			
UNIT-II			9 Hrs
Modeling: Geometric Modeling, Virtual Object Shape, Object Visual Appearance. KinematicsModeling: HomogeneousTransformationMatrices,ObjectPosition,TransformationInvariant s, Object Hierarchies, Viewing the Three-Dimensional World. Physical Modeling: Collision Detection, Surface Deformation, Force Computation, Force Smoothing and Mapping, Haptic Texturing. Behavior Modeling: Model Management Level-of-Detail Management, Cell Segmentation			
UNIT-III			9 Hrs
VR Programming: Toolkits and Scene Graphs. World Tool-Kit : Model Geometry and Appearance, The WTK Scene Graph, Sensors and Action Functions, WTK Networking. Java 3D: Model Geometry and Appearance, Java 3D Scene Graph, Sensors and Behaviors, Java 3D Networking, WTK and Java 3D Performance Comparison. General Haptics Open Software Toolkit: GHOST Integration with the Graphics Pipeline, The GHOST Haptics Scene Graph, Collision Detection and Response, Graphics and PHANToM Calibration			
UNIT-IV			9 Hrs
Augmented Reality: Introduction to Augmented Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, AR Hardware: Major Hardware Components for Augmented Reality Systems. AR Software: Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application. Interaction in AR: mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems			

Textbook:

1] rdea, G. C. and P. Coffet. *Virtual Reality Technology*, Second Edition. Wiley-IEEE Press, 2003/2006.an B. Craig, *Understanding Augmented Reality, Concepts and Applications*, Morgan Kaufmann, 2013.

Reference Book(s):

1. Dieter Schmalstieg and Tobias Hollerer, "**Augmented Reality: Principles and Practice**", Addison-Wesley Professional, 2016.Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "*Introduction to Robotic Process Automation: a Primer*", Institute of Robotic Process Automation,1st Edition 2015.
2. Dieter Schmalstieg and Tobias Hollerer, "**Augmented Reality: Principles and Practice**", Addison-Wesley Professional, 2016.Srikanth Merianda,"*Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation*", Consulting Opportunity Holdings LLC, 1st Edition 2018.
3. Steven M. LaValle, "**Virtual Reality**", Cambridge University Press, 2017.
4. Jason Jerald, "**The VR Book: Human-Centered Design for Virtual Reality**", Morgan & Claypool Publishers, 2015.

Web and Video link(s):

NPTEL offered a Video lectures on "*VirtualReality*".

Link to Videos presented by IIT Madras: <https://nptel.ac.in/courses/106/106/106106138/>

CourseArticulationMatrix(CAM):U18CS802C AUGMENTED AND VIRTUAL REALITY														
CourseOutcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PSO 1	PSO2
CO1	U18CS802C. 1	2	2	2	2	2	-	-	1	1	1	-	2	2
CO2	U18CS802C. 2	2	2	2	2	2	-	-	1	1	1	-	2	2
CO3	U18CS802C. 3	2	2	2	2	2	-	-	1	1	1	-	3	3
CO4	U18CS802C. 4	2	2	2	2	2	-	-	1	1	1	-	3	3
U18CS802C		2	2	2	2	2	-	-	1	1	1	-	2.5	2.5

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Make use of the components of VR, to interact with input & output devices	SDG 4, SDG 9	Quality Education, Industry Innovation and Infrastructure	Understanding VR components and immersive input/output devices helps in developing interactive learning systems, simulation environments, and innovative digital infrastructure for training

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
				and industrial applications.
CO2	Apply modeling techniques to prepare object position, object behavior and collision detection in VR	SDG 9, SDG 11	Industry Innovation and Infrastructure, Sustainable Cities and Communities	Applying modeling and collision detection techniques supports development of realistic simulations, smart city visualization, infrastructure planning, and advanced immersive engineering applications.
CO3	Design VR apps using various tools like Java-3D, WorldTool-Kit and Haptic General open source tool kit	SDG 8, SDG 9	Decent Work and Economic Growth, Industry Innovation and Infrastructure	Designing VR applications using advanced immersive toolkits promotes technical skill development, innovation in software industries, virtual training systems, and employment opportunities in emerging technologies.
CO4	Analyze augmented reality & mixed reality, challenges and visualization techniques	SDG 10, SDG 11	Quality Education, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Sustainable cities and communities	Analyzing AR/MR technologies and visualization techniques helps create accessible immersive systems, smart urban solutions, and inclusive digital applications that improve equal access to modern technologies and sustainable development.

