

I SEMESTER(Stream-I)(URR24)

S.No.	Category	Course Code	Course Title	Lectures/week				Credits
				L	T	P	E	C
-	IKSC	U24IK100	AICTE Mandated Student Induction Programme (Universal Human Values - I)					-
1	BSC	U24MH101	Differential Calculus and Ordinary Differential Equations	2	1	-	3	3
2	BSC	U24CY102A	Engineering Physics (from Poo II)	2	1	2	5	4
3	PCC	U24CE103	Engineering Mechanics	2	1	-	3	3
4	ESC	U24CE104	Programming for Problem Solving with C	2	1	2	5	4
5	ESC	U24EE105A	Basic Electrical & Electronics Engineering (from Pool II)	2	1	2	5	4
6	VAC	U24VA106	Environmental Studies	2	-	-	2	-
7	AEC	U24AE107	IDEA Lab Makerspace	-	-	2	2	1
8	ELC	U24EL108	Practicum-1	-	-	-	-	1
9	VAC	U24VA109	SEA-I/SAA-1	-	-	-	-	1
10	AEC	U24AE110	ExpertTalkSeries-1	-	-	-	-	1
			Total:	12	5	8	22	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				

S. No.	Course Code	Course Title	S. No.	Course Code	Course Title
Pool -I			Pool -II		
1.	U24PY102A	Engineering Physics (for Civil Engineering)	1.	U24EE105A	Basic Electrical and Electronics Engineering (for Civil Engineering)
2.	U24PY102B	Engineering Physics (for ECIE)	2.	U24EE105B	Basic Electrical Engineering (Common to ECE and ECIE)
3.	U24PY102C	Engineering Physics (for CSE)	3.	U24EE105C	Basic Electrical Engineering (for CSE)
4.	U24PY102D	Engineering Physics (for EEE)	4.	U24EE105D	Basic Electrical Engineering (for EEE)
	U24PY102E	Engineering Physics (for ECE)			

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- 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 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 equations 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)			
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			
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			
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			

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 CE)			
Class: B.Tech. II – Semester		Branch: CE	
Course Code:	U24PY102A	Credits:	3
Hours/Week (L-T-P-E):	3-1-0-0	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 : determine the ultrasonic velocity, elastic constants and defects/cracks in solids using non-destructive testing methods.			
CO2 : evaluate properties of lasers and optical fibre parameters			
CO3 : examine the crystal structures and defects in civil engineering materials using crystallography principles and material characterization techniques			
CO4 : calculate reverberation time in buildings and absorption coefficient of civil engineering materials; determine properties of the magnetic and superconducting materials			
THEORY COMPONENT			
UNIT-I		9 Hrs	
Ultrasonics: Properties, Production of ultrasonics- Piezo-electric method; Determination of velocity in liquids using ultrasonic interferometer, Determination of velocity in solids- measurement of elastic constants in solids, Applications- Marine, Industrial and medical fields			
NDT applications to Civil Engineering: Introduction, Advantages and limitations of non-destructive testing (NDT), Methods of NDT- Visual inspection of distressed structures, Magnetic particle testing, Eddy current testing and Ultrasonic testing of concrete- Normal beam Pulse echo testing, Normal beam pulse through transmission testing, Angle beam pulse echo testing			
UNIT-II		9 Hrs	
Applied Optics and Lasers: Principles of interference, Diffraction phenomena and their 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- Determination of particle size of fly ash and slags using 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)			
UNIT-III		9 Hrs	
Crystallography: Bonding in crystals, Classification of solids, Space lattice, Crystal structure, Unit cell, Bravais lattices, Lattice plane, Miller indices, Interplanar spacing in a cubic lattice, Atomic packing fraction (SC, BCC, FCC), Bragg's law, Classification of defects- Point defects, Line defects, Surface defects (qualitative)			
Material Characterization Techniques: Principles for determination of materials structure by using Bragg's X-ray diffraction spectrometer (XRD); Study of morphology, Microstructure, Micro fractures using scanning electron microscope (SEM) and transmission electron microscope (TEM) for civil engineering materials			

UNIT-IV	9 Hrs
Acoustics of Buildings: Introduction, Classification of sound, Characteristics of sound, Sound pressure level, Intensity, Absorption coefficient, Determination of absorption coefficient of civil engineering materials, Reverberation, Sabine's formula, Factors affecting acoustics of buildings and their remedies, Noise and its measurements, Sound proofing applications in civil engineering 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, Applications of magnetic materials; Superconductivity, Meissner effect, Transition temperature, Isotope effect, Type-I and type-II superconductors, High T_c superconductors, Applications of superconductors	
<u>Textbook(s):</u> 1. M.N. Avadhanulu, P.G. Khirsagar and T.V.S Arun Murthy, "A Textbook of Engineering Physics", S Chand Publishing, 11th edition, 2018 (Unit-II-Chapter 1 & 2) 2. V. Rajendran "Engineering Physics", 2008 (Unit-I, III, IV-Chapter 1 & 2)	
<u>Reference Book(S):</u> 1. B. P. Singh and Devaraj Singh, "Building Science: Lighting and Acoustics, Dhanpat Rai Publications (P) Ltd., 2013 (Unit-I-Chapter 1 & 2) 2. P.K Mitra "Characterization of Materials", PHL learning Pvt Ltd, 2014 (Unit-II-Chapter 2) 3. R.K. Gaur and S.L.Gupta, "Engineering Physics", Dhanpath Rai and Sons, 2013 4. David Halliday, Robert Resnick and S Krane, <i>Physics Volume I&II</i>, Wiley India Limited, 5th edition, 2014	
<u>Web and Video link(s):</u> 1. https://nptel.ac.in/courses/113106070, NPTEL Video Lecture on Theory and Practice of Non Destructive Testing, Dr. Ranjit Bauri, IIT Madras 2. https://nptel.ac.in/courses/113/105/113105101/ NPTEL Video Lecture on Techniques of materials characterization, Prof. Shibayan Roy, Materials Science Centre, IIT Kharagpur 3. https://nptel.ac.in/courses/113/104/113104081/, NPTEL Video Lecture on Defects in crystalline solids (Part-1), Prof. Shashank Shekar, Dept. of Materials Science and Engineering, IIT Kanpur 4. https://onlinecourses.nptel.ac.in/noc24_mm28/preview NPTEL Video Lecture on Defects in Crystalline Solids (Part - I), Prof. Shashank Shekhar, IIT Kanpur	

Course Articulation Matrix (CAM):				U24PY102A : ENGINEERING PHYSICS (for CE)										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24PY102A.1	2	1	-	-	-	1	-	1	1	1	-	1	-
CO2	U24PY102A.2	2	1	-	-	-	1	-	1	1	1	-	1	-
CO3	U24PY102A.3	2	1	-	-	-	1	-	1	1	1	-	1	-
CO4	U24PY102A.4	2	1	-	-	-	1	-	1	1	1	-	1	-
U24PY102A		2	1	1	-	-	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	determine the ultrasonic velocity, elastic constants and defects/cracks in solids using non-destructive testing methods.	SDG 9	Industry, Innovation and Infrastructure	NDT techniques improve the safety, reliability and durability of infrastructure, supporting sustainable industrial development.
CO2	evaluate properties of lasers and optical fibre parameters	SDG 9	Industry, Innovation and Infrastructure	Optical and laser technologies are essential for modern communication, sensing and technological innovation.
CO3	examine the crystal structures and defects in civil engineering materials using crystallography principles and material characterization techniques.	SDG 12	Responsible Consumption and Production	Material characterization facilitates efficient material selection, quality control and sustainable utilization of resources.
CO4	calculate reverberation time in buildings and absorption coefficient of civil engineering materials; determine properties of the magnetic and superconducting materials	SDG 11	Sustainable Cities and Communities	Acoustically efficient buildings and advanced materials contribute to sustainable, safe and comfortable living environments.

ENGINEERING PHYSICS LABORATORY (for CE)			
Class: B.Tech. II – Semester		Branch: CE	
Course Code:	U24PY102A	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 cognitive skills acquired from theory component)</i>			
CO1 : measure diameter of wire and hollow tubes using Vernier calipers and screw gauge; determine the rigidity modulus and velocity of ultrasonic waves CO2 : determine the thickness of thin sheet, particle size of given fly ash, numerical aperture of an optical fiber, width of a narrow slit and wavelength of laser CO3 : calculate atomic packing fractions by constructing crystal models (BCC and FCC); analyse X-ray diffraction spectra of civil engineering materials CO4 : determine the sound absorption coefficient of civil engineering materials and B-H curve tracing using CRO.			
THEORY COMPONENT			
Experiment-1 (UNIT-I)			
1. Linear Measurements using Vernier callipers and screw gauge			
Experiment-2 (UNIT-I)			
1. Determination of (a) rigidity modulus of a given wire (b) moment of inertia of a ring using torsional pendulum			
Experiment-3 (UNIT-I)			
1. Determination of velocity of ultrasonic waves in liquid using ultrasonic interferometer			
Experiment-4 (UNIT-II)			
1. Determination of thickness of thin sheet using air-wedge method			
Experiment-5 (UNIT-II)			
1. Determination of slit width using He-Ne laser			
Experiment-6 (UNIT-II)			
1. Determination of wavelength of He-Ne laser using reflection and transmission diffraction grating			
Experiment-7 (UNIT-II)			
1. Determination of particle size of fly ash or slag cement powders using laser			
Experiment-8 (UNIT-II)			
1. Numerical aperture and acceptance angle of a given optical fiber			
Experiment-9 (UNIT-III)			
1. Preparation and study of body centred cubic and face centred cubic crystal models			
Experiment-10 (UNIT-III)			
1. Structural analysis of given X-ray diffraction spectra for a given concrete material			
Experiment-11 (UNIT-IV)			
1. Determination of absorption coefficient of sound of given materials			
Experiment-12 (UNIT-IV)			
1. Magnetic hysteresis- B-H curve tracing using CRO			
Textbook(s): 1. M. Avadhanulu and Kshirsagar, TVS Arun Murthy, <i>A Text Book of Engineering Physics</i>, S. Chand & Company Ltd, 11th edition, 2018 (Unit-I, II- Chapter 40, 41, 42, 44 & 47) 2. V. Rajendran "<i>Engineering Physics</i>", 2008 (Unit-I, III, IV-Chapter 1 & 2)			

Reference Book(S):

1. B. P. Singh and Devaraj Singh, “*Building Science: Lighting and Acoustics*”, Dhanpat Rai Publications (P) Ltd., 2013 (Unit-I-Chapter 1 & 2)
2. P.K Mitra “*Characterization of Materials*”, PHL learning Pvt Ltd, 2014(Unit-II-Chapter 2)
3. R.K. Gaur and S.L.Gupta, “*Engineering Physics*”, Dhanpath Rai and Sons, 2013.
4. David Halliday, Robert Resnick and S Krane, *Physics Volume I&II*, Wiley India Limited, 5th edition, 2014

Web and Video link(s):

1. <https://nptel.ac.in/courses/113106070>, NPTEL Video Lecture on Theory and Practice of Non Destructive Testing, Dr. Ranjit Bauri, IIT Madras
2. <https://nptel.ac.in/courses/113/105/113105101/> NPTEL Video Lecture on Techniques of materials characterization, Prof. Shibayan Roy, Materials Science Centre, IIT Kharagpur
3. <https://nptel.ac.in/courses/113/104/113104081/>, NPTEL Video Lecture on Defects in crystalline solids (Part-1), Prof. Shashank Shekar, Dept. of Materials Science and Engineering, IIT Kanpur
4. https://onlinecourses.nptel.ac.in/noc24_mm28/preview NPTEL Video Lecture on Defects in Crystalline Solids (Part - I), Prof. Shashank Shekhar, IIT Kanpur

Laboratory Manual (for laboratory component):

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

Course Articulation Matrix (CAM):				U24PY102A: ENGINEERING PHYSICS LABORATORY (<i>for CE</i>)										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24PY102A.1	2	1		-	1	1	1	1	2	-	1	-	-
CO2	U24PY102A.2	2	1	-	-	1	1	1	1	2	-	1	-	-
CO3	U24PY102A.3	2	1	-	-	1	1	1	1	2	-	1	-	-
CO4	U24PY102A.4	2	1	-		1	1	1	1	2	1	1	-	-
U24PY102A		2	1			1	1	1	1	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	measure diameter of wire and hollow tubes using Vernier calipers and screw gauge; determine the rigidity modulus and velocity of ultrasonic waves	SDG4	Quality Education	Experimental measurement skills strengthen scientific understanding, practical learning, and laboratory competency essential for quality engineering education.
CO2	determine the thickness of thin sheet, particle size of given fly ash, numerical aperture of an optical fiber, width of a narrow slit and wavelength of laser	SDG9	Industry, Innovation and Infrastructure	Optical fiber characterization, laser-based measurements, and particle-size analysis are widely used in communication technology, advanced manufacturing, materials research, and industrial quality control.
CO3	calculate atomic packing fractions by constructing crystal models (BCC and FCC); analyse X-ray diffraction spectra of civil engineering materials	SDG11	Sustainable Cities and Communities	Evaluating the durability and performance of construction materials, contributing to safer and more sustainable buildings and infrastructure.
CO4	determine the sound absorption coefficient of civil engineering materials and B-H curve tracing using CRO	SDG9	Industry, Innovation and Infrastructure	Characterization of acoustic and magnetic materials supports the design of advanced infrastructure, electrical devices, and innovative engineering systems..

ENGINEERING MECHANICS			
Class: B. Tech. I – Semester		Branch: CE	
Course Code:	U24CE103	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 : distinguish various force systems and their applications.			
CO2 : analyze plane trusses			
CO3 : evaluate centroid and moment of inertia of geometric and composite areas			
CO4 : construct shear force and bending moment diagrams			
UNIT-I		9 Hrs	
Laws of Mechanics: Parallelogram law of forces, triangle law of forces, Newton's law of gravitation, law of superposition and transmissibility of forces.			
Force Systems: Types of forces, co-planar, concurrent and parallel forces, moment and couple, free body diagram, resultant of force systems, resolution of forces, composition of forces, equilibrium equations of forces, Lami’s theorem, Varignon’s theorem, moment equilibrium equations.			
UNIT-II		9 Hrs	
General Equilibrium: Types of supports, beams and loadings, statically determinate structures, resultant and equilibrium of general force system.			
Plane Trusses: Rigid truss, stability and determinacy conditions, basic assumptions for a perfect truss, analysis of trusses by method of joints and method of sections of a cantilever and simply supported statically determinate pin-jointed trusses			
UNIT-III		9 Hrs	
Centroid: Centroid of one-dimensional figures, centroid of simple figures from first principles, centroid of composite sections.			
Moment of Inertia: Moment of inertia of plane sections from first principles, theorems of moment of inertia – parallel axis theorem and perpendicular axis theorem, moment of inertia of standard sections and composite sections.			
UNIT-IV		9 Hrs	
Shear force: Concept of shear force, shear force diagram for simply supported, cantilever and overhanging beams, loading from shear force diagram.			
Bending moment: Concept of bending moment, bending moment diagram for simply supported, cantilever and overhanging beams, loading from bending moment diagram.			
Textbook(s):			
1. Tayal A.K., Engineering Mechanics: Statics and Dynamics, Umesh Publishers, New Delhi, 15th edition, 2020.			
2. Rajput R.K., Strength of Materials, S. Chand and Company, New Delhi, 8th edition. 2021.			
Reference Book(S):			
1. Timoshenko S., Young D.H., Rao J.V., and Sukumar Pati, Engineering Mechanics in SI units, McGraw Hill Education Pvt. Ltd., New Delhi, 6th edition, 2021.			
2. Bhavikatti S.S., Engineering Mechanics, New Age International, New Delhi, 5th edition, 2013 (reprint).			
3. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi 10th edition, 2020.			
4. Subramanian R., Strength of Materials, Oxford University Press, New Delhi, 4th edition, 2021.			
5. Ramamrutham S., Strength of Materials, Dhanpat Rai & Sons, New Delhi, 3rd edition, 2017.			

Web and Video link(s):

1. <https://youtu.be/nGfVTNfNwnk?si=F7BEBuhGhrhvf71> NPTEL Video Lecture on Introduction to Engineering Mechanics by Prof.K Ramesh, Professor , Applied Mechanics, IIT Madras.
2. <https://youtu.be/ljDIIMvx-eg?si=RTFveUSwBfju9Mqy> NPTEL Video Lecture on Equilibrium of Rigid Bodies by Prof.K Ramesh, Professor , Applied Mechanics, IIT Madras.
3. <https://youtu.be/lheoBL2QaqU?si=XFq5Xn6NrdxYgsT3> NPTEL Video Lecture on Analysis of Trusse by Prof.K Ramesh, Professor , Applied Mechanics, IIT Madras.
4. <https://youtu.be/z95UW4wwzSc?si=8oQeghkeSwS7GQMO> NPTEL Video Lecture on Analysis of Beams by Prof.K Ramesh, Professor , Applied Mechanics, IIT Madras.
5. https://youtu.be/L_xTyy4wqtw?si=vQkD1Cc73rfzSspW NPTEL Video Lecture on Shear Force and Bending Moment by Prof.M.S.Siva Kumar , Department of Applied Mechanics, IIT Madras.

Course Articulation Matrix (CAM):				U24CE103: ENGINEERING MECHANICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE103.1	3	2	1	-	-	1	-	1	1	1	1	2	1
CO2	U24CE103.2	3	2	1	-	-	1	-	1	1	1	1	2	1
CO3	U24CE103.3	3	2	1	-	-	1	-	1	1	1	1	2	1
CO4	U24CE103.4	3	2	1	-	-	1	-	1	1	1	1	2	1
U24CE103		3	2	2	-	-	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	distinguish various force systems and their applications.	SDG4	Quality Education	Builds foundational knowledge in mechanics, enabling students to apply force analysis in civil, mechanical, and structural engineering contexts.
CO2	analyze plane trusses	SDG11	Sustainable Cities and Communities	Truss analysis supports safe and sustainable infrastructure design; friction concepts are vital in transport, machinery, and energy efficiency.
CO3	evaluate centroid and moment of inertia of geometric and composite areas	SDG4	Quality Education	Essential for structural stability and material optimization, directly linked to resilient infrastructure.
CO4	construct shear force and bending moment diagrams	SDG11	Sustainable Cities and Communities	Ensures safe design of beams and load-bearing structures, critical for sustainable urban development.

PROGRAMMING FOR PROBLEM SOLVING WITH C			
Class: B.Tech. I -Semester		Branch: CE	
Course Code:	U24CE104	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	48 Hrs	ESE:	40%
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			
UNIT-I			9 Hrs
Introduction to Programming and Overview: Art of programming through algorithms and flowcharts, 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			
UNIT-III			9 Hrs
Character Arrays and Strings: Declaring and initializing string variable, Reading strings from terminal, Writing strings to screen, String handling functions, Table of strings Modular Programming with User Defined Functions: Need for user-defined functions, Elements of user-defined functions, Definition of functions, Return values and their types, Function calls, Function declaration, Category of functions, Recursion			
UNIT-IV			9 Hrs
Structures and Unions: Defining a structure, Declaring and initializing structure variables, Accessing structure members, Array of structures, Structures within structures, Unions Pointers: Understanding pointers, Declaring and initializing pointer variables, Pointer expressions, Pointers and arrays, Pointers and character strings, Pointers to functions, Pointers and structures File Management in C: Defining and opening a file, Closing a file, Input and output operations on sequential text files			
Textbook(s): 1. Balagurusamy.E, <i>Programming in ANSI C</i> , McGraw Hill, 8 th edition, 2022			

Reference Book(s):

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

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	U24CE104.1	2	1	1	1	-	-	-	1	-	1	-	1	2
CO2	U24CE104.2	2	2	2	1	-	-	-	1	-	1	-	2	2
CO3	U24CE104.3	2	2	3	1	-	-	-	1	-	1	-	2	2
CO4	U24CE104.4	2	2	3	2	-	-	-	1	-	1	-	2	2
U24CE104		2	1.75	2.25	1.25	-	-	-	1	-	1	-	1.75	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 a flowchart for a given application	SDG 4	Quality Education	Builds computational literacy and systematic design skills, essential for engineering education and lifelong learning.
CO2	Apply logical skills for problem solving using control structures and arrays	SDG 9	Industry, Innovation & Infrastructure	Logical reasoning and array-based solutions strengthen industry-ready skills for infrastructure and technology development.
CO3	Develop string operations and modular programming with functions	SDG 8	Decent Work & Economic Growth	Modular programming fosters reusable, maintainable code, supporting sustainable growth in IT and engineering sectors.
CO4	Analyse and implement structures, unions, pointers and files in C programming	SDG 11	Sustainable Cities & Communities	Mastery of advanced C concepts enables robust software for urban systems, engineering simulations, and community-focused solutions.