BLOCKCHAIN TECHNOLOGIES			
Class: B.Tech. VIII–Semester		Branch: CSE	
Course Code:	U24CS802D	Credits:	3
Hours/Week (L-T-P-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: Understand blockchain fundamentals, decentralization concepts, and cryptographic techniques used for secure distributed systems. CO2: Analyze consensus algorithms and Bitcoin architecture for secure cryptocurrency transactions and blockchain operations. CO3: Develop and deploy smart contracts and decentralized applications using Ethereum, Solidity, and Web3 technologies. CO4: Evaluate enterprise blockchain frameworks, blockchain security, decentralized finance and digital identity			
UNIT-I			9 Hrs
Blockchain: The growth of blockchain technology, Distributed systems, The history of blockchain, Introducing blockchain, Types of blockchain Decentralization: Introducing decentralization, Full-ecosystem decentralization, Decentralization in practice, Innovative trends Symmetric Cryptography: Introducing cryptography, Cryptographic primitives, Advanced Encryption Standard Asymmetric Cryptography: Foundational mathematics, Asymmetric cryptography, Introducing RSA, Introducing ECC, Digital signatures, Cryptographic constructs and blockchain technology			
UNIT-II			9 Hrs
Consensus Algorithms: Introducing consensus, Analysis and design, Classification, Algorithms Choosing an algorithm Bitcoin Architecture: Introducing Bitcoin, Cryptographic keys, Addresses, Transactions, Blockchain, Miners, Network, Wallets Bitcoin in Practice: Bitcoin in the real world, Bitcoin payments, Innovation in Bitcoin, Bitcoin client installation, Experimenting further with bitcoin-cli, Bitcoin programming			
UNIT-III			9 Hrs
Smart Contracts: Introducing smart contracts, Ricardian contracts, Smart contract templates, Oracles, The DAO, Advances in smart contract technology Ethereum Architecture: Introducing Ethereum, Cryptocurrency, Keys and addresses, Accounts, Transactions and messages, Ethereum virtual machine, The Ethereum network, Precompiled smart contracts, Wallets and client software, Supporting protocols Ethereum in Practice: Ethereum in Practice, Ethereum payments, Setting up a development environment, Introducing Remix IDE, Interacting with the Ethereum Blockchain with MetaMask Tools, Languages, and Frameworks for Ethereum Developers: Languages, The Solidity compiler Tools, libraries, and frameworks, Contract development and deployment, The Solidity			

language	
Web3 Development Using Ethereum: Interacting with contracts using Web3 and Geth, Interacting with contracts via frontends, Deploying and interacting with contracts using Truffle	
UNIT-IV	9 Hrs
Hyper ledger: Projects under Hyperledger, Hyperledger reference architecture, Hyperledger Fabric	
Tokenization: Tokenization on a blockchain, Types of tokens, Process of tokenization	
Enterprise Blockchain: Enterprise Blockchain, Enterprise blockchain versus public blockchain, Enterprise blockchain architecture, Designing enterprise blockchain solutions, Currently available enterprise blockchains	
Blockchain Privacy: Privacy, Techniques to achieve privacy	
Decentralized Identity: Identity, Digital identity, Identity in Ethereum, Identity in the world of Web3, DeFi, and Metaverse	
Decentralized Finance: Introduction, Financial markets, Applications of blockchain in finance, Decentralized finance	
<u>Textbook(s):</u>	
1. Imran Basir, Mastering Blockchain, 4th ed., Packt Publishing Ltd., Birmingham - Mumbai, 2023	
<u>Reference Book(s):</u>	
1. Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, California, Updated Edition, 2024.	
2. Elad Elrom, The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, Wiley, New Jersey, 2025.	
3. Arjuna Sky Kok, Hands-On Blockchain for Python Developers, Packt Publishing Ltd., Birmingham – Mumbai, 2024.	
<u>Web and Video link(s):</u>	
https://nptel.ac.in/courses/106/104/106104220/ by Prof. Sandeep Shukla, IIT Kanpur	
https://nptel.ac.in/courses/106/105/106105184/ by Prof. Sandip Chakraborty, IIT Kharagpur	

Course Articulation Matrix (CAM):				U24CS802D BLOCKCHAIN TECHNOLOGIES											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	U24CS802D.1	2	2	2	2	1	1	2	1	1	1	-	2	2	2
CO2	U24CS802D.2	2	2	2	2	1	1	2	1	1	1	-	2	2	2
CO3	U24CS802D.3	2	2	2	2	1	1	2	1	1	1	-	2	2	2
CO4	U24CS802D.4	2	2	2	2	1	1	2	1	1	1	-	2	2	2
U24CS802D		2	2	2	2	-	-	2	1	1	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW															

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Understand blockchain fundamentals, decentralization concepts, and cryptographic techniques used for secure distributed systems.	SDG 9	Industry, Innovation and Infrastructure	Focuses on foundational blockchain technologies such as distributed systems, decentralization, AES, RSA, ECC, and digital signatures, which are essential for secure and resilient digital infrastructure. The unit promotes innovation in secure communication and decentralized computing systems. Cryptographic techniques improve reliability, privacy, and trust in digital platforms. Knowledge of blockchain architecture supports the development of advanced technological ecosystems and next-generation digital infrastructure.
CO2	Analyze consensus algorithms and Bitcoin architecture for secure cryptocurrency transactions and blockchain operations.	SDG 8	Decent Work and Economic Growth	Focuses on Bitcoin architecture, consensus mechanisms, mining, and decentralized payment systems that contribute to digital economic growth. Blockchain-based financial technologies create opportunities in fintech, digital commerce, and cryptocurrency ecosystems. Knowledge of blockchain transactions and wallets supports innovation in secure financial systems. The unit encourages entrepreneurship, decentralized finance innovation, and emerging employment opportunities in blockchain and digital payment industries.
CO3	Develop and deploy smart contracts and decentralized applications using Ethereum, Solidity, and Web3 technologies.	SDG 9	Industry, Innovation and Infrastructure	Emphasizes Ethereum development, smart contracts, Web3 technologies, and decentralized applications that drive innovation in digital infrastructure. Practical exposure to Solidity, MetaMask, Geth, Remix IDE, and Truffle develops modern blockchain development skills. Smart contracts automate digital processes securely and efficiently without intermediaries. Topics such as Ethereum scalability, sharding, and The Merge contribute toward sustainable, scalable, and advanced technological infrastructure.
CO4	Evaluate enterprise blockchain frameworks, blockchain security, decentralized finance, digital identity, and emerging blockchain applications.	SDG 11	Sustainable Cities and Communities	Focuses on blockchain applications in healthcare, governance, decentralized identity, IoT, and enterprise systems that support smart and sustainable communities. Blockchain improves transparency, efficiency, and security in public services and digital governance. IoT-enabled blockchain systems assist in resource monitoring and smart infrastructure management. Applications in healthcare, enterprise systems, and digital identity management contribute toward secure, sustainable, and technologically advanced communities.