PROGRAMMING FOR PROBLEM SOLVING WITH C LABORATORY			
Class: B. Tech. I – Semester		Branch: CIVIL	
Course Code:	U24CE104	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 programs using operators and decision-making statements CO2: apply loops and arrays to develop a program of an application CO3: implement string operations and develop modular programs using user-defined functions, recursion, and storage classes. CO4: develop programs using structures, unions, pointers and files			
List of programs 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			
<u>Textbook(s):</u> 1. Balagurusamy.E, <i>Programming in ANSI C</i>, McGraw Hill, 8th edition, 2022 2.			
<u>Reference Book(S):</u> 1. Yashavant Kanetkar, <i>Let Us C</i>, BPB Publications, 19th edition, 2022 2. A.K.Sharma, <i>Computer Fundamentals and Programming in C</i>, Universities Press, 2nd edition, 2018			
<u>Web and Video link(s):</u> 1. https://nptel.ac.in/courses/106105171NPTEL Video Lecture on Problem Solving through Programming in C by Prof. Anupam Basu, Professor of CSE, IIT Kharagpur. 2. https://nptel.ac.in/courses/106104128NPTEL Video Lecture on Introduction to Programming in C by Prof. Satyadev Nandakumar, Professor of CSE, IIT Kanpur			
<u>Laboratory Manual (for laboratory component):</u> 1. PROGRAMMING FOR PROBLEM SOLVING WITH CLaboratory Manual, prepared by faculty Department of CIVIL, KITSW			

Course Articulation Matrix (CAM):				U24CE104 : PROGRAMMING FOR PROBLEM SOLVING WITH C LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE104.1	1	1	1	1	1	-	-	1	1	1	-	1	2
CO2	U24CE104.2	1	2	2	2	1	-	-	1	1	1	-	2	2
CO3	U24CE104.3	1	2	3	2	1	-	-	1	1	1	-	2	2
CO4	U24CE104.4	1	2	3	2	1	-	-	1	1	1	-	2	2
U24CE104		1	1.75	2.25	1.75	1	-	-	1	1	1	-	1.75	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	develop programs using operators and decision-making statements	SDG 4	Quality Education	Builds foundational programming skills, fostering logical thinking and innovation in computing infrastructure.
CO2	apply loops and arrays to develop a program of an application	SDG 11	Sustainable Cities & Communities	Enables efficient problem-solving and supports applications in urban/smart systems development.
CO3	implement string operations and develop modular programs using user-defined functions, recursion, and storage classes.	SDG 8	Decent Work and Economic Growth	Equips students with employable skills in database management and software engineering, enhancing career readiness.
CO4	develop programs using structures, unions, pointers and files	SDG 12	Responsible Consumption and production	Supports advanced data management, efficient resource handling, and collaborative software development.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING			
Class: B. Tech. I / II – Semester		Branch: CSE, CSE-Allied, IT, ME, CE	
Course Code:	U24EE105A	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> <i>(based on cognitive skills acquired from theory component)</i>			
CO1 : determine voltage, current & power in electrical circuits using network reduction techniques CO2 : determine impedance, voltage, current, and power in 1- $\emptyset$ AC circuits & determine line and phase quantities in 3- $\emptyset$ AC circuits CO3 : select a suitable electrical machine for the given applications CO4 : determine the voltage and current characteristics of diodes and transistors			
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 trans formation, Mesh analysis & Nodal analysis			
UNIT-II			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, Concept of reactance, Impedance, Complex power, Real power, Reactive power and Power factor 3- $\emptyset$ AC circuits: Generation of 3- $\emptyset$ voltages, Advantages, Disadvantages, Applications of three phase system, Voltage & Current relationships of line and phase values for balanced star and delta connections			
UNIT-III			9 Hrs
Electrical Machines (Qualitative treatment): Construction, Principle of operation & applications of 1- $\emptyset$ transformer, 1- $\emptyset$ induction motor, DC motor, Stepper motor, and BLDC motor Energy calculations: Elementary calculations of energy consumption, (domestic applications)			
UNIT-IV			9 Hrs
Diodes: P-N Junction diode, volt-amp characteristics, Zener diode, volt-amp characteristics, Half-wave rectifier and Full-wave rectifier (centre-tapped), Transistors: Bi-polar Junction Transistor symbol, operation of N-P-N and P-N-P transistors, Characteristics of BJT (CE, CB & CC configurations), Applications of diodes and transistors			
Textbook(s): 1. K. Uma Rao, <i>Basic Electrical Engineering</i>, 5th ed., 2011, Pearson Education, Delhi. (Part-I-Chapters 1 to 5, Part-II-Chapters 1 to 4 and 7) 2. S Salivahanan & N Suresh Kumar, <i>Electronic Devices and Circuits</i>, 5th ed., 2006, Tata McGraw Hill, Delhi. (Chapters 1 to 3)			

Reference Book(S):

1. B.L.Thereja, A.K.Thereja, *Electrical Technology Vol. I & II*, 2005, S.Chand & Company Ltd.
2. Chakravarthy A, Sudhipanath and Chandan Kumar, *Basic Electrical Engineering*, 3rd ed., 2009, Tata McGraw Hill, Delhi.

Web and Video link(s):

<https://nptel.ac.in/courses/108105112>; *Fundamentals of Electrical Engineering*, by Prof. Debapriya Das, Professor, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24EE105A: BASIC ELECTRICAL & ELECTRONICS ENGINEERING										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PS O1	PS O2
CO1	U24EE105A.1	3	3	1	1	1	—	—	—	1	1	1	3	—
CO2	U24EE105A.2	3	3	1	1	1	—	—	—	1	1	1	3	—
CO3	U24EE105A.3	2	2	1	1	1	—	—	—	1	1	2	2	—
CO4	U24EE105A.4	2	1	1	1	1	—	—	—	1	1	—	2	—
U24EE105A		2.5	2.25	1	1	1	—	—	—	1	1	1.33	2.25	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	Determine voltage, current & power in electrical circuits using network reduction techniques	SDG 9	Industry, Innovation and Infrastructure	Circuit analysis using Kirchhoff's laws, mesh/nodal analysis, and source transformation forms the foundation for designing efficient power distribution networks, supporting industrial infrastructure development.
CO2	Determine impedance, voltage, current, and power in 1- ϕ AC circuits & determine line and phase quantities in 3- ϕ AC circuits	SDG 7	Affordable and Clean Energy	AC circuit analysis (real power, reactive power, power factor) and three-phase systems are essential for efficient power transmission and distribution, directly enabling affordable and reliable energy access.
CO3	Determine the voltage and current characteristics of diodes and transistors	SDG 9	Industry, Innovation and Infrastructure	Understanding PN junction diodes, Zener diodes, and BJT characteristics is fundamental to modern electronics, enabling innovation in industrial control systems, communication devices, and power supplies.
CO4	Select a suitable electrical machine for the given applications	SDG 7	Affordable and Clean Energy	Selection of appropriate motors (1- ϕ IM, DC motor, stepper, BLDC) and transformers improves energy efficiency in pumps, fans, EVs, and industrial drives. Renewable energy sources (solar PV, wind, bioenergy) covered in this unit directly support clean energy transition.

BASIC ELECTRICAL & ELECTRONICS ENGINEERING LABORATORY			
Class: B. Tech. I / II – Semester		Branch: CSE, CSE- Allied, IT, ME, CE	
Course Code:	U24EE105A	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 : validate mesh and nodal analysis CO2 : determine the impedance of the series RL, RC circuits CO3 : determine the efficiency of transformer by conducting load test and verify Kirchoff's laws using PSPICE CO4 : determine the characteristics of BJT and parameters of a rectifier circuit			
List of Experiments			
1. Verification of voltage divider rule and current divider rule 2. Verification of Mesh Analysis 3. Verification of Nodal Analysis 4. Determination of internal parameters of a choke coil 5. Impedance calculations and phasor representation of R-L series circuit 6. Impedance calculations and phasor representation of R-C series circuit 7. Load test on 1-phase transformer 8. Single phase bridge rectifier using R load 9. Zener diode as voltage regulator 10. Input and output characteristics of BJT 11. Verification of Kirchoff's laws using PSPICE / MATLAB 12. Interfacing Sensors with Arduino using TINKER CAD - LED blinking - IR Sensor - Ultrasonic Sensor - Voltage Sensor - Current Sensor - Speed Sensor			
Textbook(s): K. Uma Rao, <i>Basic Electrical Engineering</i>, 5th ed., 2011, Pearson Education, Delhi. (Chapters 1 to 9) - S Salivahanan & N Suresh Kumar, <i>Electronic Devices and Circuits</i>, 5th ed., 2006, Tata McGraw Hill, Delhi. (Chapters 1 to 6, 8 to 13)			
Reference Book(S): - B.L.Thereja, A.K.Thereja, <i>Electrical Technology Vol. I & II</i>, 2005, S.Chand & Company Ltd. - Chakravarthy A, Sudhipanath and Chandan Kumar, <i>Basic Electrical Engineering</i>, 3rd ed., 2009, Tata McGraw Hill, Delhi.			

Laboratory Manual (for laboratory component):1. *Basic Electrical & Electronics Engineering Laboratory Manual*, Department of EEE, KITSW

Course Articulation Matrix (CAM):				U24EE105A: BASIC ELECTRICAL & ELECTRONICS ENGINEERING LABORATORY										
CO		PO1	PO2	PO 3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	U24EE105A.1	3	3	2	2	1	-	-	-	2	2	-	2	1
CO2	U24EE105A.2	3	2	2	3	1	-	-	-	2	2	-	2	1
CO3	U24EE105A.3	2	2	3	2	3	-	-	-	2	2	-	3	2
CO4	U24EE105A.4	3	2	2	2	1	-	-	-	2	2	-	3	2
U24EE105A		2.75	2.25	2.25	2.25	1.5	-	-	-	2	2	-	2.5	1.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to)	Relevant SDG	SDG Description	Mapping Justification
CO1	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.
CO2	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.
CO3	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).
CO4	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:	U24VA106	Credits:	0
Hours/Week(L-T-P-O-E):	2-0-0-2	CIE:	60(%)
Total Number of Teaching Hours:	24Hrs	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			6Hrs
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 (Text 1: unit 2,topic 2.2.2)			
UNIT-II			6Hrs
Ecosystem and Biodiversity: Ecosystem: Concepts of an ecosystem, Food chain, Food webs, Ecological pyramids, Energy flow in the ecosystem and ecological succession Biodiversity and its Conservation: Introduction, Definition, Genetic, Species and ecosystem diversity, Value of biodiversity, Biodiversity in India, Hotspots of biodiversity, Man-wild life conflicts, Endangered and endemic species of India; In-situ and Ex-situ conservation Self- Learning Topics (SLTs): Introduction and definition of biodiversity (Text1:unit 4,topic 4.1)			
UNIT-III			6Hrs
Environmental Pollution: Global issues- Global climatic change, Greenhouse gases, Effects of global warming, Ozone layer depletion International Conventions / Protocols: Earth summit, Kyoto protocol, Montreal protocol Environmental Pollution- Causes and effects of air, Water, Soil, Marine and noise pollution with case studies Solid and Hazardous Waste Management: Introduction, Types, Effects of urban industrial and nuclear waste Natural Disaster Management: Introduction to disaster, Management of disaster, Disaster management of flood, earth quake, 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, topic5.10)			
UNIT-IV			6Hrs
Social Issues and the Environment: Role of Individual and Society, Water conservation, Rain water harvesting Environmental Protection/Control Acts: Air (prevention and control of pollution) act 1981, Forest conservation act (1980 and 1992), Wild life protection act 1972, Environment protection act 1986, Issues involved in enforcement of environmental legislations Green Methodology: Principles of green chemistry, Green methods in electronic production,			

Impact of electronic waste on public health and environment; United nations goals of sustainable development

Self-Learning Topics (SLTs): Water (prevention and control of pollution) act 1974 (Text1: unit 6, topics6.10), Water pollution cess act 1977 (Text1: unit 6, topics6.11)

Text book(s):

1. Erach Bharucha, *Text Book of Environmental Studies for Under Graduate Courses*, 3rd ed., Hyderabad, Universities Press (India) Pvt. Ltd, 2021.

Reference Book(s):

1. Y. Anjaneyulu, *Introduction to Environmental Science*, 1st ed., Hyderabad, B.S. Publications, 2020 (reprint).
2. Gilbert M. Masters, *Introduction to Environmental Engineering & Science*, 3rd ed., Prentice Hall of India, 2023.
3. Anubha Kaushik, C.P. Kaushik, *Environmental Studies*, 5th ed., New Delhi, New Age International Publishers, 2021.
4. R. Rajagopalan, *Environmental Studies from crisis to cure*, 3rd ed., New Delhi, Oxford University Press, 2018.

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.

Course Articulation Matrix (CAM):		U24CY106: ENVIRONMENTAL STUDIES												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CY106.1	2	1	2	1	-	1	-	1	-	-	-	-	-
CO2	U24CY106.2	-	-	2	-	-	2	-	1	-	-	-	-	-
CO3	U24CY106.3	1	2	1	-	-	1	1	1	-	-	-	-	-
CO4	U24CY106.4	-	-	1	-	-	2	-	1	-	-	-	-	-
U24CY106		1.50	1.50	1.50	1	-	1.50	1	1	-	-	-	-	-
3-HIGH, 2-MEDIUM, 1-LOW														

IDEA LAB MAKERSPACE

Class: B. Tech. I & II – Semester		Branch: Common to all branches	
Course Code:	U24AE107	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)

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

(based on psychomotor skills acquired from laboratory component)

- CO1 :** develop technical skills such as 3D printing, Laser engraving, Wood carving and Robotics
- CO2 :** apply the techniques and principles of welding, carpentry and foundry to produce required prototype/model
- CO3 :** design and build a IoT based and PCB system for a given application
- CO4 :** engage in project-based learning which reinforces theoretical knowledge through practical application

S. No.	Creative Fabrication Technology	List of Experiments
1.	3D Printing	Prepare a key chain on 3D printer with the given dimensions
2.		Prepare a Spur Gear on 3D printer with the given dimensions
3.	Laser Engraving	Perform key chain by using CO ₂ laser cutting machine
4.	Welding	Prepare a Single V-Butt joint on mild steel plates using AC arc welding machine
5.	CNC Wood Router	Perform wood carving using CNC (Computer numerical Control) Wood Router
6.	Carpentry	Prepare a half lap dovetail joint
7.	Foundry	Prepare a sand mould using single piece pattern
8.	Injection Moulding	Prepare a plastic product using Injection moulding machine
9.	Printed Circuit Board (PCB)	Design and fabricate a PCB (Printed Circuit Board) for a given application
10.	Internet of Things (IoT)	Measure the temperature and humidity by using DHT11 sensor and Arduino UNO
11.		Create a Smart Plant Watering System using IoT (Internet of Things) technology
12.	Robotics	Perform basic pick-and-place operation using robot
Course Project		- Students are required to create an affordable prototype as their final project for the end semester exam (ESE), 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.

Textbook(s):

- 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.

Reference Book(S):

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "Additive Manufacturing Technologies-3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer Nature, 2nd Edition 2021.
2. R.S. Khandpur, "Printed Circuit Boards: Design, Fabrication, Assembly and Testing", New Delhi Tata Mc Graw Hill-2008.
3. Sudeep Mishra, Anandarupmukherjee and Arijit Roy, "Introduction to IoT", New Delhi: University Cambridge Press, 2021.

Laboratory Manual (for laboratory component):

1. *Workshop practice laboratory manual & record book prepared by the faculty of department of Mechanical engineering, KITSW, Revised version 4, July-2026.*

Course Articulation Matrix (CAM):				U24AE107: 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	PS O 2
CO1	U24AE107.1	2	2	1	1	2	1	1	1	1	1	1	1	2
CO2	U24AE107.2	2	2	1	1	2	1	1	1	1	1	1	1	2
CO3	U24AE107.3	2	2	1	1	2	1	1	1	1	1	1	1	2
CO4	U24AE107.4	2	2	1	1	2	1	1	1	1	1	1	1	2
U24AE107		2	2	1	1	2	1	1	1	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	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 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

PRACTICUM -1																																																																							
Class: B.Tech. I/II/III/IV-Semester		Branch: Common to all branches																																																																					
Course Code:	U24EL108	Credits:	1																																																																				
Hours/Week(L-T-P-O-E):	0-0-0-0	CIE Marks (%):	100																																																																				
Total Number of Teaching Hours:	-	ESE Marks (%):	-																																																																				
Course Learning Objectives(LOs): <i>This course will develop students' knowledge in/on...</i> LO1: literature review and identifying research gaps LO2: implementing a project independently by applying knowledge to practice LO3: preparing well-documented report and informative PPT LO4: effective technical presentation and creating video pitch																																																																							
Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students 'theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicum's also prepare them for their MINI and MAJOR PROJECTs and for in dependent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive																																																																							
Abilities (HOCAs). (i) Practicum is a mandatory semester project work. (ii) Practicum is offered as a one credit course. Student has to earn 4 credits (one in each Semester from I to IV semesters) (iii)Allotment of Practicum topics for students: ○ Practicum matrix: In week (-1), the class teacher, in consultation with HoD, shall Prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.																																																																							
<table><tr><th>Course</th><th>U24MH101</th><th>U24PS102</th><th>U24EC103</th><th>U24CS104</th><th>U24EE105</th><th>U24CH106</th></tr><tr><td rowspan="10">Students allotted to different courses</td><td>B24XX001</td><td>B24XX011</td><td>B24XX021</td><td>B24XX031</td><td>B24XX041</td><td>B24XX051</td></tr><tr><td>B24XX002</td><td>B24XX012</td><td>B24XX022</td><td>B24XX032</td><td>B24XX042</td><td>B24XX052</td></tr><tr><td>B24XX003</td><td>B24XX013</td><td>B24XX023</td><td>B24XX033</td><td>B24XX043</td><td>B24XX053</td></tr><tr><td>B24XX004</td><td>B24XX014</td><td>B24XX024</td><td>B24XX034</td><td>B24XX044</td><td>B24XX054</td></tr><tr><td>B24XX005</td><td>B24XX015</td><td>B24XX025</td><td>B24XX035</td><td>B24XX045</td><td>B24XX055</td></tr><tr><td>B24XX006</td><td>B24XX016</td><td>B24XX026</td><td>B24XX036</td><td>B24XX046</td><td>B24XX056</td></tr><tr><td>B24XX007</td><td>B24XX017</td><td>B24XX027</td><td>B24XX037</td><td>B24XX047</td><td>B24XX057</td></tr><tr><td>B24XX008</td><td>B24XX018</td><td>B24XX028</td><td>B24XX038</td><td>B24XX048</td><td>B24XX058</td></tr><tr><td>B24XX009</td><td>B24XX019</td><td>B24XX029</td><td>B24XX039</td><td>B24XX049</td><td>B24XX059</td></tr><tr><td>B24XX010</td><td>B24XX020</td><td>B24XX030</td><td>B24XX040</td><td>B24XX050</td><td>B24XX060</td></tr></table>				Course	U24MH101	U24PS102	U24EC103	U24CS104	U24EE105	U24CH106	Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060
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 ○ In week (-1), the class teacher of a section shall collect 10 - 12 topics for practicum from each of the course teachers of that section. ○ The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format. 																																																																							

CIRCULAR

Allotment of Practicum topics to students

Section:.....

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

Note:

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

(Signature of class teacher)

- (iv). To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the class work timetable and outside the class work hours during week days.
- (v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100marks.
- (vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.
- (vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.
- (viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course
- (ix). A sample rubrics for assessment and evaluation of practicum is as follows:

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

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

- (a) **Practicum Topic:** Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.
- (b) **Working Model:** Each student is required to develop a proto type/process/system/simulation model on the given practicum topic and demonstrate

/present, during the allotted time, before the course teacher.

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

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

d) Anti-Plagiarism Check: The practicum report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

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

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

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

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

Course Learning Outcomes (COs):

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

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

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

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

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

Course Articulation Matrix (CAM):				U24EL108 PRACTICUM -1										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24EL108.1	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	U24EL108.2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	U24EL108.3	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	U24EL108.4	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL108		2	2	2	2	2	2	2	2	2	2	2	2	2
3-HIGH,2-MEDIUM,1-LOW														

SOCIAL EMPOWERMENT ACTIVITY -1/ SELF ACCOMPLISHMENT ACTIVITY - 1 (SEA -1/SAA-1)			
Class: B.Tech. I-Semesters	Branch: Common to all branches		
Course Code:	U24VA109	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-0	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-
Course Learning Objectives (LOs): <i>This course will develop students' knowledge in /on...</i> LO1: holistic development through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life LO3: skills for effective fieldwork practice , which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation LO4: making a well-documented report and an effective oral presentation through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity			
Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) is introduced for building generic competencies in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the physical, emotional, cognitive, spiritual and social aspects. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society. It is more than just learning from books to lead a successful life. These activity-based liberal learning courses, which help students to expand their social roles later in life, are offered under two sequels namely SEA (Social Empowerment Activities) and SAA (Self Accomplishment Activities) These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset. - Each SEA/SAA activity is treated as one credit course - Student must select one activity per semester, through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester. - Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA - To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc., - If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters. <u>Monitoring SEA/SAA:</u> Nodal units: The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE) shall act as nodal units for activities listed under SEA/SAA. - During the semester period, the student has to acquire requisite knowledge, conduct fieldwork, acquire skills and propose unique solutions to the real-life problems Knowledge Acquisition & Skilling: - Students have to identify goals, acquire and accumulate knowledge on the chosen			

- SEA/SAA activity
- ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.
 - iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.
- (d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.
- i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.
 - ii. Fieldwork consists of three phases: preparation, the actual activity and feedback
 - iii. **As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**
 - iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.
 - v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more
 - vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.
 - vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**
Eminent personalities/ Achievers / Renowned personalities:
 - (a). **In case of socially relevant problems/ activities of SEA/SAA:** Eminent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities
 - (b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.
 - viii. **For appointment to interact eminent personalities:** Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction
 - ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork
 - x. **Ethics of fieldwork:** Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged
 - xi. Student is expected to take care of health and Safety practices for fieldwork and travel
 - xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.
 - xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and

- record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.
- xiv. **Feedback:** The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.
- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.
- (e) **Demonstration / Presentation and Report:** Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.
- (f) **Flow process for completion of SEA/SAA course:**
- i. **Faculty counsellor approval:** In week (-1), in consultation with faculty counsellor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student
 - ii. **Identification of goals and preparation of action plan:** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.
 - iii. **Field work:** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.
 - iv. **Demonstration/ Presentation:** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.
 - v. **Report writing:** After successful demonstration/presentation, student shall write a 2-3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.
- (g) **Assessment & Evaluation:** There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1). The CIE for SEA/SAA is as follows:

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

Note:

- (a) **Presentation/ Demonstration:** It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.
 - The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.
- (b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator*.
- (c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.
- (d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she
 - a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
 - b. scores a minimum of 40 marks in the CIE of the course
- (e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Course Learning Outcomes (COs):

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

- CO1:** integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensitivity
- CO2:** interact effectively through written, oral and nonverbal communication with external world in a professional, sensitive and culturally relevant manner
- CO3:** analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensitivity
- CO4:** demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Text / Reference book(s):

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

Course Articulation Matrix (CAM):				U24VA109ZZ SEA-1/ SAA-1										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA109.1	-	-	-	-	-	2	2	2	2	2	2	1	1
CO2	U24VA109.2	-	-	-	-	-	2	2	2	2	2	2	1	1
CO3	U24VA109.3	-	-	-	-	-	2	2	2	2	2	2	1	1
CO4	U24VA109.4	-	-	-	-	-	2	2	2	2	2	2	1	1
U24VA109		-	-	-	-	-	2	2	2	2	2	2	1	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Course Code: U24VAXYY(SE/SA)ZZZ X represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA - represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