PRIVACY & SECURITY IN IOT			
Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS802E	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : explain IoT security fundamentals, privacy concepts, threats, vulnerabilities, and security requirements.			
CO2 : analyze cryptographic techniques, authentication mechanisms, and secure communication protocols for IoT systems.			
CO3 : apply access control, intrusion detection, and privacy-preserving techniques in IoT environments.			
CO4 : implement secure IoT architectures, risk management, governance, and security best practices for IoT applications.			
UNIT-I			9 Hrs
Introduction to IoT Privacy and Security: Introduction to IoT security and privacy, IoT architecture and security challenges, Threat models in IoT systems, Security requirements for IoT, Privacy issues in IoT environments, Attack surfaces and vulnerabilities, Malware and cyber-attacks in IoT, Security principles and objectives, Risk assessment and threat analysis, Emerging security challenges in IoT			
UNIT-II			9 Hrs
Cryptography and Secure Communication in IoT: Cryptographic fundamentals, Symmetric and asymmetric cryptography, Hash functions and digital signatures, Key management techniques, Authentication mechanisms in IoT, Identity management, Secure communication protocols, Transport Layer Security (TLS), Datagram TLS (DTLS), Secure MQTT and CoAP protocols, Public key infrastructure for IoT.			
UNIT-III			9 Hrs
Access Control and Privacy Preservation: Access control mechanisms in IoT, Role-based and attribute-based access control, Intrusion detection systems for IoT, Security monitoring techniques, Privacy-preserving data collection, Data anonymization techniques, Differential privacy concepts, Secure data storage, Blockchain applications for IoT security, Privacy regulations and compliance frameworks.			
UNIT-IV			9 Hrs
Secure IoT Deployment and Governance: Secure IoT architecture design, Security by design principles, Firmware and software security, Secure device provisioning, IoT risk management, Security governance frameworks, Vulnerability assessment and penetration testing, Incident response and recovery, Cloud security for IoT, Operational security best practices for IoT systems			
Text book(s): 3. Fei Hu, <i>Security and Privacy in Internet of Things (IoTs): Models, Algorithms and Implementations</i> , CRC Press, First Edition, 2016. (All Units)			
Reference book(S): 1. Brian Russell and Drew Van Duren, <i>Practical Internet of Things Security</i> , Packt Publishing, First Edition, 2016. 2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, <i>IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things</i> , Cisco Press, 2017.			

Course Articulation Matrix (CAM):				U24CS802E: PRIVACY & SECURITY IN IOT										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS802E.1	2	2	2	2	2	1	1	-	1	1	1	2	2
CO2	U24CS802E.2	2	2	2	2	2	-	-	-	-	-	1	2	2
CO3	U24CS802E.3	2	2	3	3	2	-	-	-	-	-	1	2	2
CO4	U24CS802E.4	2	2	3	3	2	1	1	-	1	1	1	2	2
U24CS802E		2	2	2.5	2.5	2	1	1	-	1	1	1	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	explain IoT security fundamentals, privacy concepts, threats, vulnerabilities, and security requirements.	SDG3	Good Health and Well-being	Enables secure and privacy-preserving IoT healthcare systems, improving the reliability and safety of smart healthcare applications.
CO2	analyze cryptographic techniques, authentication mechanisms, and secure communication protocols for IoT systems.	SDG9	Industry, Innovation and Infrastructure	Supports the development of secure communication infrastructures and innovative IoT technologies for sustainable industries.
CO3	apply access control, intrusion detection, and privacy-preserving techniques in IoT environments.	SDG9	Industry, Innovation and Infrastructure	Promotes advanced security mechanisms and privacy-preserving technologies for resilient digital infrastructure.
CO4	implement secure IoT architectures, risk management, governance, and security best practices for IoT applications.	SDG9	Industry, Innovation and Infrastructure	Enables the deployment of secure, scalable, and well-governed IoT systems that strengthen sustainable industrial infrastructure.