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

EXPERT TALK SERIES-1			
Class: B.Tech. I-Semester	Branch: Common to all branches		
Course Code:	U24AE110	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-0	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-
Course Learning Objectives (LOs): <i>This course will develop students' knowledge in /on...</i> LO1: 21 st century skills needed for industry, current industry trends, challenges and innovations LO2: latest technology in practice and applying knowledge to solve real-world problems LO3: smart work, soft skills, professional etiquette, networking abilities LO4: making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning			
In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important. (a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade. (b) Learning from industry experts with real-world examples, is important to enhance your educational experience. (c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximized if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations. (d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations". But how would you know all this without venturing into the industry? (e) The answer is Industry Expert Talk Series (ETS). Through ETS, we invite industry experts in different fields to deliver talks and interact with students. (f) Through Industry expert talks students get to know so much more that textbooks don't explain. (g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts. (h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses (i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development. (j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under ability enhancement category of courses. (k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves. (l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing			

styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

- (m) ETS enhances your learning in many ways for global opportunities for your career.
- (n) All in all, learning from industry experts, is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.
- (o) Salient features of ETS are hereunder:
 - (i) ETS is offered from I semester to VI semester.
 - (ii) ETS, in any given semester, is treated as one credit course
 - (iii) Students are required to earn six credits (from I to VI semester)
 - (iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**
 - (v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.
 - (vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks (10 MCQs/FiBs ; *duration: 10-15 mins*), on the contents covered in the expert talk.
 - (vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators**.
 - (viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.
 - (ix) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.
 - (x) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks
 - (xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).
- (p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

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

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

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

ii. Supplementary Exam:

- (a) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE
- (b) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; *duration: 2Hrs*) on the content covered in ETS lectures.
- (c) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE
- (d) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Learning Outcomes (COs):

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

- CO1:** identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology
- CO2:** identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement
- CO3:** interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects
- CO4:** demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

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

II SEMESTER(Stream-I)(URR24)

S.No.	Category	CourseCode	CourseTitle	Lectures/week				Credits
				L	T	P	E	
1	BSC	U24MH201	Matrix Theory and Vector Calculus	2	1	-	3	3
2	BSC	U24CH202A	Engineering Chemistry(from pool III)	2	1	2	5	4
3	PCC	U24CE203	Strength of Materials	2	1	-	3	3
4	ESC	U24CE204	Data Structures through C	2	1	2	5	4
5	HSMC	U24MH205	English Communication and Report Writing	2	-	-	2	2
6	VAC	U24VA206	Sports & Yoga	-	-	2	2	-
7	ESC	U24CE207	Engg. Graphics through CAD*	1	-	4	5	3
8	SEC	U24SE208	Programming Skill Development (PSD) Lab-1	-	-	2	2	1
9	ELC	U24EL209	Practicum-2	-	-	-	-	1
10	VAC	U24VA210	SEA-2/SAA-2	-	-	-	-	1
11	AEC	U24AE211	Expert Talk Series-2	-	-	-	-	1
			Total:	11	4	12	27	23
Summer/Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1credit to each Bridge course under additional learning(will be printed on grade sheet)				NIL				

S. No.	Course Code	CourseTitle	S. No.	Course Code	CourseTitle
Pool -III					
1.	U24CH202A	Engineering Chemistry (for Civil Engineering)			
2.	U24CH202B	Engineering Chemistry (for ECIE)			
3.	U24CH202C	Engineering Chemistry (for CSE)			
4.	U24CH202D	Engineering Chemistry (for EEE)			
	U24CH202E	Engineering Chemistry (for ECE)			

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- 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 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			
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)			
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			
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			

Textbooks:

1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, Delhi, 44th edition, 2017(Chapters 2,7,8)
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, U.K, John Wiley & sons, 10th edition, 2020 (Chapter 8(8.2))

Reference Book(S):

1. Spiegel M, *Vector Analysis* -Schaum's Series, McGraw Hill, 2nd edition, 2017
2. S.S. Sastry, *Engineering Mathematics, Vol.II*, Prentice Hall of India, 3rd edition, 2014.
3. Gilbert Strang, *Introduction to Linear Algebra*, 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 MATRIX THEORY AND VECTOR CALCULUS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24MH201.1	2	2	1	1	-	-	-	1	1		1		
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		
U2MH201		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 CE)			
Class: B. Tech. I – Semester		Branch: CE	
Course Code:	U24CH202A	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 suitable techniques of water analysis and corrosion treatment of solid materials			
CO2: apply the concepts of electrochemical energy systems for batteries and fuel cells			
CO3: appraise the spectroscopic techniques of chemical analysis and applications of polymers			
CO4: summarize the synthesis and applications of engineering materials			
UNIT-I			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 method; Ion-exchange method, Desalination processes; Reverse osmosis, Quality parameters of potable water (BIS,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			
UNIT-II			9 Hrs
Electrochemical Technology: 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 and weak acid vs weak base), Advantages of conductometric titration, Galvanic cell, Electrode potential, Electrochemical series, Nernst equation, Potentiometric titrations; Acid - base titrations			
Batteries: Classification, Lead-acid battery, Fuel cells; Hydrogen-oxygen fuel cell, Biosensors			
UNIT-III			9 Hrs
Polymers in construction: Introduction, Monomer, Polymer, Types of polymerizations; Addition and condensation, Preparation, Properties and applications of Polythene, Polyvinyl cyanide, Polyvinyl chloride, Bakelite, Nylon 6:6, Thermosetting resins and thermoplastic resins, epoxy, liquid resins, Conducting polymers and their applications			
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			
UNIT-IV			9 Hrs
Cement chemistry: Introduction, Cement, Manufacture of portland cement, Chemical constitution of portland cement, Setting and hardening of portland cement, Heat of hydration of cement, concrete, Polymer concrete, Polymer Impregnated concrete, Glasses and ceramics, Glass Fiber in reinforced cement (GRC)			
Nano materials: Introduction, Synthesis of nano materials; Top down and bottom-up approaches, Synthesis by sol-gel method, Nano scale materials; Fullerenes, Carbon nanotubes, Graphene; Properties and applications			

Textbook(s):

1. Jain and Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company, 17th edition, 2019

Reference Book(s):

1. J. C. Kuriacose and J. Rajaram, *Chemistry in Engineering and Technology* (vol. I & vol. II), Tata Mc. Graw-Hills Education Pvt. Ltd., 2010
2. Shashi Chawla, *Textbook of Engineering Chemistry*, Dhanpat Rai Publishers, 3rd edition, 2003
3. S. S. Dara, S. S. Umare, *A Text book of Engineering Chemistry*, S. Chand & Company Ltd., 12th edition, 2010
4. A. R. Santhakumar, *Concrete Technology*, Oxford University Press, 2nd Edition, New Delhi, 2018

Web and Video link(s):

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

Course Articulation Matrix (CAM):				U24CY202A: ENGINEERING CHEMISTRY (for CE)										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CY202A.1	2	-	-	-	1	1	1	-	1	-	1	1	1
CO2	U24CY202A.2	2	-	-	-	1	1	1	-	1	-	1	1	1
CO3	U24CY202A.3	2	-	-	-	1	1	1	-	1	-	1	1	1
CO4	U24CY202A.4	2	-	-	-	1	1	1	-	1	-	1	1	1
U24CY202A		2	-	-	-	1	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	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.
CO2	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.
CO3	appraise the spectroscopic techniques of chemical analysis and applications of polymers	SDG9	Industry, Innovation and Infrastructure	Spectroscopic techniques develop knowledge of modern spectroscopic techniques used in industrial chemical analysis and quality control. It enhances understanding of polymer applications in advanced materials and manufacturing industries.
CO4	summarize the synthesis and applications of engineering materials	SDG9	Industry, Innovation and Infrastructure	The synthesis and applications of engineering materials promoting innovation in material development for advanced industrial applications. It helps to understand modern materials used in sustainable infrastructure, manufacturing, and technology.

ENGINEERING CHEMISTRY LABORATORY (for CE)			
Class: B. Tech. I- Semester		Branch: CE	
Course Code:	U24CH202A	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: make use of analytical instruments for chemical analysis CO2: determine water quality parameters-alkalinity, hardness CO3: determine metals present in their ores CO4: design the synthesis of nanomaterial and polymer			
List of Experiments			
1. Estimation of hydroxide ion by acidimetry 2. Estimation of alkaline species present in the given water sample 3. Determination of viscosity of the given liquid by Ostwald's viscometer 4. Determination of rate of corrosion of mild steel in the presence and absence of inhibitor. 5. Determination of hardness of water by complexometric method 6. Estimation of chloride ion in water sample by argentometry method 7. Standardization of weak acid (acetic acid) by conductometry using sodium hydroxide (NaOH) and standard hydrochloric acid (HCl) 8. Standardization of strong acid (HCl) by potentiometry using standard sodium hydroxide (NaOH) 9. Colorimetric analysis- verification of Lambert-Beer's law 10. Estimation of ferrous (Fe^{2+}) ion in the given solution using potassium permanganate 11. Synthesis of polymer (phenol-formaldehyde) 12. Determination of soundness of aggregate (Sodium sulphate/Magnesium sulphate Test)			
Textbook(s): 1. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K., <i>Vogel's Textbook of Quantitative Chemical Analysis</i> , Pearson Education, 6 th edition, 2009. 2. Sivasankar, B., <i>Engineering Chemistry</i> , Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2 nd edition, 2013.			
Reference Book(s): 1. J.C. Kuriacose and J. Rajaram, <i>Chemistry in Engineering and Technology</i> (vol. I), Tata Mc. Graw-Hills Education Pvt. Ltd., 2010 2. Sharma, B.K., <i>Instrumental Methods of Chemical Analysis</i> , Goel Publishing House, Meerut, 24 th Edition, 2005.			
Laboratory Manual: <i>Engineering Chemistry Laboratory Manual for CE, Department of PS, KITSW</i>			

Course Articulation Matrix (CAM):				U24CY202A:ENGINEERING CHEMISTRYLABORATORY (for CE)										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CY202A.1	2	1	-	-	-	1	1	-	1	-	1	1	1
CO2	U24CY202A.2	2	1	-	-	2	1	1	-	1	-	1	1	1
CO3	U24CY202A.3	2	1	-	-	-	1	1	-	1	-	1	1	1
CO4	U24CY202A.4	2	1	-	-	-	1	1	-	1	-	1	1	1
U24CY202A		2	1	-	-	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	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.	
CO2	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.	
CO3	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.	
CO4	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.	

STRENGTH OF MATERIALS			
Class: B. Tech. II – Semester		Branch: Civil Engineering	
Course Code:	U24CE203	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: Assess the mechanical behaviour of materials under axial loading.			
CO2: Analyse bending and shear stress distributions in beams.			
CO3: Evaluate the torsional behaviour of shafts and performance of springs.			
CO4: Determine stress states in pressure vessels using analytical and graphical methods.			
UNIT-I			9 Hrs
Simple stresses and strains: Types of stresses, strains, stress-strain diagram, elastic limit, Hooke’s law, bars of varying sections, uniformly tapering circular and rectangular sections, elongation of bars due to self-weight.			
Elastic Modulii: Elastic constants, longitudinal strain, lateral strain, Poisson ‘s ratio, complimentary shear stress, state of simple shear, modulus of elasticity (E), modulus of rigidity(N), bulk modulus(K), relation between E, N&K, strain energy, resilience.			
UNIT-II			9 Hrs
Bending stresses in beams: Assumptions, theory of simple bending, application of bending equation and calculation of bending stresses in beams of homogeneous and fletched beam material, beams of uniform strength.			
Shearing stresses in beams: Shearing stress due to bending, variation of flexural shear stress distribution across rectangular, triangular, circular, flanged section, shear resilience.			
UNIT-III			9 Hrs
Torsion of Circulars hafts: Theory of pure torsion in solid and hollow circular shafts, shear stresses, angle of twist, power transmitted by shaft.			
Springs in compression: Types of springs, functions of springs, closed-coiled and open coiled helical spring subjected to axial load and axial twist, springs in series and parallel.			
UNIT-IV			9 Hrs
Thin Cylinders: Analysis of thin-walled pressure vessels, hoop stress, longitudinal stress.			
Principal stresses: Definition, normal and shear stress, principal stresses, principal planes, and their graphical representation by Mohr ‘s circle.			
Textbook(s):			
1. Dr. R.K.Rajput, Strength of Materials, 7th ed., Delhi, S.Chand Publishers, 2022.			
Reference Book(S):			
1. PunmiaB.C., Arun K.Jain, Ashok K.Jain, Mechanics of Materials, 2nd ed., New Delhi, Laxmi Publications, 2012.			
2. Subramanian R., Strength of Materials, 3rd ed., Oxford University Press, 2016.			
3. Ramamrutham S., Strength of Materials, 18th ed., New Delhi, Dhanpat Rai & Sons publications, 2014.			
4. Timoshenko and Gere, Mechanics of Materials, 8th ed., McGraw Hill International publishers, 2014.			

Web and Video link(s):

1. <https://nptel.ac.in/courses/105105108> NPTEL Course module on Strength Of Materials - IITKGP, IIT Kharagpur by Prof. Sriman Kumar Bhattacharya

Course Articulation Matrix (CAM):				U24CE203 : STRENGTH OF MATERIALS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE203.1	3	2	1	1	2	-	-	-	-	-	1	2	1
CO2	U24CE203.2	3	2	2	2	2	-	-	-	-	-	1	2	1
CO3	U24CE203.3	3	2	2	2	2	-	-	-	-	-	1	2	1
CO4	U24CE203.4	3	2	3	3	2	-	-	-	-	-	1	2	1
U24CE203		3	2	2	2	2	-	-	-	-	-	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	Assess the mechanical behaviour of materials under axial loading.	SDG9	Industry Innovation and Infrastructure.	Understanding stress-strain behaviour and deformation of structural members forms the foundation for safe and sustainable infrastructure design in civil engineering applications.
CO2	Analyze bending and shear stress distributions in beams.	SDG11	Sustainable cities and communities	Analysis of bending and shear stresses enables the design of safer beams and structural systems used in buildings, bridges, and urban infrastructure.
CO3	Evaluate the torsional behaviour of shafts and performance of springs.	SDG9	Industry Innovation and Infrastructure.	Torsion and spring analysis contribute to efficient mechanical and structural component design, supporting industrial innovation and durable engineering systems.
CO4	Determine stress states in pressure vessels using analytical and graphical methods.	SDG12	Responsible Consumption and Production	Accurate stress analysis of pressure vessels and structural components helps optimize material usage, improve safety, and reduce engineering failures and wastage.

DATA STRUCTURES THROUGH C			
Class: B.Tech. II -Semester		Branch: CE	
Course Code:	U24CE204	Credits:	3
Hours/Week (L-T-P-O-E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	48 Hrs	ESE:	40%
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to,</i> CO1: analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities CO2: analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities CO3: analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities CO4: develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies			
UNIT-I			12 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			
UNIT-II			12 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			
UNIT-III			12 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)			
UNIT-IV			12 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			
Textbook(s): 1. Debasis Samanta, Classic Data Structures, Prentice Hall India, 2nd ed., 2009			
Reference Book(s): 1. Reema Thareja, Data Structures Using C, 2nd ed., Oxford University Press, 2014 2. Balagurusamy E, Data Structure Using C, 1st ed., McGraw Hill Education, 2017 3. Richard F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudo code Approach with C, C engage Learning, 2nd ed., 2007			
Web and Video link(s): https://nptel.ac.in/courses/106106130 ;NPTEL Video Lecture on Programming and Data Structures Dr.N.S. Narayana Swamy, CSE, IIT Madras.			

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	U24CE204.1	2	2	2	1	-	-	1	-	1	-	-	2	1
CO2	U24CE204.2	2	2	2	2	-	-	1	-	1	-	-	2	2
CO3	U24CE204.3	2	2	2	2	-	-	1	-	1	-	-	2	2
CO4	U24CE204.4	2	2	2	2	-	-	1	-	1	-	-	2	2
U24CE204		2	2	2	1.75	-	-	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	analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities	SDG 4	Quality Education	Builds computational literacy and efficiency awareness, fostering innovation in data-driven infrastructure.
CO2	analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities	SDG 11	Sustainable Cities & Communities	Supports structured problem-solving for applications like scheduling, resource allocation, and urban systems.
CO3	analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities	SDG 8	Decent Work & Economic Growth	Enhances employability by teaching advanced memory management and supports innovation in scalable software systems.
CO4	develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies	SDG 9	Industry, Innovation & Infrastructure	Promotes efficient data handling, sustainable resource use in computing, and collaborative algorithmic problem-solving.

DATA STRUCTURES THROUGH C LABORATORY			
Class: B. Tech. II – Semester		Branch: CE	
Course Code:	U24CE204	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 and test basic data structures and array operations, including dynamic memory allocation to evaluate their performance and complexity CO2: apply the linear data structures such as stacks and queues and perform various operations using LIFO or FIFO order respectively CO3: solve problems using various linked list representations for efficiently storing And retrieving the data CO4: apply different sorting techniques on unsorted data and sort them in an order, able to store the data using hashing techniques to retrieve the data very effectively			
List of programs 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			
<u>Textbook(s):</u> 1. Debasis Samanta, Classic Data Structures, Prentice Hall India, 2nd ed., 2009			
<u>Reference Book(S):</u> 1. Reema Thareja, Data Structures Using C, 2nd ed., Oxford University Press, 2014 2. Balagurusamy E, Data Structure Using C, 1st ed., McGraw Hill Education, 2017 3. Richard F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudo code Approach with C, C engage Learning, 2nd ed.,, 2007			
<u>Web and Video link(s):</u> 1. https://nptel.ac.in/courses/106106130;NPTEL Video Lecture on Programming and Data Structures Dr.N.S. Narayana Swamy, CSE, IIT Madras.			

Laboratory Manual (for laboratory component):

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

Course Articulation Matrix (CAM):				U24CE204: DATA STRUCTURES THROUGH C LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE204.1	2	2	2	1	-	-	1	1	1	-	-	2	1
CO2	U24CE204.2	2	2	2	2	-	-	1	1	1	-	-	2	2
CO3	U24CE204.3	2	2	2	2	-	-	1	1	1	-	-	2	2
CO4	U24CE204.4	2	2	2	2	-	-	1	1	1	-	-	2	2
U24CE204		2	2	2	1.75	-	-	1	1	1	-	-	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	develop and test basic data structures and array operations, including dynamic memory allocation to evaluate their performance and complexity	SDG 4	Quality Education	Builds computational literacy and efficiency awareness, fostering innovation in data-driven infrastructure.
CO2	apply the linear data structures such as stacks and queues and perform various operations using LIFO or FIFO order respectively	SDG 11	Sustainable Cities & Communities	Supports structured problem-solving for scheduling, resource allocation, and automation in smart systems.
CO3	solve problems using various linked list representations for efficiently storing and retrieving the data	SDG 8	Decent Work & Economic Growth	Enhances employability by teaching advanced memory management and supports scalable software innovation.
CO4	apply different sorting techniques on unsorted data and sort them in an order, able to store the data using hashing techniques to retrieve the data very effectively	SDG 9	Industry, Innovation & Infrastructure	Promotes efficient data handling, sustainable digital resource use, and collaborative algorithmic problem-solving.

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- E):	2-0-0-2	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 : 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			9 Hrs
SPEAKING ACTIVITIES Self-Introduction- News Paper Reading (reading aloud)-Pronunciation check-Presentation, Narration/ Oral Description of a story/incident/event with the clues (JAM) GRAMMAR Tenses: Definition and identification through examples-Main and Sub Tenses-Present Tense- Structures through examples-usage- Correct use of Tenses with a focus on Present Tense- exercises for practice VOCABULARY Word formation: Prefixes-Suffixes- Definition & Examples-Sentence Formation with newly READING SKILL Reading: Definition: Sub skills of Reading- Emphasis on Skimming-Definition-Purpose-How to skim through the text- Exercises for practice WRITING PRACTICES Report Writing: Definition-Purpose- Qualities of a good Report-Types-Format Paragraph Writing: Definition-Organizing Principles of paragraphs-Making a paragraph through hints/graphs and pictures-Coherence-Linking Devices- Systematic Development of Ideas LIFE SKILLS: Ethical Values and Humanity The Last Leaf: A Short Story by O. Henry - Discussion based on collaborative interaction - Comprehension of Grammar, Vocabulary and Content			
UNIT-II			9 Hrs
SPEAKING ACTIVITIES Group Discussion-Narration/ Oral Description of a story/incident/event with the clues provided (JAM)--Debate GRAMMAR Tenses: Past Tense-Sub Tenses-Structures- Correct use of Past Tense- exercises for practice Subject-Verb Agreement: Identification with examples-Rules-Exercises for practice Reported Speech: Definition-Rules-Examples-Transformation Process-Exercises for practice			

Sentence Correction: Emphasis on Concord, Reported Speech and Present and Past Tenses-
Sentence Structures

VOCABULARY

Synonyms-Antonyms-Single-Word Substitutes- Definition-Examples-Popular Abbreviations

READING STRATEGY

Reading Strategy-Emphasis on Scanning the Text- Definition of Scanning-Purpose
advantages- Examples, Exercises and Practice through Team work

WRITING PRACTICES

Report Writing: Technical Reports-Purpose-Format-significance of abstract/ Executive
Summary

Letter Writing: Effective Letter Writing Techniques-Information Seeking Letters-Job
Application Letters- Apology Letters -Resume and Cover letter

LIFE SKILLS: Determination

How I Became a Public Speaker: An essay by George Bernard Shaw

Discussion based on collaborative interaction - Comprehension of Grammar, Vocabulary
and Content

UNIT-III

9 Hrs

SPEAKING ACTIVITIES

Self-Introduction through videos- Narration/ Oral Description of a story/incident/event
with the clues provided (JAM)- Poster presentations / Power-Point presentations

GRAMMAR

Tenses: Future Tense- Sub Tenses-Structures- Correct use of Future Tense- exercises for
practice

Nouns-Prepositions-Adverbs-Adjectives-Definition-Identification-Exercises for practice

Sentence Correction based on correct use of Future Tense- Nouns- Prepositions-Adverbs -
Adjectives

VOCABULARY

Phrasal Verbs- Technical Words-Latin Words

READINGS TRATEGY

Intensive Reading: purpose-Types of Comprehension Questions-Examples, Exercises and
Practice through Team work

WRITING PRACTICES

Report Writing: Informational Reports- Inspection Reports -Feasibility Reports- Purpose -
Format-Content-Exercises for Practice

LIFE SKILLS: Positive Attitude

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

Discussion based on collaborative interaction - Comprehension of Content

UNIT-IV

9 Hrs

SPEAKING ACTIVITIES

Extempore speech on the given topic- Visual Presentation- Group Discussion on the topic
given well in advance- Providing the required inputs- Story telling of one's choice

GRAMMAR

Tenses: Revision-Exercises for Practice

Clauses: Definition-Identification through examples-Objective/Purpose- Types-
Conjunctions-

Discussion based on collaborative interaction - Comprehension of Content

2. “Language and Life: A Skill’s Approach” Based on the latest AICTE model curriculum Orient Black swan Private Limited 2nd Edition 2019.

3. Standard Allen W., "*Living English Structure*", Pearson India Education Pvt Ltd.5th Edition 2009

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 AND REPORT WRITING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
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		
U24MH205		-	-	-	-	-	1	-	2	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 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
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 and YOGA			
Class: B.Tech. I/II-Semester		Branch: Common to all branches	
Course Code:	U24VA206	Credits:	0
Hours/Week(L-T-P-O-E):	0-0-2-2	CIE:	60(%)
Total Number of Teaching Hours:	24 Hrs	ESE:	40(%)
Course Learning Objectives (LOs): <i>This course will develop students 'knowledge in/on...</i> LO1: yoga and its benefits LO2: various sports & games LO3: sports man spirit LO4: all round development			
Sports and Games			
List of Sports and Games			
Sl. No.	Game	Sl. No	Game
1	Badminton	7	Volleyball
2	Basket ball	8	Cricket
3	Chess	9	Hand Ball
4	Carom	10	Kabaddi
5	Foot Ball	11	Kho-Kho
6	Table Tennis	12	Yoga Aasanas
<u>Text book (s):</u> 1.B.K. Chaturvedi, <i>Rules and Skills of Games and Sports</i> , Publisher – Good will Publishing House, B-9, Rattan Jyoti, 18 Rajendra Place, New Delhi.			
<u>Reference Book(s):</u> 1. Sakure Girish Madhao Rao, <i>Foundation of Physical Education and Sports</i> , Sports Publication, New Delhi.			
<u>Web and Video link(s):</u> Badminton game Video Link : https://www.youtube.com/watch?v=HucIqi8Lw3E&t=22s Basketball game Video Link: https://www.youtube.com/watch?v=-tkE2IJoR58 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 Volley ball game Video Link: https://www.youtube.com/watch?v=BJJb3-O0Q1U Cricket game Video Link: https://www.youtube.com/watch?v=87hO_Vs3-wQ Hand ball game Video Link: https://www.youtube.com/watch?v=VCa_0USaq8k Kabaddi game Video Link: https://www.youtube.com/watch?v=ai1m7ARNyNI Kho-Kho game Video Link: https://www.youtube.com/watch?v=P3_z3LKdLdg Yoga Aasanas Video Link: https://www.youtube.com/watch?v=e0Q88DUOXjk https://www.youtube.com/watch?v=JoDKbXEUrVQ			

Course Learning Outcomes(COs):

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

CO1:demonstrate physical fitness by performing yoga asanas

CO2:demonstrate physical fitness through various games & sports events with defined benchmarks

CO3:demonstrate sports man spirit and ethics

CO4: demonstrate physical, psychological, social and emotional balance

Course Articulation Matrix (CAM):		U24VA206Sports and Yoga												
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	PS O 2
CO1	U24VA206.1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	U24VA206.2	-	-	-	-	-	-	-	1	-	-	-	-	-
CO3	U24VA206.3	-	-	-	-	-	-	2	-	-	-	-	-	-
CO4	U24VA206.4	-	-	-	-	-	-	-	-	1	-	1	-	-
U24VA206		-	-	-	-	-	-	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	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: Civil Engineering	
Course Code:	U24CE207	Credits:	3
Hours/Week(L-T-P-O-E):	1-0-4-5	CIE:	60(%)
Total Number of Teaching Hours:	72 Hrs	ESE:	40(%)
Course Learning Outcomes (COs): After completion of this course, the students should be able to, <i>(based on psychomotor skills acquired from laboratory component)</i> CO1: illustrate conventional signs and functional planning of buildings CO2: distinguish types of doors, windows and staircases CO3: create plan, section and elevation of buildings using Auto CAD CO4: develop floor plan into 3D building plan			
THEORY COMPONENT			
UNIT-I		6+12=18 Hrs	
Basic Provisions of NBC2016 Key Plan, Site Plan, Subdivision/Layout Plan, Building Plan and Details, Services Plans and Specifications Layout of Drawings Title Block, Size of Title Block, North Point, Scale Indications, Lines of Drawings-Centre Lines, Hidden Outlines, Dimension, Extension and Hatching Lines, Lettering, Size of letters and numerals for drawings, Dimensioning, Units of Dimensioning. Introduction to Auto CAD: Practice drawing and modify commands in Auto CAD, Building Planning as per NBC recommendations, Drawing Conventional signs in Auto CAD, Description of Building components as per NBC recommendation Self- Learning Topics (SLTs): NBC 2016 Part 2 Administration and Part 3 Development Control Rules and General Building Requirements			
UNIT-II		6+12=18 Hrs	
Building Planning General Building Requirements, Space Requirement for Different Parts of Building, Other General Requirements - Kitchen, Bathroom and W.C., Minimum Width Provisions for Stairways, Minimum Width Provisions for Passageway/Corridors, Doorways, Lighting and Ventilation of Rooms, Height Limit, Exit Requirements, Land use classifications, Permissible Setbacks and Heights. Building Bye-Laws Floor Area Ratio (F.A.R.), Building Line, Open Space around Buildings, Built up Area for Residential Buildings, Minimum Recommended Floor area and Height of rooms of Residential Buildings. 1. Planning of space from Line diagram and development of plan, section and elevation 2. Drawings of Various types of doors, windows 3. Plan and Section of Dog-Legged staircase, Open Well Staircase and Spiral Staircase using Auto CAD Self- Learning Topics (SLTs): NBC 2016 Part 3 Development Control Rules and General Building Requirements			

UNIT-III	6+12=18 Hrs
Building Components Understanding Plan, Elevation and Section of a Building, Definitions of Items used in Building Construction: Balcony, Basement/Cellar, Building height, Building line, Canopy, Carpet area, Court yard, Covered area, Damp Proof Course, Mezzanine floor, Room height, Verandah.	
Structural Components Foundation, Damp Proof Course, Plinth beam, Lintel beam, floors, walls, beams, columns, roof, stair, parapet and others	
1. Plan, section and elevation of a residential building with restricted / unrestricted plinth area 2. Plan, section and elevation of a school building 3. Plan, section and elevation of a primary health center	
<i>Self - Learning Topics (SLTs): NBC 2016 Part 3 Development Control Rule sand General Building Requirements.</i>	
UNIT-IV	6+12=18 Hrs
Principles of Planning a building Planning a House orientation, Ventilation, Lighting, Arrangement for Light and Ventilation, Acoustics	
Functional aspects of a building Drawing or Living Room, Bed Rooms, Guest Room, Verandah, Office Room, Dining room, Kitchen, storeroom, Bath and W.C, Garage.	
1. Development of site layout with restricted area for required amenities Plan of a Dream house/Duplex house	
<i>Self - Learning Topics (SLTs): NBC 2016 Part 3 Development Control Rules and General Building Requirements</i>	
<u>Text Book(s):</u>	
1. Bureau of Indian Standards, National Building Code of India, 2nd revision, New Delhi: BIS, 2016.	
<u>Reference Book(s):</u>	
1. M.G.Shah, C.M.Kale, S.Y.Patki, <i>Building Drawing: With an Integrated Approach to Built Environment</i>, 6th ed., New Delhi, Tata McGraw Hill Book Company Limited, 2020. 2. T. Jeyapoovan, <i>Engineering Drawing and Graphics Using Auto CAD</i>, 4th ed., New Delhi, Vikas Publishing, 2020. 3. Auto CAD users guide 2016 Autodesk, Inc.	
<u>Web and Video link(s):</u>	
https://onlinecourses.nptel.ac.in/noc21_me125/preview ; NPTEL Video Lecture on Engineering Drawing and Computer Graphics by Prof. Rajaram Lakkaraju, Professor of Mechanical Engineering, IITK Kharagpur.	

Course Articulation Matrix (CAM):				U24CE207 ENGINEERING GRAPHICS AND CAD										
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	U24CE207.1	3	-	-	-	1	-	1	-	1	-	1	2	1
CO2	U24CE207.2	3	-	-	-	2	-	1	-	1	-	1	2	1
CO3	U24CE207.3	3	-	1	-	1	1	1	-	1	-	1	2	1
CO4	U24CE207.4	3	-	1	-	1	1	1	-	1	-	1	2	1
U24CE207		3	-	1	-	1.25	1	1	-	1	-	1	2	1
3-HIGH, 2-MEDIUM, 1- LOW														

PRACTICUM-2

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

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on...

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparing well-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

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

- (i). Practicum is a mandatory semester project work.
- (ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)
- (iii). Allotment of Practicum topics for students:
 - **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24MH101	U24PS102	U24EC103	U24CS104	U24EE105	U24CH106
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053
	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

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

CIRCULAR

Allotment of Practicum topics to students

Section :

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

Note:

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

(Signature of class teacher)

- (iv). *To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.*
- (v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.
- (vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.
- (vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.
- (viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course
- (ix). A sample rubrics for assessment and evaluation of practicum is as follows:

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

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

- (a) **Practicum Topic:** Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.
- (b) **Working Model:** Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.
- (c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.
 - What was the objective of the practicum assigned?
 - What are the main responsibilities and tasks for practicum?
 - What knowledge and skills from the coursework are applied in the practicum?
 - What new knowledge and skills are acquired during the practicum?
 - In what ways, can the practicum be helpful for the professional career?
 - What gaps are identified in your practicum work?
 - What improvements or changes you suggest for addressing the identified gaps for future work?
- (d) **Anti-Plagiarism Check:** The practicum report should clear plagiarism check as per the Anti-Plagiarism policy of the institute
- (e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacher as per the schedule notified by the department
- (f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact
- (g) The student has to register for the Practicum as a supplementary examination in the following cases:
 - i) he/she is absent for oral presentation and viva-voce

- ii) he/she fails to submit the report in prescribed format
- iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

Course Learning Outcomes (COs):

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

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

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

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

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

Course Articulation Matrix (CAM):				U24EL209 PRACTICUM-2										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24EL2098.1	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	U24EL209.2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	U24EL209.3	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	U24EL209.4	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL209		2	2	2	2	2	2	2	2	2	2	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

SOCIAL EMPOWERMENT ACTIVITY / SELF ACCOMPLISHMENT ACTIVITY -2 (SEA-2/SAA-2)			
Class: B.Tech. II -Semesters	Branch: Common to all branches		
Course Code:	U24VA210	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-0	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-
Course Learning Objectives (LOs): <i>This course will develop students' knowledge in /on...</i> LO1: holistic development through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life LO3: skills for effective fieldwork practice , which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation LO4: making a well-documented report and an effective oral presentation through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity			
Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) is introduced for building generic competencies in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the physical, emotional, cognitive, spiritual and social aspects. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society. It is more than just learning from books to lead a successful life. These activity-based liberal learning courses, which help students to expand their social roles later in life, are offered under two sequels namely SEA (Social Empowerment Activities) and SAA (Self Accomplishment Activities) These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset. (a) Each SEA/SAA activity is treated as one credit course (b) Student must select one activity per semester, through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester. (c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA (d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc., (e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.			

Monitoring SEA/SAA:

- (a) **Nodal units:** The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE) shall act as nodal units for activities listed under SEA/SAA.
- (b) During the semester period, the student has to **acquire requisite knowledge, conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems
- (c) **Knowledge Acquisition & Skilling:**
 - i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity
 - ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.
 - iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.
- (d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.
 - i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.
 - ii. Fieldwork consists of three phases: preparation, the actual activity and feedback
 - iii. **As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**
 - iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.
 - v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more
 - vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.
 - vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**
Eminent personalities/ Achievers / Renowned personalities:
 - (a). **In case of socially relevant problems/ activities of SEA/SAA:** Eminent personalities/ achievers include district administrative officers, Eminent Social

workers / NGOs, other inspiring and great personalities

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

- viii. **For appointment to interact eminent personalities:** Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction
- ix. On fieldwork, student is expected to demonstrate solid time management, organizational and note taking skills during fieldwork
- x. **Ethics of fieldwork:** Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged
- xi. Student is expected to take care of health and Safety practices for fieldwork and travel
- xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.
- xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practice sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.
- xiv. **Feedback:** The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.
 - During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.
- (e) **Demonstration / Presentation and Report:** Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.
- (f) **Flow process for completion of SEA/SAA course:**
 - vi. **Faculty counsellor approval:** In week (-1), in consultation with faculty counsellor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

- vii. **Identification of goals and preparation of action plan:** In week (1), the respective faculty coordinator(s) of nodal centers shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.
- viii. **Field work:** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.
- ix. **Demonstration/ Presentation:** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.
- x. **Report writing:** After successful demonstration/presentation, student shall write a 2-3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.
- (g) **Assessment & Evaluation:** There shall be *only Continuous Internal Evaluation (CIE)* for SEA/SAA. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centers and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

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

Note:

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

the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.
- (b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator*.
- (c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.
- (d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she
 - a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
 - b. scores a minimum of 40 marks in the CIE of the course
- (e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Course Learning Outcomes (COs):

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

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

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

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

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

Text / Reference book(s):

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

Course Articulation Matrix (CAM):				U24VA210- SEA-2/ SAA-2										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA210.1	-	-	-	-	-	2	2	2	2	2	2	1	1
CO2	U24VA210.2	-	-	-	-	-	2	2	2	2	2	2	1	1
CO3	U24VA210.3	-	-	-	-	-	2	2	2	2	2	2	1	1
CO4	U24VA210.4	-	-	-	-	-	2	2	2	2	2	2	1	1
U24VA210		-	-	-	-	-	2	2	2	2	2	2	1	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Course Code: U24VA XXX(SE/SA)ZZZX *represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA - represents SAA activity; ZZZ represents activity code from SEA/SAA baskets*

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 SEA/SAA course serial number: 09 SEA/SAA category: SEA course number: 302	Semester: 4 SEA/SAA course serial number: 10 SEA/SAA category: SAA course number: 206

The course code will be U24VA109SE302	The course code will be U24VA410SA206

EXPERT TALK SERIES-2			
Class: B.Tech.	II -Semester	Branch: Common to all branches	
Course Code:	U24AE211	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-0	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-
Course Learning Objectives (LOs): <i>This course will develop students' knowledge in /on...</i> LO1: 21 st century skills needed for industry, current industry trends, challenges and innovations LO2: latest technology in practice and applying knowledge to solve real-world problems LO3: smart work, soft skills, professional etiquette, networking abilities LO4: making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning			
In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important. (a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade. (b) Learning from industry experts with real-world examples, is important to enhance your educational experience. (c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations. (d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations". But how would you know all this without venturing into the industry? (e) The answer is Industry Expert Talk Series (ETS) . Through ETS, we invite industry experts in different fields to deliver talks and interact with students. (f) Through Industry expert talks students get to know so much more that textbooks don't explain. (g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world			

examples and perspectives that go beyond theoretical concepts.

- (h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses
- (i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.
- (j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.
- (k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.
- (l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.
- (m) ETS enhances your learning in many ways for global opportunities for your career.
- (n) All in all, learning from industry experts, is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.
- (o) Salient features of ETS are hereunder:
 - (i) ETS is offered from I semester to VI semester.
 - (ii) ETS, in any given semester, is treated as one credit course
 - (iii) Students are required to earn six credits (from I to VI semester)
 - (iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**
 - (v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.
 - (vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks (10 MCQs/FiBs ; *duration: 10-15 mins*), on the contents covered in the expert talk.
 - (vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators**.
 - (viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.
 - (ix) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.
 - (x) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks
 - (xi) The department ETS coordinator shall, in coordination with institute level

ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

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

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

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

iii. **Supplementary Exam:**

- (e) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE
- (f) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; duration: 2Hrs) on the content covered in ETS lectures.
- (g) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE
- (h) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Learning Outcomes (COs):

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

- CO1:** identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology
- CO2:** identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement
- CO3:** interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects
- CO4:** demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

Course Articulation Matrix (CAM):				U24AE210 EXPERT TALK SERIES-2										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24AE210.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AE210.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AE210.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AE210.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE210		1	1	1	1	1	1	2	1	2	1	2	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

FUNDAMENTALS OF SURVEYING			
Class: B.Tech. II-Semester(Exit)		Branch: Civil Engineering	
Course Code:	U24CE212X	Credits:	3
Hours/Week(L-T-P-O-E):	2-0-2-4	CIE:	60(%)
Total Number of Teaching Hours:	16Hrs	ESE:	40(%)
Course Learning Objectives (LOs):			
This course will develop students' knowledge in/on...			
LO1: basic principles of surveying and linear measurements			
LO2: compass and theodolite surveying			
LO3: concepts of leveling			
LO4: total station surveying			
THEORYC OMONENT			
UNIT-I		4Hrs	
Chain surveying: Principles of surveying, Types of Chain and Tape, Error due to incorrect chain, Errors in chaining, Tape corrections, Chaining and Ranging on level ground and Sloping ground.			
UNIT-II		4Hrs	
Compass and Theodolite Surveying: Types of compass, bearings, Magnetic declination, Local Attraction, Temporary and permanent adjustments of theodolite, Measurement of angles, Fundamental lines and relations, Traverse methods and computations.			
UNIT-III		4Hrs	
Leveling: Instruments for leveling, Principle and classification of leveling, Readings and booking of levels, field work in leveling, longitudinal section and cross section, plotting the profile, Height (level)computations			
UNIT-IV		4Hrs	
Total station Surveying: Introduction and features of total station, Setting up and orienting, Capabilities and advantages of total station, Uses, applications.			
LABORATORY COMPONENT			
List of Experiments			
1. Chain surveying: use of optical quire or cross staff, check line, timeline			
2. Horizontal angle measurement by repetition and re-iteration methods			
3. Measuring the distance between two inaccessible points using theodolite			
4. Theodolite traversing-closed traverse			
5. Fly leveling using auto level			
6. Profile leveling using auto level			
7. Determine area of given a terrain using total station.			
8. Determine the elevation of the remote object using total station.			
Text book(s):			
1. B. C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, <i>Surveying (Volumes I, II, and III)</i> , 18th ed., New Delhi, Laxmi Publications, 2020.			
2. S.K.Duggal, <i>Surveying(Volume I and II)</i> , 4th ed., McGraw Hill Education (India)Pvt.Ltd., , 2022.			

Reference Book(S):

1. Dr.K.R.Arora, *Surveying (Volume I and II)*, 16th ed., Delhi, Standard Book House, 2022.
2. T.P. Kanetker and S.V. Kulkarni, *Surveying and Levelling (Volume I and II)*, 26th ed., Pune, Vidyarthi Griha Prakashan, 2017.
3. R.Subramanian, *Surveying and Leveling*, 2nd., New Delhi, Oxford University Press, 2014.
4. S.K.Roy, *Fundamentals of Surveying*, 2nd ed., New Delhi, PHI Learning Private Limited, 2010.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105107122> NPTEL Video Lecture on Introduction to Surveying by Prof.J. K.Ghosh, Surveying, IIT Roorkee.
2. <https://archive.nptel.ac.in/courses/105/103/105103176/> NPTEL Video Lecture on Higher Surveying by Dr. Ajay Dashora, Civil Engineering, IIT Guwahati.
3. <https://archive.nptel.ac.in/courses/105/107/105107157/> NPTEL Video Lecture on GPS Surveying, Prof. J. K. Ghosh, IIT Roorkee.
4. <https://nptel.ac.in/courses/105104100> NPTEL Video Lecture on Modern Surveying Techniques by Dr. Onkar Dikshit, Civil Engineering, IIT Kanpur.

Laboratory Manual and Record Book (for laboratory component):

1. *Surveying fieldwork laboratory manual and record book*, prepared by Faculty, Department of Civil Engineering.

Course Learning Outcomes (COs)

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

CO1: measure linear distances using chain and tape.

CO2: build a traverse using theodolite.

CO3: interpret elevations using leveling instrument

CO4: determine area and elevations using total station.

(based on psychomotor skills acquired from laboratory component)

CO5: measuredistancesandangleusingtapeandtheodolite

CO6 : determine distance between inaccessible points using theodolite

CO7:estimate elevations using leveling instrument

CO8: estimate area and elevations using total station.

Course Articulation Matrix (CAM):			U24CE212X Fundamentals of Surveying											
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	U24CE212X.1	3	2	-	-	-	-	1	1	1	1	1	2	1
CO2	U24CE212X.2	3	2	-	-	-	-	1	1	1	1	1	2	1
CO3	U24CE212X.3	3	2	-	-	-	-	1	1	1	1	1	2	1
CO4	U24CE212X.4	3	2	-	-	-	-	1	1	1	1	1	2	1
CO5	U24CE212X.5	3	2	-	-	-	-	1	1	1	1	1	2	1
CO6	U24CE212X.6	3	2	-	-	-	-	1	1	1	1	1	2	1
CO7	U24CE212X.7	3	2	-	-	-	-	1	1	1	1	1	2	1
CO8	U24CE212X.8	3	2	-	-	-	-	1	1	1	1	1	2	1
U24CE212X		3	2	-	-	-	-	1	1	1	1	1	2	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CIVIL ENGINEERING MATERIALS			
Class: B.Tech. II-Semester (Exit)		Branch: CE	
Course Code:	U24CE213X	Credits:	3
Hours/Week(L-T-P-O-E):	2-0-2-0-4	CIE:	60(%)
Total Number of Teaching Hours:	32Hrs	ESE:	40(%)
Course Learning Objectives (LOs):: This course will develop students' knowledge in/on... LO1: Civil engineering materials and their classification. LO2: Manufacturing, using and testing of bricks and tiles. LO3: Types of aggregates and their uses in construction. LO4: Concrete and concrete making materials & other construction materials.			
THEORYCOMPONENT			
UNIT-I		4Hrs	
Introduction: Introduction to building materials, classification of materials, properties of good building materials, Indian Standard codes. Stones: Classification of rocks, Characteristics of good building stone, Quarrying, Quarry sap, Common varieties of stones-granite, marble, Kadapaslab, Shahabad stones, Dressing of stones-purpose, tools used.			
UNIT-II		4Hrs	
Bricks and Tiles: Method of manufacture of bricks - continuous kiln process, ISI specification for bricks IS-1077-1971, Characteristics of good bricks, Testing of bricks as per IS-3495-1966 - tests on water absorption and compressive strength of bricks, Refractory bricks, AAC, CLC and Fly ash bricks & their uses, Tiles-Types of tiles roofing tiles, floor tiles, Ceramic tiles, Vitrified tiles, Morbonite, Characteristics of good tiles, Porcelain-glazed Tiles (uses only), Stone ware pipes and their uses.			
UNIT-III		4Hrs	
Aggregates: Fine and coarse aggregates, Utility in concrete, classification, effect of geometry & texture, strength, mechanical properties, moisture content, water absorption, bulking of sand, deleterious substances, sieve analysis, Fineness modulus, various grading and grading requirements, sampling & testing as per Indian Standards. Steel: Structural steel and its properties, various tests on steel as per Indian standard code.			
UNIT-IV		4Hrs	
Cement and concrete: Chemical composition, hydration, heat of hydration, various types of cement, testing of cement as per Indian standard, Admixtures, types, uses, concrete making materials, mixing, transportation, placing, workability, compaction, segregation and bleeding, precautions, Hardened concrete properties, compressive strength, split tensile strength. Other Materials: Surface protective materials, paints, plastics, asbestos, timber, glass.			