UNIVERSAL HUMAN VALUES - II			
Class: B. Tech. VIII – Semester		Branch: ALL BRANCHES	
Course Code:	U24IK803B	Credits:	1
Hours/Week (L-T-P- E):	2-0-0-2	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
<i>After completion of this course, the students should be able to,</i>			
CO1: describe harmony within the individual by understanding the distinct roles of the self and the body CO2: analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society. CO3: explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfilment among all orders of nature. CO4: apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being.			
UNIT-I			6 Hrs
Course Introduction - Need, Basic guidelines, Content and Process for value education Self-exploration: ‘Natural acceptance’ and Experiential validation, Basic human aspirations, Right understanding, Relationship and Physical facility, fulfilment of aspirations, Understanding happiness and prosperity, Harmony at various levels Understanding Harmony in the Human Being: Harmony in myself, Understanding human being, Understanding the harmony of self with the body, Harmony in self; Health; Program for self and health			
UNIT-II			6 Hrs
Understanding Harmony in the Family: Harmony in human - human Relationship, Understanding values in human-human relationship, Meaning of Justice (universal values in relationships), Mutual happiness Understanding Harmony in the Society: Harmony in the society, Visualizing a universal harmonious order in society- Undivided society, Universal order- from family to world family			
UNIT-III			6 Hrs
Understanding Harmony in the Nature: Whole existence as coexistence, Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Recyclability and Self-regulation in nature, Understanding Harmony in the Existence: Understanding existence as co-existence of mutually interacting units in all- pervasive space; Holistic perception of harmony at all levels of existence.			
UNIT-IV			6 Hrs
Professional Ethics: People friendly and eco-friendly production systems, Appropriate technologies and management patterns.			

Case Studies: Case studies of typical holistic technologies, Management models and production systems
Textbooks: 1. R.R. Gaur, R. Sangal and G. P. Bagaria, <i>Human Values and Professional Ethics</i> , New Delhi Excel Books, 2010.
Reference Book(S): 1. A.Nagaraj, <i>Jeevan Vidya: Ek Parichaya</i> , Raipur: Jeevan Vidya Prakashan, Amarkantak, 2018. 2. A.N. Tripathi, <i>Human Values</i> , New Age International Publisher, 3 rd ed., New Delhi, 2019. 3. M. Govindrajran, S. Natrajan & V.S. Senthil Kumar, <i>Engineering Ethics (includes Human Values)</i> , PHI Learning Pvt. Ltd., 12 th ed., Haryana, 2011. 4. Jayshree Suresh, B. S. Raghavan, <i>Human Values & Professional Ethics</i> , 4 th ed., S. Chand & Co. Ltd., New Delhi, 2012.
Additional Resources: 1. A set of DVDs containing - Video of Teachers' Orientation Program - PPTs of Lectures and Practice Sessions (<i>Audio-visual material for use in the practice sessions</i>)
Web and Video link(s): 3. https://fdp-si.aicte-india.org/UHVII.php

Course Articulation Matrix					U24IK803B Universal Human Values - II									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IK803B.1	2	1	-	-	-	1	-	3	-	-	-	1	1
CO2	U24IK803B.2	-	2	-	-	-	3	-	3	2	2	-	-	1
CO3	U24IK803B.3	1	2	-	-	-	2	3	2	-	-	-	1	1
CO4	U24IK803B.4	1	2	-	-	-	3	3	3	2	2	3	2	1
U24IK803B		1	1.75	-	-	-	2.25	1.5	2.75	1	1	0.75	1	1

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	describe harmony within the individual by understanding the distinct roles of the self and the body	SDG 4	Quality Education	1. Develops self-awareness, values, ethical thinking, and holistic education for responsible citizenship.
CO2	analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society.	SDG 16	Peace, Justice and Strong Institutions	1. Promotes justice, mutual respect, harmonious relationships, and peaceful societies.
CO3	explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfillment among all orders of nature.	SDG 13, SDG 15	Climate Action; Life on Land	1. Enhances understanding of ecological balance, coexistence, environmental sustainability, and conservation.
CO4	apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being.	SDG 9, SDG 12	Industry, Innovation and Infrastructure; Responsible Consumption and Production	1. Encourages ethical professional practices, sustainable technologies, and environmentally responsible production systems.

MAJOR PROJECT PHASE II

Class: B. Tech. VIII – Semester		Branch: CSE	
Course Code:	U24CS804	Credits:	6
Hours/Week (L-T-P- E):	0-0-12-12	CIE:	60%
Total Number of Teaching Hours:	-	ESE:	40%

Course Learning Outcomes (COs):

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

Upon completion of the major project work, students will be able to...

- CO1: review research literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)
- CO2: design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)
- CO3: apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (Ethics and teamwork)
- CO4: collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (Communication skills and life-long learning)

- Major project work shall be continued in 8th semester as major project *phase-II*:** All the major project teams shall take the *phase -I* work forward and complete the remaining work as *Phase-II* in the 8th semester.
- Final Year Major Project work represents the culmination of study towards the B. Tech degree. **Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems.** The **student learning assessment process (SLAP)** shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project
- Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
- Team work:** Major project work is a team work
 - The students of a project team shall work together to achieve a common objective.
 - Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of team having knowledge diversity, gender diversity, social and cultural diversity among its members.
- Every student is expected to put approximately **168 hours of work** into the major project phase-II course over the 12 weeks of 8th semester.
- Major project work *Phase-II*: 8th semester**

- (i) The convener DPEC shall release complete schedule of *phase-II* CIE during last week of 7th semester (*well in advance before start of 8th semester*), immediately after completion of Progress Presentation-I, so that student teams would complete the scheduled works during inter-semester break and get ready with informative, confident and comfortable presentation for progress presentation-II.
- (ii) The project supervisors: The project supervisors are expected to guide the students to systematically continue the phase-I work, useful work during inter- semester break, meeting the deadlines as proposed in project timeline.
- (iii) The project supervisors shall ensure students focus on the project objectives and expected deliverables
- (iv) The project supervisors shall ensure students have sufficient resources for successful project completion.
- (v) The project supervisors shall ensure students have sufficient resources for successful project completion.
- (vi) The project supervisors shall continue guiding students on
 - (a) *Knowledge, skills and qualities (KSQ) of a professional engineer to be acquired* to propose solutions and design the systems to the identified real-world problems.
 - (b) *Problem analysis* - to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
 - (c) *Applying engineering knowledge* - to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
 - (d) *Design/development of solutions* - to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental Considerations
 - (e) *Conduct investigations of complex problems* - to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
 - (f) *Modern tool usage* - to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
 - (g) *The Engineering and the world* - to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
 - (h) *Ethics* - to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice
 - (i) *Individual and team work* - to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
 - (j) *Communication* - to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
 - (k) *Project management and finance* - to demonstrate knowledge and understanding of

the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

- (l) *Life-long learning* – to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

(vii) The project supervisors are also expected to continuously emphasize and guide the students on

(a) **Following project timeline:** completing the tasks as planned in project timeline

(b) **Meeting Cadence:**

i. **Regular meetings with supervisor:** Short and frequent meetings increase a team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.

ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week**. Due weightage will be given to meeting cadence and considered for evaluation during presentations, i.e., number of planned meetings and number attended by students

(c) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).

ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-II*, the supervisor shall specifically comment, in the project log book, on whether the project team met each of the project work outcomes and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(d) **Writing down whatever is done and making notes of whatever is read.** Writing down the procedures / models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, *difficulties faced and how they were fixed* are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well- documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on. This information will be needed for the bibliography in your project report. On the other hand, documenting a report *on the spur of the moment* would end up copying things from other sources resulting in a plagiarized