LABORATORY COMPONENT	
List of Experiments 1. Determination of Compressive Strength of Stone Blocks 2. Determination of Compressive Strength of Burnt Clay Bricks 3. Determination of Water Absorption and Efflorescence of Burnt Clay Bricks 4. Determination of Fineness Modulus of Fine and Coarse Aggregates 5. Determination of Specific Gravity, Bulk Density, Voids Ratio, and Porosity of Fine Aggregate 6. Determination of Specific Gravity, Bulk Density, Voids Ratio, and Porosity of Coarse Aggregate 7. Determination of Bulking of Fine Aggregate 8. Determination of Workability of Fresh Concrete 9. Determination of Modulus of Elasticity of Steel by Conducting Tension Test 10. Determination of the Brinell's Hardness Numbers for Steel, Brass, and Aluminium 11. Bend and Re-bend Test on Steel Specimen Used in RCC 12. Impact Test on Metal Specimens Using Charpy and Izod Test 13. Determination of Compressive Strength and Split Tensile Strength of Concrete	
Text book(s): 1. S.K.Duggal, "Building materials", New Age international Pvt., Ltd., New Delhi 2. N. L. Arora and B. L. Gupta, "Building construction", Satya prakshan publications, New Delhi. 3. C.Rangwala, K.S.Rangwala and P.S.Rangwala, "Engineering materials", Charotar Publishers 4. M. L .Gambhir, "Concrete Technology", 5th ed., New Delhi, Tata Mc Graw-Hill, 2013.	
Reference Book(S): 1. M.S. Shetty, "Concrete Technology (Theory and Practice)", 7th ed., New Delhi, S.Chand Company, 2010. 2. A. M. Neville, "Properties of Concrete", 5th ed., New Delhi, Mc Graw Hill Publications, 2012. 3. B.C. Punmia, "Building construction" 19th Ed., New Delhi, Laxmi Publications Pvt.,Ltd., 2005 4. "Civil Engineering Materials Laboratory Manual", prepared by faculty of Department of Civil Engineering.	
Web and Video link(s): 1. https://youtu.be/ULt4aEst4mM?si=hv1Jn-6GhDHjaNUe NPTEL Video Lecture on Introduction to Construction Materials by Prof. Manu Santhanam, IIT Madras.. 2. https://youtu.be/SLPPFykORjA?si=Duu5wHRsfNMMuwr NPTEL Video Lecture on Stone Bricks and Mortar by Prof. Manu Santhanam, IIT Madras.. 3. https://youtu.be/4tgkRcLvQFc?si=4kOualIs5P0fslJq NPTEL Video Lecture on Cement and Concrete by Prof. Manu Santhanam, IIT Madras. 4. https://youtu.be/kBjJKrEMFj0?si=IJFuFgne0-ly4lkH NPTEL Video Lecture on Metals by Prof. Manu Santhanam, IIT Madras. 5. https://youtu.be/CHs83nfkTy8?si=sCs9d-RZmJHpb9g NPTEL Video Lecture on Cement Properties and tests by Prof. B.Bhattacharjee, IIT Delhi. 6. https://youtu.be/9PSuiuGic3w?si=A_DOI8MOE6XiDZ41 NPTEL Video Lecture on Aggregate shapes, sizes and tests by Prof. B.Bhattacharjee, IIT Delhi. 7. https://youtu.be/8Fk1H-sQhoo?si=q3i7mbv5wVlay-7I NPTEL Video Lecture on Workability of Concrete by Prof. B.Bhattacharjee, IIT Delhi. 8. https://youtu.be/DGhQYSIzTUw?si=rvYP3RD6G5GB6t8 NPTEL Video Lecture on	

<i>Factors affecting strength of concrete by Prof. B.Bhattacharjee, IIT Delhi.</i> 9. https://youtu.be/CaDyeLe6J80?si=-k2tUrQYOvdLW9-1 NPTEL Video Lecture on Strength of Concrete: Factors Affecting Test Results by Prof. B. Bhattacharjee, IIT Delhi.
Laboratory Manual (for laboratory component): 1. "Civil Engineering Materials Laboratory Manual", prepared by faculty of Department of Civil Engineering.
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to:</i> <i>(Based on cognitive skills acquired from the theory component)</i> CO1: Classify and demonstrate the occurrence and existence of stone. CO2: Portray the manufacturing of lime, cement, and tiles. CO3: Classify aggregates and steel used in construction. CO4: Summarize constituent materials, properties, and tests on fresh and hardened concrete. <i>(Based on psychomotor skills acquired from the laboratory component)</i> CO5: Correlate theory with the testing of engineering material. CO6: Establish the mechanical properties of civil engineering materials. CO7: Appraise the behavior of civil engineering materials when tested under various loads. CO8: Realize the specifications recommended by various codes to civil engineering materials.

Course Articulation Matrix (CAM):					U24CI213X:Civil Engineering Materials									
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24CE213X.1	1	-	-	-	-	2	1	-	1	-	2	1	1
CO2	U24CE213X.2	1	-	-	-	-	2	1	-	1	-	2	1	1
CO3	U24CE213X.3	1	-	-	1	-	2	1	-	1	-	2	1	1
CO4	U24CE213X.4	1	-	-	1	-	2	1	-	1	-	2	1	1
CO5	U24CE213X.5	3	2	2	3	2	1	3	3	2	-	2	2	2
CO6	U24CE213X.6	3	2	2	3	2	1	3	3	2	-	2	2	2
CO7	U24CE213X.7	3	2	2	3	2	1	3	3	2	-	2	2	2
CO8	U24CE213X.8	3	2	2	3	2	1	3	3	2	-	2	2	2
U24CI213X		2	2	2	2.33	2	1.5	2	3	1.5	-	2	1.5	1.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CONSTRUCTION PRACTICES			
Class: B.Tech. II-Semester (Exit)		Branch: Civil Engineering	
Course Code:	U24CE214X	Credits:	3
Hours/Week(L-T-P-O-E):	2-0-2-0-4	CIE:	60(%)
Total Number of Teaching Hours:	32Hrs	ESE:	40(%)
Course Learning Objectives (LOs):			
This course will develop students' knowledge in/on...			
LO1: construction of different building components as per building specifications			
LO2: substructure and superstructure of building.			
LO3: erection and removal of different temporary structures			
LO4: protection of buildings and essential services			
THEORY COMPONENT			
UNIT-I		4Hrs	
Components of Building and Building Specifications: Basic requirements of building, building line, set back line, covered area, plinth area, floor area, carpet area, building height, room height, habitable rooms, bathroom, water closet, Balcony. Building components and their functions - substructure and super structure; Orientation of Building; Construction sequence of residential building.			
Site Preparation and Setting Out of works: Site layout, site clearing, enclosing the site, water and electrical supply for construction at site, setting out of buildings, methods to determine depth of excavation.			
UNIT-II		4Hrs	
Construction of substructure and superstructure: Types and functions of foundations, procedure for excavation for foundation. Brick masonry - Bonds in brick work; Stone masonry - types of stone masonry.			
Flooring: Functions of a floor, Details of construction of sub base and base, selection of floor; planning for the layout of tiled floors. General principles of laying concrete floor. Types of flooring			
UNIT-III		4Hrs	
Formwork and Scaffolding: Form work, requirements of form work, types of form works for concreting, Scaffolding-components of scaffolding, requirements of scaffolding.			
Framed Structures: Principles of framed structures; components of framed structures-beams, columns, and slab. Advantages of framed structures.			
UNIT-IV		4Hrs	
Finishing and Protection of Buildings: Plastering, plastering techniques, Pointing-methods of pointing, types of pointing, Painting, Varnishing; Anti-termite treatment, Damp prevention, Fire protection-general safety requirements against fire.			
Essential and Special services in buildings: Plumbing services- principles of plumbing services in buildings, water supply fittings and fixtures, sanitary fittings and appliances, layout of building drainage.			

LABORATORY COMPONENT	
List of Experiments 1. Layout Plan and Marking of a Building 2. Setting Out of a Building – Foundation Marking as per the Given Plan 3. Construction of a Wall (Height of 50 cm and Wall Thickness of 1" and 1.5") Brick Walls in English Bond without Cement Mortar – Corner Portion, Length of Side Walls 60 cm 4. Construction of 1" and 1.5" Thick Brick Pillar Using Cement Mortar or Brick Piers in English Bond and Flemish Bond 5. Construction of Base Coat and Laying of Tile Flooring of One Square Meter 6. Plastering and Finishing of Wall 7. Pipe Joints and Plumbing Fixtures like Tap, T-Joint, Bend, Elbow 8. Demonstration on Formwork and Scaffolding – Detailing, Erection, and Removal for Different Structural Members	
Textbook(s): 1. P. Purushothama Raj, <i>Building Construction Materials and Techniques</i>, 2nded., Noida, Pearson India Education Services Pvt. Ltd., 2018. 2. P. C. Varghese, <i>Building Construction</i>, 2nded., New Delhi, PHI Learning Private Limited, 2018.	
Reference Book(S): 1. Dr. Anil Kumar Misra, <i>Building Materials and Construction</i>, 6th ed., New Delhi, S Chand and Company Limited, 2021. 2. SP62 (S&T): 1997 Bureau of Indian Standards, <i>Hand book on Building Construction Practices</i> (Excluding Electrical Work), New Delhi.	
Web and Video link(s): 1. https://www.youtube.com/watch?v=NnIE2mDAmHE NPTEL Video Lecture on Introduction to lean construction by Prof. N. Raghavan and Prof. Koshy Varghese, Department of Civil Engineering, IIT Madras. 2. https://www.youtube.com/watch?v=btajjXi0q9s NPTEL Video Lecture on Building Materials and construction by Dr. B. Bhattacharjee, Department of Civil Engineering, IIT Delhi. 3. https://www.youtube.com/watch?v=KZGNmzH7IdA NPTEL Video Lecture on Masonry by Dr. B. Bhattacharjee, Department of Civil Engineering, IIT Delhi.	
Laboratory Manual and Record Book (for laboratory component): 1. "Construction Practice Laboratory Manual and Record Book", prepared by Faculty of Department of Civil Engineering.	
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to:</i> <i>(Based on cognitive skills acquired from the theory component)</i> CO1: Identify the different building components and their specifications. CO2: Distinguish substructure and superstructure of a building. CO3: Recommend various types of temporary structures for construction and maintenance of a building. CO4: Prioritize the essential services to be provided to a building. <i>(Based on psychomotor skills acquired from the laboratory component)</i> CO5: Create a layout plan and marking for building. CO6: Construct brick wall and brick pier. CO7: Create a layout plan for tile flooring. CO8: Propose different types of temporary structures and various building services.	

Course Articulation Matrix (CAM):				U24CI214X:CONSTRUCTION PRACTICES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE214X.1	3	2	-	-	-	-	1	1	1	1	1	2	2
CO2	U24CE214X.2	3	2	-	-	-	-	1	1	1	1	1	2	2
CO3	U24CE214X.3	3	2	-	-	-	-	1	1	1	1	1	2	2
CO4	U24CE214X.4	3	2	-	-	-	-	1	1	1	1	1	2	2
CO5	U24CE214X.5	3	2	-	-	-	-	1	1	1	1	1	2	2
CO6	U24CE214X.6	3	2	-	-	-	-	1	1	1	1	1	2	2
CO7	U24CE214X.7	3	2	-	-	-	-	1	1	1	1	1	2	2
CO8	U24CE214X.8	3	2	-	-	-	-	1	1	1	1	1	2	2
U24CI214X		3	2	-	-	-	-	1	1	1	1	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

III SEMESTER(Stream-I)(URR24)

Sl. No.	Category	Course Code	CourseTitle	Lectures/week				Credits
				L	T	P	E	
1	BSC	U24MH301A	Numerical and Statistical Methods (for Civil Engineering)	2	1	-	3	3
2	PCC	U24CE302	Construction Materials	2	1	2	5	4
3	PCC	U24CE303	Surveying	2	1	2	5	4
4	PCC	U24CE304	Mechanics of Materials	2	1	-	3	3
5	ESC	U24CE305	Python Programming	2	1	2	5	4
6	VAC	U24VA306A	Quantitative Aptitude & Logical Reasoning(QALR)	2	-	-	2	2
7	SEC	U24SE307	PSD LAB-02(DSC)	-	-	2	2	1
8	ELC	U24EL308	Practicum-3	-	-	-	-	1
9	VAC	U24VA309	SEA-3/SAA-3	-	-	-	-	1
10	AEC	U24AE310	Expert Talk Series-3	-	-	-	-	1
Total:				12	5	8	25	24
Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)								

Branch Specific Mathematics:

S.No.	Course Code	Course Title
1.	U24MH301A	Numerical and Statistical Methods (for Civil Engineering)
2.	U24MH301B	Applied Mathematics (Mechanical Engineering)
3.	U24MH301D	Applied Mathematics (Electronics and Communication Engineering)
4.	U24MH301E	Essential Mathematics and Statistics for Machine Learning (AI&ML)
5.	U24MH301F	Essential Mathematics and Statistics for Data Science (Data Science)
6.	U24MH301G	Applied Mathematics (Electrical & Electronics Engineering)

Value Added Courses (VAC)					
Sr.No.	Course Type	Course Code	Course Name	Semester	Credits
1.	VAC01	U24CY106	Environmental Studies	I	-
2	VAC02	U24VA109	SEA-I/SAA-1	I	1
3	VAC03	U24VA206	Sports & Yoga	II	1
4	VAC04	U24VA210	SEA-2/SAA-2	II	1
5	VAC07	U24VA306A	QALR	III	2
6	VAC06	U24VA309	SEA-3/SAA-3	III	1
7	VAC05	U24VA406A	Soft & Interpersonal Skills	IV	1
8	VAC08	U24VA409	SEA-4/SAA-4	IV	1

NUMERICAL AND STATISTICAL METHODS			
Class: B.Tech. III -Semester		Branch: Civil Engineering	
Course Code:	U24MH301A	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 interpolation technique to solve various real-world problems CO2 : apply numerical methods to find solution to ordinary differential equations CO3 : interpret the data using various statistical measures and probability distributions CO4 : apply exact sampling distributions in testing of hypothesis			
UNIT-I			9 Hrs
Numerical Analysis: Finite differences and difference operators, Newton's forward and backward interpolation formulae, Lagrange interpolation Numerical Differentiation and Integration: First and second derivatives using forward and backward interpolation polynomials at the tabulated points. Gaussian quadrature formula, Trapezoidal rule, Simpson's $1/3^{\text{rd}}$ rule and Simpson's $3/8^{\text{th}}$ rule			
UNIT-II			9 Hrs
Numerical Solution to System of Linear, Algebraic and Transcendental Equations: Gauss elimination method, Jacobi Method and Gauss-Seidel Iteration Method, Bisection method, Regula-Falsi method, Secant method and Newton Raphson's method, Operational counts (computational complexity) for Gauss elimination method, Jacobi and Gauss-Seidel iterative methods Numerical Solution of Ordinary Differential Equations: Taylor's method, Picard's method, Euler's method and Runge - Kutta methods of second and fourth order			
UNIT-III			9 Hrs
Statistical Methods: Correlation, Rank correlation Regression- Lines of regression Probability: Review of the concepts of probability, Addition law of probability, independent events, Multiplication law of probability, Random variables, Discrete and continuous probability distributions, Mean and variance of a distribution, Binomial distribution, Poisson distribution, Normal distribution, and Exponential distribution. Fitting of these probability distributions to the given data			
UNIT-IV			9 Hrs
Sampling & Inference: Sampling distribution, Testing a Hypothesis, Null hypothesis, Alternative hypothesis, Errors in sampling, Critical region and level of significance, One tailed and two tailed tests, Procedure for testing of hypothesis, Test of significance for large samples (single mean and difference of means) Test of significance for small samples: t-test for single mean and difference of means, F-test for comparison of variances, Chi-square test for goodness of fit.			
Textbook(s): 1. Grewal, B.S., <i>Higher Engineering Mathematics</i> , Khanna Publishers, Delhi, 44 th edition, 2017			

Reference Book(S):

1. Kreyszig E, *Advanced Engineering Mathematics*, Inc, U.K, John Wiley & sons, 10th edition, 2020
2. S.S. Sastry, *Introductory Methods of Numerical Analysis*, 5th ed., New Delhi: Prentice Hall of India, 2012.
3. Richard L. Burden, Douglas Faires.J, *Numerical Analysis*, 9th ed, 2011.
4. T.K.V Iyengar etc, *Probability and Statistics*, S. Chand Publishers.
5. S.C. Gupta V.K. Kapoor, *Fundamentals of Mathematical Statistics*, 12th ed., New Delhi: Sultan Chand & Sons Publishers, 2020.

Web and Video link(s):

1. https://youtu.be/2NcQi41VX9g?si=IY5l42ue87U_EDx: NPTEL Video Lecture on Numerical methods./Prof.R. Usha / IIT Madras
2. <https://youtu.be/JyVWQZNfE1I?si=k7NOS4VBtW33UMl> : NPTEL Video Lecture on Introduction to Probability and Statistics-Binomial Distribution/Prof.G.Srinivasan /IIT Madras

Course Articulation Matrix (CAM):				U24MH301A:- NUMERICAL AND STATISTICAL METHODS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24MH301A.1	2	2	1	1				1	1		1		
CO2	U24MH301A.2	2	2	1	1				1	1		1		
CO3	U24MH301A.3	2	2	1	1				1	1		1		
CO4	U24MH301A.4	2	2	1	1				1	1		1		
U24MH301A		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	Apply interpolation technique to solve various real-world problems	SDG4	Quality Education	Interpolation is used to estimate missing indicators (e.g., test scores, attendance) for specific years in datasets when data is unavailable. By interpolating test results, educators can track a student's progress between formal assessments.
CO2	Apply numerical methods to find solution to ordinary differential equations	SDG9	Industry, Innovation and Infrastructure	Numerical methods (e.g., Runge-Kutta, Euler's) to solve Ordinary Differential Equations (ODEs) drives by enabling predictive modeling for sustainable industrial processes, infrastructure resilience, and R&D innovation. It allows simulation of complex systems—such as chemical reactors, traffic flows, and structural health—without costly, wasteful physical prototypes, reducing emissions and optimizing resources.
CO3	Interpret the data using various statistical measures and probability distributions	SDG4 & SDG9	Quality Education & Industry, Innovation and Infrastructure	Statistical tools are essential for mapping and achieving Quality Education by analyzing relationships between educational inputs and outcomes. Probability is a critical tool for achieving Industry, Innovation, and Infrastructure by modeling uncertainty to build resilient infrastructure, optimizing industrial processes, and managing risks in innovation. It justifies mapping by enabling evidence-based, sustainable development that accounts for future variability and promotes efficient, data-driven industrial growth.
CO4	Apply exact sampling distributions in testing of hypothesis	SDG4 & SDG9	Quality Education & Industry, Innovation and Infrastructure	Exact sampling distributions are crucial for testing hypotheses with small samples, providing precise probabilities where large-sample asymptotic tests (Z-tests) fail. They are essential in educational research to ensure robust, accurate, and fair assessments of learning outcomes, vocational training effectiveness, and equity in small student populations & are crucial to test hypotheses with small samples, such as verifying new technology adoption, ensuring infrastructure resilience, or optimizing manufacturing variances.

CONSTRUCTION MATERIALS			
Class:B.Tech. III -Semester		Branch: CivilEngineering	
Course Code: U24CE302	U24CE302	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 stone and brick masonry CO2:Judge suitability of timber, plastic, glass and steel in construction CO3: Examine the properties of cement and differentiate the pozzolana’s CO4: Identify suitable flooring and damp proofing materials for construction			
UNIT-I			9Hrs
Stone masonry: Rock forming minerals and their properties, Classification of rocks, Classification stone masonry, qualities of good building stone, tests on building stones, IS codal provisions of stone masonry.			
Brick masonry: Types of bricks, IS classification of bricks, Materials for Clay burnt brick, flyash brick, physical and chemical properties, English and Flemish bonds in brick masonry, tests on bricks, Defects in brick masonry, related IS codal provisions.			
UNIT-II			9Hrs
Timber and plastics: Classification of trees, Structure of timber, Characteristics of good timber, seasoning, defects of timber, preservation, Classification of plastics, thermoplastics and thermosetting plastics, moulding compounds, properties of plastics, use of PVC in civil engineering construction, IS codal provisions.			
Steel, glass and bitumen: Types of steel, properties, forms of steel, testing of steel, corrosion, Composition and properties of glass, Forms of Bitumen, properties and applications of bitumen, IS codal provisions.			
UNIT-III			9 Hrs
Cement: Portland cement, Chemical composition of Ordinary Portland Cement (OPC), Manufacturing of Portland cement – Wet and Dry process, Basic properties of cement in terms of oxides and Bouge compounds, Physical and chemical properties Hydration of cement, relevant IS codes.			
Pozzolan materials: Pozzolana, Sources and properties of Surki, Blast furnace slag, Fly ash, Silica Fume, Rice husk Ash, and Metakaolin, importance as alternative to cement, relevant IS codes.			
UNIT-IV			9Hrs
Flooring and Formwork: Flooring, Selection of flooring material, types, Requirements of Formwork, Types of formworks, Timber, Steel, Modular shuttering, Slip forms, Scaffolding.			
Damp proofing and termite proofing : Dampness in buildings, effects of dampness, methods of damp proofing, materials used for damp proofing course, Termite proofing, types, Anti termite treatment.			