- document.
- (e) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, which can be specially acquired by participating in major project work
 - (f) **Good and sufficient literature review:** Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.
 - (g) Completing the proposed work by the end of *phase-II*
 - (h) Right conduct of research to promote academic integrity, honesty and time management
 - (i) Preparing a well-documented overall project report in proper format, covering the complete work carried out during both the phases (*phase-I and phase-II*).
 - (j) Consequences of plagiarism, and use of anti-plagiarism software to detect plagiarism in the report
 - (k) Submission of major project work report within acceptable plagiarism levels (including AI Plagiarism), as per the *Anti-plagiarism policy-2020 of our institute*
 - (l) **Video pitch on complete project work:** Capturing short videos, photos, screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the complete work done during both phases (*phase-I and phase-II*).
 - (m) **Project Paper:** Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.
 - (n) **Project poster:** At the end of phase-II, the project teams shall have to present their project in the form of posters, at the time of demonstration of complete prototype / working model / software package / system developed.
- (viii) **Phase - II evaluation:** There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components
- (a) **Progress Presentation -II** (*during third / fourth week of 8th semester*): The progress presentation-II shall include the identified problem, objective(s), literature review, expected outcome(s), results of work done as per project plan timeline.
 - i. **Following project timeline:** The project timeline shall be meticulously followed and the tasks shall be completed as planned in project timeline.
 - ii. 80-85% of work is expected to be completed
 - iii. Project teams shall compulsorily show the following as part of their progress presentation-II
 - 1. *The slides on project timeline and*
 - 2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*
 - iv. **Project log book:** Every student of the Project team shall compulsorily show the activity journaling in the log book (with due signatures of project supervisor) during presentations
 - (b) **Final Presentation** (*during penultimate week of 8th semester*): **Project supervisor shall ensure that the project team has accomplished 100% of work proposed.** The project team shall
 - i. **Follow project timeline:** The project timeline shall be meticulously followed

- and the tasks shall be completed as planned in project timeline.
- ii. compulsorily show the following as part of their final presentation
 1. *The slides on project timeline and*
 2. *A table showing targeted tasks as per timeline and whether all the identified tasks accomplished?*
- iii. **show project log book:** Every student of the Project team shall compulsorily show the complete activity journaling in the log book (*with due signatures of project supervisor*)
- iv. present complete results & analysis
- v. **demonstrate the completed project:** working model / process / software package / system developed
- vi. demonstrate the completed project with the **project poster presentation**

- (ix) **Evaluation for Major project phase-II:** There shall be continuous internal evaluation (CIE) and end semester examination (ESE). The evaluation for *phase-II* shall be as given below:

Assessment	Weightage
A. CIE (i) Supervisor Assessment(10%) (ii) DPEC Assessment (50%) (a) <i>Progress presentation-II (10%)</i> (b) <i>Final presentation(10%)</i> (c) <i>Working model/process/software package/system developed(20%)</i> (d) <i>Project video pitch (5%)</i> (e) <i>Project paper(5%)</i>	60%
B. ESE (i) <i>Well-documented project report(15%)</i> (DPEC shall evaluate the project reports, as per the rubrics, well before the ESE. At the time of ESE, evaluated project report marks shall be posted in the award list, along with the ESE oral presentation marks. Students shall appear for Viva-Voce with project report) (ii) <i>Oral presentation with PPTs and viva-voce(10%)</i> (iii) <i>Project poster(5%)</i> (DPEC shall evaluate the project poster, as per the rubrics, well before the ESE. At the time of ESE, evaluated project poster marks shall be posted in the award list. Students shall appear for Viva-Voce with project poster) (iv) <i>SDG (5%)</i> (v) <i>Research Orientation (5%)</i>	40%
Total Weightage	100%

- (a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system on the chosen work. The completed working model/ process/software package/system shall be demonstrated during the final presentation at the end of *phase-II*.
- (b) **Video pitch:** Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I & phase-II*. The project team shall present the produced video pitch during Final presentation. The produced video pitch should
 - (i) be 3 to 5-minute-long video (no longer than 5 minutes)
 - (ii) be concise and to the point, on the problem, proposed solution and its salient features.
 - (iii) show project timeline and sample page of log book