Textbook(s):

1. N. Chenna Keshavulu, "Textbook of Engineering Geology", 3rd ed. Laxmi Publications Pvt. Ltd., New Delhi: 2018. (Chapters 1 to 5, 17)
2. Dr. B.C. Punmia, Er. Ashok K. Jain and Dr. Arun K. Jain "Building Construction ", 11th ed. Laxmi Publications Pvt. Ltd. New Delhi: 2016
3. Eva Kultermann and William P. Spence "Construction, Materials, Methods, and Techniques-

ReferenceBook(s):

1. S. P. Arora and Bindra, "A Textbook of Building Constructions", Dhanpat Rai and Sons, 4th Edn., 2010
2. S. K. Duggal, "Building materials", New Age International Pvt., Ltd., New Delhi 3rd Edn
3. S.C.Rangwala, K.S.Rangwala and P.S.Rangwala, "Engineering Materials", Charotar Publishers, Feb. 2019
4. A.R. Santha Kumar "Concrete Technology", Oxford Publishers, 1st Edn., 2010.
5. IS 1077 (1992): Common Burnt Clay Building Bricks. BIS, New Delhi
6. IS 4031 (Part 1-Part 5), 1988: Methods of Physical Tests For Hydraulic Cement, BIS, New Delhi
7. IS 383 (2016): Specification for Coarse and Fine Aggregates from natural sources for concrete
8. IS 1786:2008 "High strength deformed steel bars and wires for concrete reinforcement-specification. BIS, New Delhi, 2008.
9. IS 432 (Part-I & Part II) 1982: "Specification for mild steel and medium tensile steel bars and Hard drawn steel wires for concrete reinforcement". BIS, New Delhi, 2004

WebandVideolink(s):

1. <https://archive.nptel.ac.in/courses/105/106/105106206/NPTEL> Video Lecture on Civil Engineering - Basic Construction Materials by Prof. Prof. Radhakrishna G. Pillai & Prof. Manu Santhanam, IIT Madras
2. <https://archive.nptel.ac.in/courses/105/102/105102088/NPTEL> Video Lecture on Civil Engineering - Building materials and Construction by Dr. B. Bhattacharjee, IIT Delhi

Course Articulation Matrix (CAM):				U24CE302 CONSTRUCTION MATERIALS										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24CE302.1	3	2	1	1	1	1	1	1	1	1	1	2	1
CO2	U24CE302.2	3	2	1	1	1	1	1	1	1	1	1	2	1
CO3	U24CE302.3	3	2	1	1	1	1	1	1	1	1	1	2	1
CO4	U24CE302.4	3	2	1	1	1	1	1	1	1	1	1	2	1
U24CE302		3	2	1	1	1	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	Interpret stone and brick masonry	SDG 9	Industry, Innovation and Infrastructure	Understanding minerals and rocks supports selection of durable and sustainable construction materials for infrastructure development.
CO2	Judge suitability of timber, plastic, glass and steel in construction	SDG 11	Sustainable Cities and Communities	Knowledge of masonry systems promotes safe, durable and sustainable building practices for urban and rural development.
CO3	Examine the properties of cement and differentiate the pozzolana's	SDG 12	Responsible Consumption and Production	Selection of appropriate construction materials encourages efficient utilization of resources, recyclability and reduced environmental impact.
CO4	Identify suitable flooring and damp proofing materials for construction	SDG 11 and SDG 12	Sustainable Cities and Communities	Use of smart, sustainable and eco-friendly materials contributes to reduction of carbon footprint and supports climate-resilient construction practices.

CONSTRUCTION MATERIALS LABORATORY			
Class: B.Tech. III -Semester		Branch: Civil Engineering	
Course Code:	U24CE302	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: Identification of different minerals and rocks CO2: Characteristics of bricks and stones CO3: Mechanical properties of structural steel CO4: Measure the shear and impact strength of steel specimen			
THEORY COMPONENT			

List of Experiments

1. Identification of rock forming minerals.
2. Determination of physical properties of rocks.
3. Identification of structural features of rocks.
4. Determination of water absorption and efflorescence of bricks.
5. Determination of dimensional characteristics and compressive strength of bricks.
6. Determination of crushing strength of stone/aggregate.
7. Determination of compressive strength of wood
8. Determination of stress-strain characteristics of steel.
9. Determination of the Young's modulus of the given material by conducting flexural test on simply supported beam.
10. Determination of the modulus of rigidity by conducting compression test on spring
11. Determination of the modulus of rigidity by conducting torsion tests on steel
12. Determination of impact and shear strength of given steel specimen by Izod and Charpy test
13. Demonstration of formwork and scaffolding.

Textbook(s):

1. N. Chenna Keshavulu, "Textbook of Engineering Geology", 3rd ed. Laxmi Publications Pvt. Ltd., New Delhi: 2018. (Chapters 1 to 5, 17)
2. Dr. B.C. Punmia, Er. Ashok K. Jain and Dr. Arun K. Jain "Building Construction", 11th ed. Laxmi Publications Pvt. Ltd. New Delhi: 2016
3. Eva Kultermann and William P. Spence "Construction, Materials, Methods, and Techniques- Building for a sustainable future", 5th ed. Cengage 2021 (Part IV, chapters 15-23)

Reference Book(s):

1. S. P. Arora and Bindra, "A Textbook of Building Constructions", Dhanpat Rai and Sons, 4th Edn., 2010
2. S. K. Duggal, "Building materials", New Age International Pvt., Ltd., New Delhi 3rd Edn
3. S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, "Engineering Materials", Charotar Publishers, Feb. 2019
4. A.R. Santha Kumar "Concrete Technology", Oxford Publishers, 1st Edn., 2010.
5. IS 1077 (1992): Common Burnt Clay Building Bricks. BIS, New Delhi
6. IS 4031 (Part 1-Part 5), 1988: Methods of Physical Tests For Hydraulic Cement, BIS, New Delhi
7. IS 383 (2016): Specification for Coarse and Fine Aggregates from natural sources for concrete

8. IS 1786:2008 "High strength deformed steel bars and wires for concrete reinforcement- specification. BIS, New Delhi, 2008.
9. IS 432(Part-I & Part II)1982: "Specification for mild steel and medium tensile steel bars and Hard drawn steel wires for concrete reinforcement". BIS, New Delhi,2004

WebandVideolink(s):

1. <https://archive.nptel.ac.in/courses/105/106/105106206/NPTELVideoLectureonCivilEngineering-BasicConstructionMaterialsbyProf.Prof.RadhakrishnaG.Pillai&Prof.ManuSanthanam,IITMadras>
2. <https://archive.nptel.ac.in/courses/105/102/105102088/NPTELVideoLectureonCivilEngineering-BuildingmaterialsandConstructionbyDr.B.Bhattacharjee,IITDelhi>

Laboratory Manual Record (for laboratory):

1. Construction Materials laboratory manual prepared by CED, KITSW

Course Articulation Matrix (CAM):		U24CE307 CONSTRUCTION MATERIALS LABORATORY												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24CE307.1	3	2	1	1	1	1	1	1	1	1	1	2	1
CO2	U24CE307.2	3	2	1	1	1	1	1	1	1	1	1	2	1
CO3	U24CE307.3	3	2	1	1	1	1	1	1	1	1	1	2	1
CO4	U24CE307.4	3	2	1	1	1	1	1	1	1	1	1	2	1
U24CE307		3	2	1	1	1	1	1	1	1	1	1	2	1
3-HIGH,2-MEDIUM,1-LOW														

CO-SDG Alignment Matrix

CO	CO Statement - The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	Perform tests on construction materials	SDG 9	Industry, Innovation and Infrastructure	Laboratory testing of construction materials supports quality infrastructure development and promotes reliable engineering practices.
CO2	Determine physical and mechanical properties of construction materials	SDG 11	Sustainable Cities and Communities	Evaluation of material properties helps in selecting durable and safe materials for sustainable construction and urban development.
CO3	Analyze suitability of construction materials for engineering applications	SDG 12	Responsible Consumption and Production	Assessment of construction materials encourages efficient utilization of resources and selection of environmentally responsible materials.
CO4	Prepare laboratory reports and interpret test observations	SDG 13	Climate Action	Proper interpretation of material performance promotes sustainable construction practices and supports environmentally conscious engineering decisions.

SURVEYING			
Class: B. Tech. III – Semester		Branch: CE	
Course Code:	U24CE303	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 : prepare traverse maps using chain, tape and theodolite. CO2 : develop contour maps, longitudinal cross sections and estimate the areas, volumes. CO3 : estimate the elevations using tacheometry, trigonometric levelling and design the curves CO4 : appraise the use of photogrammetry, Remote sensing & Geographic Information System, totalstationand GlobalPositioning System.			
UNIT-I			9 Hrs
Linear Measurements: Principles of surveying, Types of chain and tape, Tape corrections, Chaining, Ranging on levelling and sloping ground, Types of compass, Bearings, Magnetic declination, and Local attraction. Theodolite and traverse surveying: Temporary and permanent adjustments, Measurement of angles, Fundamental lines and relations, Traverse methods and computations, Balancing traverse			
UNIT-II			9 Hrs
Levelling and contouring: Definitions, Terms and abbreviations, Methods of levelling, Differential, Profile, Cross section levelling, Characteristics of contours, Methods of contouring, Interpolation of contours, Contour gradient, Uses of contour maps Areas and volumes: Areas computed by sub-division into triangles, Offsets from baseline, Calculations of volumes for same level sections by prismoidal and trapezoidal formula, Volume from spot levels, Capacity of reservoir			
UNIT-III			9 Hrs
Tacheometry and trigonometric surveying: Types of tacheometric measurements, Determination of tacheometric constants, Distance and elevation formulae and uses of tacheometric survey, Trigonometric survey with accessible and inaccessible bases Curves: Setting out simple curves by linear methods and Rankine’s deflection angle method, Setting out compound, Transition curves with basic data of chainage, Radius and deflection angles, Advantages of transition curve			
UNIT-IV			9 Hrs
Photogrammetry and Remote Sensing: Types of photographs, scale of vertical photograph, Relief displacement, Introduction and process of remote sensing, Types of platforms, Sensors and applications, GIS introduction, Components, Data types, Functionalities of GIS Advanced surveying instruments: Features of total station, Setting up and orienting, Capabilities and advantages of total station, Introduction to GPS, Segments, Uses and applications			
Textbook(s):			

1. B.C. Punmia & Ashok kumar Jain, "Surveying Volume I, II and III", Laxmi Publications, 17th edn., 2016

Reference Book(S):

1. S.K. Duggal, "Surveying Volume I and II", McGraw Hill Education (India) Pvt. Ltd., 2013.
2. K.R. Arora, "Surveying Volume I and II", Standard Book House, 15th edn., 2015.
3. T.P. Kanetkar and S.V. Kulkarni, "Surveying and Levelling Volume I and II", Pune Vidyarthi Griha Prakashan, 24th edn., 2014.
4. R. Subramanian, "Surveying and Levelling", Oxford University Press, New Delhi, 2nd edn., 2007.
5. R. Agor, "A Textbook of Surveying and Levelling", Khanna Publisher, 12th edn., 2016..

Web and Video link(s):

1. <https://nptel.ac.in/courses/105104101> NPTEL Video Lecture on Surveying by Dr. Bharat Lohani, IIT Kanpur.
2. <https://nptel.ac.in/courses/105107121> NPTEL Video Lecture on Modern Surveying Techniques by Prof. S.K. Ghosh, IIT Roorkee.
3. <https://nptel.ac.in/courses/105107158> NPTEL Video Lecture on Digital Land Surveying and Mapping (DLS&M), Prof. Jayanta Kumar Ghosh, IIT Roorkee.

Course Articulation Matrix (CAM):		U24CE303 : SURVEYING												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE303.1	2	2	1	1	1	1	-	-	1	-	2	2	1
CO2	U24CE303.2	2	2	1	1	1	1	-	-	2	-	2	2	1
CO3	U24CE303.3	2	2	1	1	1	1	-	-	2	-	2	2	1
CO4	U24CE303.4	2	1	1	1	2	1	-	-	1	-	2	2	1
U24CE303		2.0	1.75	1.0	1.0	1.25	1.0	-	-	1.5	-	2.0	2.0	1.0
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	prepare traverse maps using chain, tape and theodolite.	SDG 9	Industry, Innovation and Infrastructure	Surveying measurements and traverse computations provide the fundamental data required for planning, design, and development of reliable civil engineering infrastructure projects.
CO2	develop contour maps, longitudinal cross sections and estimate the areas, volumes.	SDG 11	Sustainable Cities and Communities	Contour mapping, levelling, and earthwork estimation support sustainable urban planning, drainage systems, land development, and efficient resource utilization in communities.
CO3	estimate the elevations using tacheometry, trigonometric levelling and design the curves	SDG 6	Clean Water and Sanitation	Surveying supports planning and execution of canals, reservoirs, drainage systems, and irrigation structures for sustainable water management.
CO3	estimate the elevations using tacheometry, trigonometric levelling and design the curves	SDG 9	Industry, Innovation and Infrastructure	Curves are essential in transportation engineering for safe and efficient highways and railways, contributing to sustainable infrastructure development.
CO4	appraise the use of photogrammetry, Remote sensing & Geographic Information System, totalstationand GlobalPositioning System.	SDG 9	Industry, Innovation and Infrastructure	Modern geospatial technologies such as GIS, GPS, and Remote Sensing enable smart infrastructure development, digital mapping, and sustainable engineering decision-making.

SURVEYING LABORATORY			
Class: B. Tech. III – Semester		Branch: CE	
Course Code:	U24CE303	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 : analyze chain surveying data for linear measurements, areas and establish precise survey lines using theodolite angle measurements. CO2 : compute reduced levels, create sectional profiles, and conclude terrain features from auto-level observations. CO3 : apply tacheometry to determine horizontal distances and elevations, analyze gradients using tangential methods, CO4 : interpret advance surveying techniques and set out the curves.			
List of Experiments			
1. Measurement of distance between two stations using a metric chain and ranging rods.			
2. Determination of area and prepare the layout of an irregular land parcel.			
3. Horizontal angle measurement by repetition and reiteration methods			
4. Theodolite traversing – Closed traverse			
5. Levelling – temporary adjustments and recording staff readings			
6. Profile Levelling			
7. Longitudinal and Cross-section Levelling			
8. Trigonometric Levelling – Single Plane method and Double Plane method			
9. Determination of tacheometric constants, horizontal distance and elevation using tacheometry			
10. Determination of gradient between two inaccessible points by tangential tacheometry			
11. Setting out simple curve by chain and tape methods.			
12. Setting out simple curve by Rankine’s deflection angle method			
<u>Textbook(s):</u> 1. B.C. Punmia & Ashok kumar Jain, “Surveying Volume I, II and III”, Laxmi Publications, 17th edn., 2016			
<u>Reference Book(S):</u> 1. S.K. Duggal, “Surveying Volume I and II”, McGraw Hill Education (India) Pvt. Ltd., 2013. 2. K.R. Arora, “Surveying Volume I and II”, Standard Book House, 15th edn., 2015. 3. T.P. Kanetkar and S.V. Kulkarni, “Surveying and Levelling Volume I and II”, Pune Vidyarthi Griha Prakashan, 24th edn., 2014. 4. R. Subramanian, “Surveying and Levelling”, Oxford University Press, New Delhi, 2nd edn., 2007. 5. R. Agor, “A Textbook of Surveying and Levelling”, Khanna Publisher, 12th edn., 2016.			
<u>Laboratory Manual :</u> 1. Surveying Laboratory Manual, Department of CE KITSW			

Course Articulation Matrix (CAM):				U24CE309: SURVEYING LAB										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE309.1	2	2	2	1	2	1	1	1	1	-	-	2	2
CO2	U24CE309.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24CE309.3	2	2	2	2	2	1	1	1	1	-	2	2	2
CO4	U24CE309.4	2	2	3	3	3	1	1	1	1	-	2	2	2
U24CE309		2	2	2.25	1.75	2.25	1	1	1	1	-	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Apply chain surveying and theodolite surveying techniques to measure distances, areas, and horizontal angles for accurate field surveying operations.	SDG 9	Industry, Innovation and Infrastructure	Accurate surveying techniques support planning, design, and development of sustainable infrastructure and engineering projects.
CO2	Analyze levelling observations to compute reduced levels, prepare profiles, and interpret terrain characteristics using advanced levelling methods.	SDG 11	Sustainable Cities and Communities	Levelling and terrain analysis are essential for urban planning, drainage design, transportation systems, and sustainable community development.
CO2	Analyze levelling observations to compute reduced levels, prepare profiles, and interpret terrain characteristics using advanced levelling methods.	SDG 9	Industry, Innovation and Infrastructure	Reduced levels and profile surveys are essential for infrastructure projects such as highways, railways, canals, airports, and construction works.
CO3	Evaluate horizontal distances, elevations, and gradients using tacheometric surveying methods for engineering surveying applications.	SDG 11	Sustainable Cities and Communities	Accurate gradient and elevation analysis supports sustainable urban planning, transportation systems, drainage design, and safe community infrastructure development.
CO3	Evaluate horizontal distances, elevations, and gradients using tacheometric surveying methods for engineering surveying applications.	SDG 9	Industry, Innovation and Infrastructure	Tacheometric surveying is essential for infrastructure projects such as highways, railways, bridges, canals, and construction layout where distance, elevation, and gradient determination are critical.
CO4	Create simple curve layouts using chain, tape, and Rankine's deflection angle methods for field setting-out applications.	SDG 9	Industry, Innovation and Infrastructure	Curve setting and field layout techniques contribute to the accurate construction of highways, railways, and transportation infrastructure.

MECHANICS OF MATERIALS			
Class: B. Tech. III – Semester		Branch: CE	
Course Code:	U24CE304	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 : evaluate slope and deflection of determinate beams and trusses CO2 : estimate the slope and deflection for beams & trusses CO3 : determine the direct & bending stresses and critical load on columns CO4 : analyze portal frames using Castigliano's theorem and interpret failure theories to beams			
UNIT-I			9 Hrs
Deflection of beams: Macaulay's method and Moment Area method to calculate the slope and deflection of simply supported and cantilever beams Unit load method: Concepts of strain energy, Deflection of beams and application to deflection of determinate plane truss			
UNIT-II			9 Hrs
Castigliano's method: Slope and deflection of beams using Castigliano's theorem-I and deflection of determinate plane truss Fixed and continuous beams: Analysis of fixed beams for shear force and bending moment, Deflection of fixed beams, Analysis of continuous beams using Clapeyron's theorem of three moments			
UNIT-III			9 Hrs
Direct and bending stresses: Stresses in a member subjected to axial, Uniaxial and biaxial loading, Core or kernel of a section, Wind pressure on chimneys Columns and struts: Euler's theory, Euler's critical load for columns with various end conditions, Limitations, Rankine's hypothesis, IS code formula			
UNIT-IV			9 Hrs
Statically indeterminate frames: Analysis of statically indeterminate portal frames up to two degrees of indeterminacy using Castigliano's theorem-II Theories of failure: Maximum principal stress theory, Maximum principal strain theory, Maximum shear stress theory, Strain energy theory and Shear strain energy theory, Applications			
Textbook(s): 1. B. C Purnima, K. Arun Jain, K. Ashok Jain, <i>Mechanics of Materials</i> , Laxmi Publications Pvt. Ltd., 2014, 15th edition, New Delhi.			

Reference Book(S):

1. Gunneswara Rao T.D. and Mudimby Andal, *Strength of Materials*, Cambridge University Press, 1st edition, 2018.
2. H.J.Shah and S.B.Junnarkar, *Mechanics of Structures*, Volume-I and Volume-II, Charotar Publishing House Pvt. Ltd., 31st edition, 2014, Anand,.
3. R.K.Bansal, *A text book of Strength of Materials*, Laxmi Publications, 4th edition, 2010, New Delhi,
4. Andrew Pytel and L.Ferdinand Singer, *Strength of Materials*, Harper and Row Publishers, 4th edition, 2011, New York.

Web and Video link(s):

1. <https://youtu.be/GUOKSExdjq8?si=bYDU2uuuvorS51wT> NPTEL Video Lecture on Deflection of Beams by Prof.S.K. Bhattacharya, Department of Civil Engineering, I.I.T. Kharagpur
2. <https://youtu.be/vi0tjfdSjNY?si=IqmDLT5MDKKOZ0Km> NPTEL Video Lecture on Deflection of Beams – II by Prof.S.K. Bhattacharya, Department of Civil Engineering, I.I.T. Kharagpur
3. <https://youtu.be/sP34uzn7diA?si=eOy0tbQqM-1Pjd-P> NPTEL Video Lecture on Direct and Bending Stresses in Beams – I Prof. S.K. Bhattacharya, Department of Civil Engineering, I.I.T. Kharagpur
4. <https://youtu.be/6CLEWA2WNqM?si=ioUB8HOzUw0DTfQSNPTEL> NPTEL Video Lecture on Failure Theories by Dr.Ravindra Gettu, Department of Civil Engineering, IIT Madras.

Course Articulation Matrix (CAM):				U24CE304 : MECHANICS OF MATERIALS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE304.1	2	2	-	1	1	1	1	1	1	-	1	1	1
CO2	U24CE304.2	2	2	-	1	1	1	1	1	1	-	1	1	1
CO3	U24CE304.3	2	2	-	1	1	1	1	1	1	-	1	1	1
CO4	U24CE304.4	2	2	-	1	1	1	1	1	1	-	1	1	1
U24CE304		2	2	-	1	1	1	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	evaluate slope and deflection of determinate beams and trusses	SDG9	Industry, Innovation and Infrastructure	Understanding structural behavior helps in designing safe and durable infrastructure systems.
CO2	estimate the slope and deflection for beams & trusses	SDG9	Industry, Innovation and Infrastructure	Accurate estimation of deflection contributes to efficient and resilient structural design.
CO3	determine the direct & bending stresses and critical load on columns	SDG11	Sustainable Cities and Communities	Stress analysis and column stability ensure structural safety for sustainable urban infrastructure.
CO4	analyze portal frames using Castigliano's theorem and interpret failure theories to beams	SDG11	Sustainable Cities and Communities	Failure analysis and indeterminate structure analysis support resilient structures capable of withstanding environmental and loading uncertainties.

PYTHON PROGRAMMING

Class: B. Tech. III – Semester		Branch: CE	
Course Code:	U24CE305	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 Python syntax, control structures, operators, and functions to develop structured programs for basic problem solving

CO2 : develop modular Python programs using strings, regular expressions, built-in collections, and namespaces for efficient data handling

CO3 : develop Python applications using object-oriented principles, exception handling, file operations and database connectivity

CO4 : analyze and visualize data using Python libraries such as NumPy, Pandas, and Matplotlib for data science applications

UNIT-I

9 Hrs

Python Preliminaries: Features of Python, Writing and executing Python programs 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 functions.

UNIT-II

9 Hrs

Modules and Name Spaces: The from...import statement, Naming module, 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, in and not in operators, Comparing strings

UNIT-III

9 Hrs

Data Structures: Lists, Tuple, Sets, Dictionaries

Python Object Oriented Programming: Classes and objects, Class method and self- argument, The init() method, Class variables and object variables, Public and private data members, Private methods, Calling a class method from another class method, Built-in class attributes

File Handling: Opening and closing files, Reading and writing files, File positions, Renaming and deleting files, Directory methods

Database Connectivity: SQLite, creating a data base table, Insert and retrieve data from database

UNIT-IV

9 Hrs

NumPy: The basics of NumPy arrays, Array indexing, Arrayslicing, Re shaping 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

Visualization with Matplotlib: Importing Matplotlib, Saving figures to files, Simple line plots, Simple scatter plots, Histograms

Textbook(s):

1. Reema Thareja, Python Programming using problem solving approach, New Delhi: Oxford University Press, 2017. (Chapter 1 to 7)
2. Jake VanderPlas, Python Data Science Handbook - Essential Tools for Working with Data, California: O'Reilly Media Inc., 2016. (Chapter 2 to 4)

Reference Book(S):

1. Dr. Charles R. Severance, *Python for Everybody - Exploring Data Using Python*, openbook, 2016
2. David Beazley, *Python Cookbook*, 3rd ed., California: O'Reilly Media, Inc., 2013
3. Magnus Lie Hetland, *Beginning: from Novice to Professional*, 1st ed. New York City: Apress, 2005.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc23_cs99/ NPTEL Video Lecture on Python For Data Science by Prof. Ragunathan Rengasamy, IIT Madras.
2. https://onlinecourses.nptel.ac.in/noc25_cs17/ NPTEL Video Lecture on Data Analytics with Python by Prof. A Ramesh, IIT Roorkee.
3. https://onlinecourses.nptel.ac.in/noc25_cs69/ NPTEL Video Lecture on The Joy of Computing using Python by Prof. Sudarshan Iyengar, IIT Ropar

Course Articulation Matrix (CAM):				U24CE305: PYTHON PROGRAMMING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE305.1	1	2	2	2	2	1	-	-	-	1	1	2	2
CO2	U24CE305.2	2	2	2	2	2	1	-	-	-	1	1	2	2
CO3	U24CE305.3	2	2	2	2	3	1	-	-	-	1	1	2	2
CO4	U24CE305.4	2	2	2	2	3	1	-	-	-	1	1	2	2
U24CE305		1.75	2	2	2	2.5	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	Apply Python syntax, control structures, operators, and functions	SDG4	Quality Education	Builds computational thinking and problem-solving skills for engineering students.
CO2	Develop modular Python programs using strings, regex, and collections	SDG9	Industry, Innovation, and Infrastructure	Supports efficient data handling for industrial and research applications.
CO3	Develop OOP-based applications with DB connectivity	SDG8	Decent Work and Economic Growth	Enables automation and software development skills relevant to industry.
CO4	Analyze and visualize data using NumPy, Pandas, Matplotlib	SDG11	Sustainable Cities and Communities	Data analysis and visualization support urban planning and smart city initiatives.

PYTHON PROGRAMMING LABORATORY

Class: B. Tech. III – Semester		Branch: CIVIL	
Course Code:	U24CE305	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)

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

CO1: construct Python programs by applying operators, control structures, and user defined functions to address basic computational problems.

CO2: demonstrate the use of namespaces, packages, string handling functions, regular expressions, and built-in data structures to develop optimized Python programs

CO3: develop object-oriented programs by creating custom classes, manipulating objects, handling files, threads and executing database operations in Python

CO4: design visual representations of data using Matplotlib and experiment with Numpy and Pandas libraries to analyze datasets programmatically

List of programs

Experiment-1

1. Installation of Python and verifying PATH environment variable
2. Running instructions in Interactive interpreter and a python script
 - a. Executing instructions in Python Interactive Interpreter
 - b. Running python scripts in Command Prompt
 - c. Running python scripts in IDLE
3. Write a program to demonstrate importance of indentations. Purposefully raise indentation error and correct it
4. Write a program to take input text as command line argument and display it on screen

Experiment-2 (UNIT-I)

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

Experiment-3 (UNIT-I)

1. Write a program to find the Factorial of a given number
2. Write a program to evaluate the Fibonacci series for a given number `_n'`
3. Write a program to find the Armstrong for a given number
4. Write a program to find sum of N numbers
5. Write a program to take a number as input, and print count down from that number to zero (use while loop)
6. Write a program to find circulating `_n'` values

Experiment-4 (UNIT-II)

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

Experiment-5 (UNIT-II)
1. Write a python program on strings for the following a. To displaysubstringinastring b. To updateanexistingstring c. To implementstringconcatenation d. To demonstrate string formatting operator
Experiment-6 (UNIT-II)
1. Writeaprogramtodemonstrateuseofslicinginstrings 2. Writeaprogramtocomparetwostrings 3. Write a program whichprints the reverse of a giveninput string. (usea function with name 4. Reversestringandcallthisfunctionforperformingtheoperation) 5. Todemonstratebuilt-instringmethods 6. Writeaprogramtodemonstratelistandrelatedfunctions
Experiment-7 (UNIT-III)
1. Write a program to demonstratetuple,setandrelatedfunctions 2. Writeaprogramtodemonstratedictionaries 3. WriteaprogramtodemonstrateRegExfunctions
Experiment-8 (UNIT-III)
1. Write python program for the following a. To demonstrate classes and objects b. To demonstrate class method and static method c. To demonstrate inheritance 2. Write python program on file operations for the following a. To open and read data from a file b. To write data in to a file c. To compute number of characters, words, lines in a file
Experiment-9 (UNIT-III)
1. Write pythonp rograms to implement database connectivity a. InstallandverifySQLiteConnectorforPython b. To connect check SQLite Database connectivity c. To retrieve and display data from a table d. To insert data in to a table e. To delete rows in a table
Experiment-10 (UNIT-IV)
1. Install and setup NumPy environment 2. Write a program to demonstrate NumPy array 3. Write a program to demonstrate Slice operation 4. Write a program to demonstrate Reshaping of anarray
Experiment-11 (UNIT-IV)
1. Installandset uppandasenvironment 2. Writeapthonpandasprogramtocreateseriesfromanndarray 3. WriteaPython Pandasprogram todemonstrateindexingand selectingdata
Experiment-12 (UNIT-IV)
1. Install and setup mat plotlib 2. Write a program to draw a simple lineplot 3. Write a program to draw a histogramplot 4. Customize plotsand experiment with different mapsplots
Textbook(s):
1. ReemaThareja,<i>Python Programming using problem solving approach</i>, New Delhi: Oxford University Press, 2017. (Chapter 1 to 7)

- Jake VanderPlas, *Python Data Science Handbook- Essential Tools for Working with Data*, California: O'Reilly Media Inc., 2016. (Chapter 2 to 4)

Reference Book(S):

- Dr. Charles R. Severance, *Python for Everybody-Exploring Data Using Python*, openbook, 2016
- David Beazley, *Python Cookbook*, 3rd ed., California: O'Reilly Media, Inc., 2013
- Magnus Lie Hetland, *Beginning: from Novice to Professional*, 1st ed. New York City: Apress, 2005.

Web and Video link(s):

- https://onlinecourses.nptel.ac.in/noc23_cs99/ NPTEL Video Lecture on Python For Data Science by Prof. Ragnathan 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):

- Python Programming Laboratory Manual*, prepared by faculty Department of CIVIL, KITSW

Course Articulation Matrix (CAM):				U24CE305 : PYTHON PROGRAMMING LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE305.1	2	2	2	1	2	1	1	1	1	-	-	2	2
CO2	U24CE305.2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24CE305.3	2	2	2	2	2	1	1	1	1	-	2	2	2
CO4	U24CE305.4	2	2	3	3	3	1	1	1	1	-	2	2	2
U24CE305		1.75	2	2.25	1.75	2.25	1	1	1	1	-	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Construct Python programs using operators, control structures, and user-defined functions	SDG 4	Quality Education	Promotes computational thinking and problem-solving skills, ensuring students gain foundational digital literacy.
CO2	Demonstrate namespaces, packages, string handling, regex, and data structures	SDG 9	Industry, Innovation, and Infrastructure	Builds capacity for efficient coding practices, supporting innovation in software development and digital infrastructure.
CO3	Develop object-oriented programs, handle files, threads, and databases	SDG 8	Decent Work and Economic Growth	Equips students with employable skills in database management and software engineering, enhancing career readiness.
CO4	Design visual representations of data using Matplotlib, NumPy, and Pandas	SDG 12	Responsible Consumption	Enables data-driven decision-making for sustainability, resource optimization, and smart city applications.

QUANTITATIVE APTITUDE AND LOGICAL REASONING			
Class: B.Tech. III -Semester		Branch: Common to all Branches	
Course Code:	U24VA306A	Credits:	2
Hours/Week (L-T-P-O-E):	2-0-0-2	CIE	60 %
Total Number of Teaching Hours:	24 Hrs	ESE	40 %
Course Learning Outcomes (COs): <i>After completion of this course, the students should be able to...</i> CO1: apply arithmetic concepts such as averages, percentages, ratios, and time-based calculations to solve real-life quantitative problems CO2: analyze and solve problems involving financial, arithmetic and probability using structured quantitative methods CO3: identify patterns and apply deductive reasoning to solve series, coding-decoding, and arrangement-based logical problems CO4: evaluate logical statements, assess validity, and draw conclusions using tools like syllogisms, Venn diagrams, and argument analysis			
UNIT-I			6 Hrs
Quantitative Aptitude-I: Number system, Averages, Percentages, Ratios & proportions, Time, Speed & distance, Time and work			
UNIT-II			6 Hrs
Quantitative Aptitude-II: Simple interest, Compound interest, Profit & loss, Ages, Permutations & Combinations, Probability			
UNIT-III			6 Hrs
Logical Reasoning-I: Series completion, Analogy, Coding and decoding, Blood relations, Number, Ranking & Time sequence test, Linear & Circular arrangements			
UNIT-IV			6 Hrs
Logical Reasoning-II: Data sufficiency, Logical Venn diagram, Syllogisms, Statement & Arguments, Statement & Assumptions, Direction sense test			
Note: Students should go through the QALR course supplementary material made available on online learning platform - Contents covered in class shall be practiced through the material available on the online learning platform. At home practice problems and practice tests shall be made available on the online learning platform - Tutorial classes shall be conducted on the online learning platform and hence students shall attend the tutorial classes with laptop/tab - All assessments shall be conducted through online learning platform			
Textbook(s): R S Agarwal, <i>Quantitative Aptitude for Competitive Examinations</i>, 3rd ed., New Delhi: S. Chand Publications, 2019. (Chapters 1,6,7,8,10,11,12,15,17,21,22,30,31 - for Unit I & II) R S Agarwal, <i>A Modern Approach to Verbal and Non-Verbal Reasoning</i>, 3rd ed., New Delhi: S. Chand Publications, 2019. (Chapters Section I: 1,3,4,5,6,8,16, Section II: 2,3 - for Unit III & IV)			
Reference Book(s): Dinesh Khattar, <i>Quantitative Aptitude for Competitive Examinations</i>, 1st ed., New Delhi: Pearson India, 2019. Nishit K Sinha, <i>Reasoning for Competitive Examinations</i>, 1st ed., New Delhi: Pearson India, 2019. R. N. Thakur, <i>General Intelligence and Reasoning</i>, 1st ed., New Delhi: McGraw Hill Education, 2017.			

Course Articulation Matrix (CAM):				U24VA306A QUANTITATIVE APTITUDE AND LOGICAL REASONING										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA306A .1	1	2	-	1	-	-	-	-	-	-	1	1	-
CO2	U24VA306A.2	1	2	-	1	-	-	-	-	-	-	1	1	-
CO3	U24VA306A.3	-	1	-	2	-	2	-	-	-	-	1	1	-
CO4	U24VA306A.4	-	1	-	2	-	2	-	-	-	-	1	1	-
U24VA306A		1	1.5	-	1.5	-	2	-	-	-	-	1	1	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PRACTICUM - 3

Class: B.Tech. III-Semester	Branch: Common to all branches		
Course Code:	U24EL308	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-0	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on...

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparing well-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

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

- (i). Practicum is a mandatory semester project work.
- (ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)
- (iii). Allotment of Practicum topics for students:
 - o **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24MH101	U24PS102	U24EC103	U24CS104	U24EE105	U24CH106
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053
	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

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

CIRCULAR

Allotment of Practicum topics to students

Section :

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

Note:

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

(Signature of class teacher)

- (iv). *To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.*
- (v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.
- (vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.
- (vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.
- (viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course
- (ix). A sample rubrics for assessment and evaluation of practicum is as follows:

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

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

- (h) **Practicum Topic:** Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.
- (i) **Working Model:** Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

Course Articulation Matrix(CAM):				U24EL308 PRACTICUM-3										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	U24EL308.1	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	U24EL308.2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	U24EL308.3	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	U24EL308.4	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL308		2	2	2	2	2	2	2	2	2	2	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

SOCIAL EMPOWERMENT ACTIVITY - 3/ SELF ACCOMPLISHMENT ACTIVITY - 3 (SEA -3/SAA- 3)

Class: B.Tech. III-Semesters	Branch: Common to all branches		
Course Code:	U24VA309	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-2-2	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on...

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

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

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

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

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

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

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

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

Monitoring SEA/SAA:

- (a) **Nodal units:** The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE) shall act as nodal units for activities listed under SEA/SAA.
- (b) During the semester period, the student has to **acquire requisite knowledge, conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) Knowledge Acquisition & Skilling:

- i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.
- ii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

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

- i. This student-driven Fieldwork allows students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.
- ii. Fieldwork consists of three phases: preparation, the actual activity and feedback.
- iii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**
- iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.
- v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more.
- vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

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

Eminent personalities/ Achievers / Renowned personalities:

- (a). **In case of socially relevant problems/ activities of SEA/SAA:** Eminent personalities/achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities.
- (b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.
- viii. For appointment to interact eminent personalities:** Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction.
- ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork.
- x. **Ethics of fieldwork:** Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged.

- xi. Student is expected to take care of health and Safety practices for fieldwork and travel
- xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.
- xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.
- xiv. **Feedback:** The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.
 - During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.
- (e) **Demonstration / Presentation and Report:** Student after presentation/demonstration of his/her achievements/work shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.
- (f) **Flow process for completion of SEA/SAA course:**
 - xi. **Faculty counsellor approval:** In week (-1), in consultation with faculty counsellor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student
 - xii. **Identification of goals and preparation of action plan:** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.
 - xiii. **Field work:** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.
 - xiv. **Demonstration/ Presentation:** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.
 - xv. **Report writing:** After successful demonstration/presentation, student shall write a 2-3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.
- (g) **Assessment & Evaluation:** There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in

below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

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

Note:

- (f) **Presentation/ Demonstration:** It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.
- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.
- (g) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator*.
- (h) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.
- (i) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she
- a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
 - b. scores a minimum of 40 marks in the CIE of the course
- (j) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Course Learning Outcomes (COs):

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

- CO1:** integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensitivity
- CO2:** interact effectively through written, oral and nonverbal communication with external world in a professional, sensitive and culturally relevant manner
- CO3:** analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensitivity
- CO4:** demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Text / Reference book(s):

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

Course Articulation Matrix (CAM):				U24VA309ZZ SEA-3/ SAA-3										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA309.1	-	-	-	-	-	2	2	2	2	2	2	1	1
CO2	U24VA309.2	-	-	-	-	-	2	2	2	2	2	2	1	1
CO3	U24VA309.3	-	-	-	-	-	2	2	2	2	2	2	1	1
CO4	U24VA309.4	-	-	-	-	-	2	2	2	2	2	2	1	1
U24VA309		-	-	-	-	-	2	2	2	2	2	2	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

Course Code: U24VAXYY(SE/SA)ZZZX represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA - represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

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

EXPERT TALK SERIES- 3

Class: B.Tech. IV -Semester	Branch: Common to all branches		
Course Code:	U24AE310	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-0-1-1	CIE:	100%
Total Number of Teaching Hours:	-	ESE :	-

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on...

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

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

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

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

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

- (a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.
- (b) Learning from industry experts with real-world examples, is important to enhance your educational experience.
- (c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.
- (d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

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

- (e) The answer is Industry **Expert Talk Series (ETS)**. Through ETS, we invite industry experts in different fields to deliver talks and interact with students.
- (f) Through Industry expert talks students get to know so much more that textbooks don't explain.
- (g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.
- (h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses
- (i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.
- (j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.
- (k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

- (l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.
- (m) ETS enhances your learning in many ways for global opportunities for your career.
- (n) All in all, learning from industry experts, is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.
- (o) Salient features of ETS are hereunder:
- (xii) ETS is offered from I semester to VI semester.
 - (xiii) ETS, in any given semester, is treated as one credit course
 - (xiv) Students are required to earn six credits (from I to VI semester)
 - (xv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**
 - (xvi) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.
 - (xvii) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks (10 MCQs/FiBs ; *duration: 10-15 mins*), on the contents covered in the expert talk.
 - (xviii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators**.
 - (xix) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.
 - (xx) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.
 - (xxi) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks
 - (xxii) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).
- (p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

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

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

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

iv. Supplementary Exam:

- (i) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE
- (j) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; *duration: 2Hrs*) on the content covered in ETS lectures.
- (k) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE
- (l) Exam material/resources for supplementary: Recorded videos of ETS arranged for that

semester, which shall be made available on ETS webpage of institute website

Course Learning Outcomes (COs):

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

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

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

CO3:	interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects
CO4:	demonstrate the generic competencies in making a well-documented report portraying

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

Course Articulation Matrix (CAM):				U24AE310 EXPERT TALK SERIES - 3										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24AE310.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	U24AE310.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	U24AE310.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	U24AE310.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE310		1	1	1	1	1	1	2	1	2	1	2	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

IV SEMESTER (STREAM -II)(URR24)

Sl. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	
1	PCC	U24CE401	Fluid Mechanics	2	1	-	3	3
2	PCC	U24CE402	Concrete Technology	2	1	-	3	3
3	PCC	U24CE403	Theory of Structures	2	1	-	3	3
4	PCC	U24CE404	Engineering Hydrology	2	1	-	3	3
5	PCC	U24CE405	Soil Mechanics	2	1	-	3	3
6	VAC	U24VA406B	Soft and Interpersonal Skills	-	-	2	2	1
7	PCC	U24CE407	Fluid Mechanics Lab	-	-	2	2	1
8	PCC	U24CE408	Concrete Technology Lab	-	-	2	2	1
9	PCC	U24CE409	Soil Mechanics Lab	-	-	2	2	1
10	PCC	U24CE410	Advanced Surveying Lab	-	-	2	2	1
11	VAC*	U24CH411*	Environmental Studies*	2*	1*	-	-	-
Total:				12	5	8	25	20
Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)								

*For Lateral Entry Students Only

Exit Option to Qualify UG Diploma in CE: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24CE412X	Transportation Engineering	2	-	2	-	4	3
2	PCC	U24CE413X	Environmental Engineering	2	-	2	-	4	3
3	PCC	U24CE414X	Design of Reinforced Concrete Structures	2	-	2	-	4	3
4	PCC	U24CE415X	Any other course approved by BoS Chair and Dean AA	2	-	2	-	4	3

(OR)

Any two suitable skill based courses to qualify for Diploma.

Exit Option to Qualify UG Diploma in CE: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE413X	Certificate Course in Civil Structure https://www.citdindia.org/images/pdf/UPDATED-CAD-CAM-CAE-COURSES-DETAILS.pdf	-	-	6	-	6	3
2	SEC	U24SE414X	3DS MAX&REVIT STRUCTURE https://www.citdindia.org/images/pdf/UPDATED-CAD-CAM-CAE-COURSES-DETAILS.pdf	-	-	6	-	6	3
3	SEC	U24SE415X	Highway Works Supervisor https://nac.edu.in/long-term-courses/	-	-	6	-	6	3
4	SEC	U24SE416X	Training in DGPS http://www.geoinstituteoftechnologies.in/land-survey-courses-in-hyderabad	-	-	6	-	6	3
5	SEC	U24SE417X	Any other skill based course approved by BoS Chair and DeanAA	-	-	6	-	6	3

FLUID MECHANICS			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE401	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 various fluid properties and apply pressure measurement CO2 : analyze stability of floating bodies, classify fluid flows and apply continuity equation CO3 : apply Bernoulli's equation and dimensional analysis based on pressure and velocity CO4 : estimate the major and minor losses in pipes and summarize laminar flow			
UNIT-I			9 Hrs
Fluid fundamentals: Classifications of fluids, Fluid properties, Density, Specific weight, Specific gravity, Specific volume, Viscosity, Capillarity, Vapor pressure, Compressibility, Surface tension, Cohesion and adhesion Fluid statics: Pascal's Law, Hydrostatic Law, Measurement of pressure, Atmospheric pressure, Gauge pressure, Absolute pressure, Principle of manometers, Piezometer, U-tube differential manometer, Inverted differential manometer			
UNIT-II			9 Hrs
Hydrostatic forces on surfaces: Hydrostatic forces on submerged plane and curved surfaces, Total pressure and center of pressure, Buoyancy and floatation, Metacenter, Stability of floating and submerged bodies Fluid kinematics: Classification of fluid flow, Streamline, Path line, Streak line, Stream tube, Velocity potential and Stream function acceleration of fluid particle, Continuity equation in one-, two- and three-dimensional flows			
UNIT-III			9 Hrs
Fluid dynamics: Forces causing motion, Bernoulli's equation, Applications of Bernoulli's theorem, Venturimeter, Orificemeter, Orifice, Mouthpiece, Notches and Pitot tube, Linear momentum equation, Application of linear momentum equation to pipe bends Dimensional analysis: Dimension of various physical quantities and dimensional homogeneity, Dimensional analysis by Rayleigh's method and Buckingham's π - theorem, Dimensionless numbers and their consequences in fluid mechanics			
UNIT-IV			9 Hrs
Flow through pipes: Major and minor losses in a pipe, Expressions for head loss, Hydraulic gradient line, Total energy line, Pipes in series and parallel, Equivalent pipe, Power transmission through pipes Laminar flow: Characteristics of laminar flow, Reynold's experiment, Critical Reynold's number, Critical velocity, Steady laminar flow through a circular pipe, Hagen Poiseuille equation			

Textbook(s):

1. P. N. Modi and S. M. Seth, *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, Standard Book House, 21st edition, 2011, New Delhi

- Reference Book(S):**
1. A. K. Jain, *Fluid Mechanics Including Hydraulic Machines*, Khanna Publications, 2010.
 2. L. Victor Streeter and E. Benjamin Wylie, *Fluid Mechanics*, McGraw Hill, 1st Metric edition, 1983, Singapore.
 3. M. Frank White, *Fluid Mechanics*, Tata McGraw Hill, Special Indian edition, 2007, New Delhi.
 4. K. Subramanya, *Theory and Applications of Fluid Mechanics*, Tata McGraw Hill, New Delhi.
 5. C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, *Fluid Mechanics and Machinery*, Oxford University Press, 2010, New York.
 6. R.L. Daugherty, J.B. Franzini and E.J. Finnemore, *Fluid Mechanics with Engineering Applications*, Mc Graw Hill, International Student edition, New Delhi

Web and Video link(s):

1. <https://archive.nptel.ac.in/courses/105/101/105101082/NPTELVideo> Lecture on Fluid Mechanics by Dr. T.I. Eldho, IIT Bombay.
2. <https://archive.nptel.ac.in/courses/105/103/105103095/NPTELVideo> Lecture on Fluid Mechanics by Dr. Subhashisa Dutta, IIT Guwahati.
3. <https://archive.nptel.ac.in/courses/105/103/105103095/NPTELVideo> Lecture on Fluid Mechanics by Dr. N. Sahoo, IIT Guwahati.