- (iv) highlight the various stages during project implementation with the help of short videos / photos / screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project.
 - (v) discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts*.
 - (vi) emphasize key points about *business idea, potential market for the proposed solution*
- (c) **Project poster:** At the end, the project teams shall present their project in the form of posters (A2 size). The teams shall have to present their work during the poster presentation session scheduled at the end of the 8th semester, at the time of demonstration of complete prototype / working model / software package / system developed.
- (d) **Well-documented plagiarism-cleared project report:** Every project team shall be required to submit a well-documented project report on the work carried out, as per the format specified by the DPEC. The report should clear plagiarism check as per the anti-plagiarism policy-2020 of the institute. The following shall compulsorily be included in the Results-Chapter of the project report
 - (i) Photos / screen shots taken at various stages during the development of working model/ process/software package/system as part of Results-Chapter
 - (ii) Snapshot of final working model/ process/software package/system developed
 - (iii) Pictures of the team working in the lab, the team discussing with the project supervisor, working on creative project, or an event they are attending for work.
 - (iv) *All these photos / screen shots shall be properly referred in the project report by assigning figure numbers*
- (e) **Tangible outcomes of project work in Conclusions - Chapter:** These are the lessons learnt from doing a project work. The students have to describe in their own words what they learnt from the project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of major project work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be shown in the conclusions chapter.
- (f) **Student feedback on major project in Conclusions - Chapter:** To gather information on whether project work was useful and gave practical experience on chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*) with closed and open questions shall be kept in the conclusions chapter of the project report.
- (x) It is mandatory for
 - (a) every student of the team to appear for ESE oral presentation and viva-voce, to qualify for course evaluation
 - (b) every project team to write a technical paper based on the solution(s) proposed, results obtained and prototype/working model/process/software package/system developed, for submission to a reputed non-predatory conference/non-paid peer-reviewed journal
 - (c) every project team shall be required to create a pitch video, which is a video presentation on their major project work phase-I & phase-II

- (d) every project team shall present their project in the form of a poster, during the demonstration of complete prototype/working model/software package/system developed
- (xi) The student has to register for the Major project work phase-II as supplementary examination in the following cases:
 - (a) he/she is absent for oral presentation and viva-voce as part of ESE presentation
 - (b) he/she fails to fulfill the requirements of Major project work phase-II evaluation as per specified guidelines
- (xii) Supplementary examination for Major project work phase-II
 - (a) The CoE shall send the list of students registered for supplementary examination to the HoDs concerned
 - (b) The DPEC, duly constituted by the HoD, shall conduct Major Project Phase-II supplementary exam and send the award list to the CoE within the stipulated time

Course Articulation Matrix (CAM):		U24CS804: MAJOR PROJECT PHASE II												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CS804.1	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	U24CS804.2	3	2	3	2	2	1	2	1	1	2	2	2	1
CO3	U24CS804.3	1	1	1	1	1	2	1	1	2	2	1	2	1
CO4	U24CS804.4	1	1	1	2	2	1	2	1	2	1	2	2	2
U24CS804		2	1.75	1.75	2	1.75	1.25	1.5	1	1.5	1.5	1.75	2	1.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)	SDG 13	Industry, Innovation and Infrastructure	Research-based innovation and development of advanced ECE solutions contribute to technological progress, industrial growth, and infrastructure development.
CO2	design a system or product based on product/customer	SDG 12	Responsible Consumption	Sustainable design practices, efficient

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
	specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)		and Production	resource utilization, and environmentally responsible engineering solutions promote responsible production and innovation.
CO3	Apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader of a multidisciplinary team.	SDG 11	Sustainable Cities and Communities	Collaborative development of engineering solutions addressing societal needs contributes to sustainable and resilient communities.
CO4	Collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (Communication skills and life-long learning)	SDG 4	Quality Education	Technical communication, knowledge dissemination, and self-directed learning support continuous education and professional growth.