Course Articulation Matrix (CAM):				U24CE401: FLUID MECHANICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE401.1	2	1	1	-	1	-	-	-	1	-	1	2	1
CO2	U24CE401.2	2	1	2	1	2	1	-	-	2	1	1	2	1
CO3	U24CE401.3	2	1	2	1	1	-	-	-	2	1	1	2	1
CO4	U24CE401.4	2	1	1	1	1	1	-	-	1	1	1	2	1
U24CE401		2	1	1.50	1	1.25	1	-	-	1.50	1	1	2	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

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	interpret various fluid properties and apply pressure measurement	SDG6	Clean Water and Sanitation	Understanding fluid properties and pressure measurement supports efficient water supply systems, pipeline design, and water resource management.
CO2	analyze stability of floating bodies, classify fluid flows and apply continuity equation	SDG9	Industry, Innovation and Infrastructure	Knowledge of fluid flow and floating body stability contributes to the design of sustainable hydraulic and transportation infrastructure.
CO3	apply Bernoulli's equation and dimensional analysis based on pressure and velocity	SDG11	Sustainable Cities and Communities	Application of flow principles helps in urban water distribution, drainage systems, and smart city infrastructure development.
CO4	estimate the major and minor losses in pipes and summarize laminar flow	SDG6	Clean Water and Sanitation	Pipe flow analysis improves efficiency in water conveyance systems and reduces energy and water losses.

CONCRETE TECHNOLOGY			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE402	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 : investigate constituent materials and behaviour of fresh concrete CO2 : appraise phases in production of concrete and evaluate hardened concrete CO3 : formulate different grades of concrete mixes CO4 : interpret concrete durability and special concrete			
UNIT-I			9 Hrs
Concrete making materials: Concrete making materials, Cement, Oxide and chemical composition of OPC, Hydration of cement: Bogue's compounds, Heat of hydration, Water requirements for hydration, Properties of cement, Tests on cement, Aggregates- classification of aggregates based on size, shape and texture, Properties of aggregates, Grading, Tests on aggregates, Water quality for construction, Admixtures for concrete, IS codal provisions.			
Properties of Fresh Concrete: Workability, Factors affecting workability, Tests on Fresh Concrete, Measurement of workability - Slump, Compaction factor. Segregation and Bleeding. IS codal provisions.			
UNIT-II			9 Hrs
Properties of Hardened concrete: Strength of Concrete – Compression, Split tensile and Flexural, Factors affecting strength, Stress-strain Characteristics, Non-destructive techniques- Rebound hammer, Ultrasonic pulse velocity, IS codal provisions			
Production of concrete: Phases in production of concrete-Batching, Mixing, Transporting and Placing, Compaction of concrete, types of compactions, Curing of concrete – Methods of curing concrete and Finishing.			
UNIT-III			9 Hrs
Proportioning of concrete mixes: Concept of mix design, Variables influencing the concrete mix proportion and their effect on the concrete strength, Statistical quality control of concrete. IS codal provisions			
Design Mixes: Design of concrete mixes using IS code method and ACI method.			
UNIT-IV			9 Hrs
Concrete Durability: Impact of water-cement ratio, Permeability, Shrinkage and Creep, Carbonation, Sorptivity, Chloride attack, Corrosion, Acid attack, Causes of inadequate durability.			
Special concrete: Self compacting concrete (SCC), Geopolymer concrete, Fiber reinforced concrete, Vacuum concrete, Foam concrete.			
Textbook(s): 1. M. S. Shetty, A. K. Jain –Concrete Technology (Theory & Practice), 8th ed., New Delhi, S.			

2. M. L. Gambhir, —Concrete Technology, 5th ed., New Delhi: Tata McGraw-Hill, 2013.

1. A. M. Neville, Properties of Concrete, 5th ed., New Delhi: Mc Graw Hill Publications, 2012.
2. A.R. Santha Kumar —Concrete Technology, 1st ed., Oxford Publishers: 2010.
3. IS 4031 (Part 1-Part 5), 1988): Methods of Physical Tests For Hydraulic Cement, , New Delhi: BIS
4. IS 383 (2016): Specification for Coarse and Fine Aggregates from natural sources for concrete
5. IS 10262 (2019): Guidelines for concrete mix design proportioning, BIS, New Delhi.
6. IS 516 (Part 1/Sec 1): 2021: Hardened Concrete - Methods of Test - Testing of Strength of Hardened Concrete Section 1 Compressive, Flexural and Split Tensile Strength (1st Revision)

1. <https://archive.nptel.ac.in/courses/105/102/105102012/> NPTEL Video Lecture on Civil Engineering -Concrete Technology by Dr. B. Bhattacharjee, IIT Delhi
2. <https://archive.nptel.ac.in/courses/105/106/105106206/> NPTEL Video Lecture on Civil Engineering Basic Construction Materials by Prof. Radhakrishna G. Pillai & Prof. Manu Santhanam, IIT Madras
3. <https://archive.nptel.ac.in/courses/105/102/105102088/> NPTEL Video Lecture on Civil Engineering - Building materials and Construction by Dr. B. Bhattacharjee, IIT Delhi

Course Articulation Matrix (CAM):				U24CE402 CONCRETE TECHNOLOGY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE402.1	3	1	1	1	-	1	1	1	-	1	1	2	1
CO2	U24CE402.2	3	1	1	1	-	1	1	1	1	1	1	2	1
CO3	U24CE402.3	3	2	2	1	-	1	1	1	1	1	1	2	1
CO4	U24CE402.4	3	1	1	1	2	1	1	1	1	1	1	2	1
U24CE402		3	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 The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	investigate constituent materials and behaviour of fresh concrete	SDG 12	Responsible Consumption and Production	The constituent materials and behaviour of fresh concrete play a crucial role in sustainable construction. By incorporating supplementary cementitious materials, recycled aggregates, and efficient water management practices, the concrete industry can significantly contribute to global sustainability objectives..
CO2	appraise phases in production of concrete and evaluate hardened concrete	SDG 12	Responsible Consumption and Production	The constituent materials and behaviour of fresh concrete play a crucial role in sustainable construction. By incorporating supplementary cementitious materials, recycled aggregates, and efficient water management practices, the concrete industry can significantly contribute to global sustainability objectives..
CO3	formulate different grades of concrete mixes	SDG 9	Industry, Innovation & Infrastructure	The formulation of different grades of concrete is essential for achieving desired structural performance, durability, and sustainability. Appropriate mix design optimizes material usage, enhances service life, and reduces environmental impact. The use of supplementary cementitious materials, recycled aggregates, and efficient water management contributes significantly to achieving SDGs related to Innovation & Infrastructure. Therefore, sustainable concrete formulation is a key component of modern eco-friendly construction practices.
CO4	interpret concrete durability and special concrete	SDG 11 -	Sustainable Cities and Communities	sustainable concrete is a key component of modern eco-friendly construction practices in developing Sustainable Cities and Communities.

THEORY OF STRUCTURES			
Class:B.Tech.IV-Semester		Branch:CE	
CourseCode:	U24CE403	Credits:	3
Hours/Week(L-T-P-O-E):	2-1-3-3	CIE:	60(%)
TotalNumberofTeaching Hours:	36Hrs	ESE:	40(%)
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1:examine equilibrium equations for the analysis of indeterminate structures			
CO2:develop net bending moment and shear force diagrams for indeterminate structures			
CO3:analyze the tall structures using approximate analysis for horizontal loads			
CO4:estimatetheinternalforcesinvariousstructuralmembers formovingloads			
UNIT-I		9Hrs	
Slope deflection method-beams: Development of slope-deflection equations, signconvention, analysis of continuous beams with and without sinking of supports. Construction of bending moment diagram, shear force diagrams.			
Slope-deflection method- frames: Rectangular portal frames, frames with and without sidesway for single bay single storey.			
UNIT-II		9Hrs	
Moment distribution method-beams: Distribution and carry-over factors, analysis of continuous beams with and without sinking of supports.			
Moment distribution method - frames: Rectangular portal frames with and without side sway for single bay single storey.			
UNIT-III		9Hrs	
Kani's method - beams: Analysis of statically in determinate beams with and without sinking of support.			
Approximate methods - frames: Approximate analysis of frames using portal method and cantilever method.			
UNIT-IV		9Hrs	
Movin Loads: Maximum bending moment and shear force diagrams for simple beams traversed by single point load, apair of point loads, uniformly distributed load shorter and longerthan the span, series of point loads, absolute maximum bending moment and shear force, enveloping parabola and equivalent UDL.			
Influence Line Diagrams: Influence line diagram for support reaction, bending moment and shear force for simple and over hanging beams, influence line diagrams for through type bridge truss members.			
Text book(s):			
1. S.Ramamrutham and R.Narayan“TheoryofStructures”,11 th ed. Dhanpat Rai,2019.			
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain “Theory of Structures”,13thed. Laxmi Publications, New Delhi,2005.			

Reference Book(s):

1. C.S.Reddy, "Basic Structural Analysis", 19th ed. Tata McGraw Hill Education Pvt., Ltd., New Delhi, 2017.
2. C.K.Wang "Indeterminate Structural Analysis", McGraw Hill Book Co., 2017.
3. Mikus Cirulis, Phil Wicks "Structural Analysis", ICE Publishing, 2014.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc25_ce54/preview NPTEL Video Lecture on "Structural Analysis-I" by Prof. Amit Shaw, IIT Kharagpur
2. <https://nptel.ac.in/courses/105105109> NPTEL Video Lecture on "Structural Analysis II" by Prof. L.S. Ramachandra, Prof. Sudhir Kumar Barai, IIT Kharagpur.

Course Articulation Matrix (CAM):					U24CE403 THEORY OF STRUCTURES									
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24CE403.1	2	2	--	1	1	1	1	1	1	--	1	1	1
CO2	U24CE403.2	2	2	--	1	1	1	1	1	1	--	1	1	1
CO3	U24CE403.3	2	2	--	1	1	1	1	1	1	--	1	1	1
CO4	U24CE403.4	2	2	--	1	1	1	1	1	1	--	1	1	1
	U24CE403	2	2	--	1	1	1	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 equilibrium equations for the analysis of indeterminate structures	SDG9	Industry, Innovation and Infrastructure	Understanding equilibrium of indeterminate structures is foundational to designing resilient civil infrastructure, bridges, and industrial facilities that support sustainable development.
CO2	develop net bending moment and shear force diagrams for indeterminate structures	SDG9	Industry, Innovation and Infrastructure	Accurate BM and SF diagrams for indeterminate structures directly enable safe, optimised structural design – critical for sustainable construction of buildings, bridges, and urban infrastructure.
CO3	analyze the tall structures using approximate analysis for horizontal loads	SDG11	Sustainable Cities and Communities	Approximate analysis of tall structures under wind/seismic loads supports the design of disaster-resilient high-rise buildings, contributing to safe and sustainable urban environments.
CO4	estimate the internal forces in various structural members for moving loads	SDG9	Industry, Innovation and Infrastructure	Analysis of moving loads and influence line diagrams is essential for designing safe bridges, crane girders, and transport infrastructure, aligning with sustainable industrial and infrastructure development.

ENGINEERING HYDROLOGY			
Class:B.Tech.IV-Semester		Branch:CivilEngineering	
CourseCode:	U24CE404	Credits:	3
Hours/Week(L-T-P-C):	2-1-0-3	CIE:	60%
TotalNumberofTeachingHours:	36Hrs	ESE:	40%
Course Learning Outcomes (COs) After completion of this course, the students should be able to...			
CO1: describe hydrologic cycle and analyze rainfall data.			
CO2: estimate evaporation, infiltration and runoff.			
CO3: examine characteristics of hydrograph and ground water hydraulics.			
CO4: apply principles of flood routing in reservoirs.			
UNIT-I			9Hrs
Elements of Hydrology: introduction, hydrologic cycle - precipitation, evaporation, evapotranspiration, runoff, water budget, catchment area,water budget equation, application in engineering, sources of hydrological data in india.			
Precipitation and its Measurement: forms of precipitation, types of precipitation, measurement of precipitation-non-recording and recording type of rain gauges-tipping bucket, weighing bucket, natural syphon, rainguage network, estimation of missing precipitation data, errors in measurement, location of rain gauges, mass curve of rainfall, hyetograph, mean precipitation over an area, intensity duration analysis.			
UNIT-II			9Hrs
Evaporation and Evapotranspiration: factors affecting the processes and their estimation, pan evaporation, blaney criddle, hargreaves, penmann and lysimeter methods, methods of reducing evaporation from reservoirs.			
Infiltration and Runoff: factors affecting infiltration, measurements of infiltration, infiltration indices, factors affecting runoff, estimation of runoff from rainfall, flow duration curve and mass curve and their uses.			
UNIT-III			9Hrs
Hydrograph analysis: features of hydrograph, hydrograph separation, unit hydrograph theory, unit hydrographs of different durations, s-curve hydrograph.			
Groundwater: forms of sub surface water, classification of saturated formation, aquifer, aquifer parameters-porosity, specific yield, specific retention, storage coefficient, permeability, hydraulic conductivity, types of aquifers-unconfined and confined aquifers,well hydraulics steady flow, open wells, recuperation tests for yield of open well.			
UNIT-IV			9Hrs
Floods: reservoir routing, establishing storage - discharge relationship, i.s.d method, channel routing-muskingum method, determination of muskingum parameters k and x.			
Design Flood: methods of estimation of design flood empirical formulae, rational method, frequency analysis, gumbel's distribution and unit hydrograph method.			
Textbook(s): 1. P. Jayarami Reddy, <i>A Textbook of Hydrology</i> , Laxmi Publishers, 4 th ed., 2017 ,New Delhi. 2. K. Subramanya, " <i>Engineering Hydrology</i> ", Tata Mc Graw Hill Book Co., 6 th edn., 2024,New Delhi.			
ReferenceBook(s): 1. R. K. Linsley, M. A. Kohler and J. L. Paulus, <i>Hydrology for Engineers</i> , Mc Graw Hill Book Co., 3 rd edn., 1982, New Delhi.			

2. R. S. Varshney, *Engineering Hydrology*, Nemchand Bros., 4th edn., 2012, Roorkee.
3. H. M. Raghunath, *Hydrology*, New Age International Publishers, 3rd edn., 2015, New Delhi.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105103213> Lecture on Engineering Hydrology by Prof. Sreeja Pekkat, IIT Guwahati

Course Articulation Matrix (CAM): U18CE404 ENGINEERING HYDROLOGY														
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	U24CE404.1	2	2	2	1	1	2	1	-	-	1	1	2	1
CO2	U24CE404.2	2	2	2	1	1	2	1	-	-	1	1	2	1
CO3	U24CE404.3	2	2	2	1	1	2	1	-	-	1	1	2	1
CO4	U24CE404.4	2	2	2	1	1	2	1	-	-	1	1	2	1
U24CE404		2	2	2	1	1	2	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	describe hydrologic cycle and analyze rainfall data.	SDG6	Clean Water and Sanitation	Knowledge of hydrologic cycle and rainfall analysis supports sustainable water resource assessment, conservation and management for ensuring water availability and quality.
CO2	estimate evaporation, infiltration and runoff.	SDG13	Climate Action	Estimation of hydrological processes helps in understanding climate variability, water balance and impacts of changing environmental conditions on water resources.
CO3	examine characteristics of hydrograph and ground water hydraulics.	SDG11	Sustainable Cities and Communities	Hydrograph and groundwater studies aid in urban flood management, groundwater sustainability and planning resilient water systems for communities.
CO4	apply principles of flood routing in reservoirs.	SDG9	Industry, Innovation and Infrastructure	Flood routing techniques contribute to the design and operation of efficient reservoirs and hydraulic infrastructure for flood control and water management.

SOILMECHANICS			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE405	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 : integrate the concepts of soil basic properties, classification and permeability. CO2 : analyzing effective stress, seepage behavior and compaction characteristics. CO3 : computing stress distribution and consolidation settlements. CO4 : evaluating the shear strength of soil.			
UNIT-I			9 Hrs
Soil Basic Properties: Soil formation, phase diagram, simple definitions and inter-relationships, index properties, grain size distribution, hydrometer analysis, consistency limits, IS soil classification system. Permeability: concept, darcy law and its limitations, determination of coefficient of permeability, factors affecting permeability of soils, permeability of stratified soils.			
UNIT-II			9 Hrs
Effective Stress and Seepage through Soils: Total stress, effective and neutral stresses, seepage force, flow net, construction of flow net, hydrostatic conditions, quicksand condition. Compaction: Concept, standard and modified Proctor compaction tests, factors affecting compaction, field compaction method, Relative compaction.			
UNIT-III			9 Hrs
Stress distribution: Concept, Boussinesq equations for point, line and circular loads, Westergaard's analysis for point load, Concept and use of pressure bulb, Contact pressure distribution under rigid and flexible footings in sand and clay. Consolidation: Concept, components of total settlement, compressibility, role of stress history, normally consolidated and over consolidated clays, Terzaghi's one dimensional consolidation, computation of settlements.			
UNIT-IV			9 Hrs
Shear strength of Soils: Introduction to normal and shear stresses, Mohr's circle, characteristics of Mohr's circle, Mohr-Coulomb theory, Revised Mohr-Coulomb equation, factors affecting shear strength of soil, critical void ratio Shear Strength Tests: Direct shear test, unconfined compression test, Vane shear test, Tri axial test, Consolidated Drained, Consolidated Undrained and Unconsolidated Undrained shear tests.			
Textbook(s): 1. K. R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers, New Delhi, 9th edn., 2013. 2. B. C. Punmia, Er. Ashok K. Jain, Arun K. Jain, "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd, 17th edition, 2017. 3. C. Venkatramiah, "Geotechnical Engineering", New Age Publications, 2nd edn., 2006.			
Reference Book(S): 1. Gopal Ranjan and A S R Rao, "Basic and Applied Soil Mechanics", New Age			

International Publishers, Revised Second Edition, 2014. 2. Shenbaga R. Kaniraj, “Design Aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill Education Private Limited, New Delhi, 1st edn., 2013. 3. T. W. Lambe and Whiteman, “Soil Mechanics”, New Age Publications, 1st edn., 1969. WebandVideolink(s): 1. https://nptel.ac.in/courses/105105168 soil mechanics/ Geotechnical engineering I,by Prof. Dilip Kumar Baidya IIT Kharagpur. 2. https://nptel.ac.in/courses/105101084 Soil Mechanics, by prof. Dr. B.V.S. Viswanadham IIT Bombay

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| <p>International Publishers, Revised Second Edition, 2014.</p> <p>2. Shenbaga R. Kaniraj, “Design Aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill Education Private Limited, New Delhi, 1st edn., 2013.</p> <p>3. T. W. Lambe and Whiteman, “Soil Mechanics”, New Age Publications, 1st edn., 1969.</p> <p>Web and Video link(s):</p> <p>1. https://nptel.ac.in/courses/105105168 soil mechanics/ Geotechnical engineering I, by Prof. Dilip Kumar Baidya IIT Kharagpur.</p> <p>2. https://nptel.ac.in/courses/105101084 Soil Mechanics, by prof. Dr. B.V.S. Viswanadham IIT Bombay</p> |
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International Publishers, Revised Second Edition, 2014. 2. Shenbaga R. Kaniraj, “Design Aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill Education Private Limited, New Delhi, 1st edn., 2013. 3. T. W. Lambe and Whiteman, “Soil Mechanics”, New Age Publications, 1st edn., 1969. Web and Video link(s): 1. https://nptel.ac.in/courses/105105168 soil mechanics/ Geotechnical engineering I, by Prof. Dilip Kumar Baidya IIT Kharagpur. 2. https://nptel.ac.in/courses/105101084 Soil Mechanics, by prof. Dr. B.V.S. Viswanadham IIT Bombay

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| <p>International Publishers, Revised Second Edition, 2014.</p> <p>2. Shenbaga R. Kaniraj, “Design Aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill Education Private Limited, New Delhi, 1st edn., 2013.</p> <p>3. T. W. Lambe and Whiteman, “Soil Mechanics”, New Age Publications, 1st edn., 1969.</p> <p>WebandVideolink(s):</p> <p>1. https://nptel.ac.in/courses/105105168 soil mechanics/ Geotechnical engineering I,by Prof. Dilip Kumar Baidya IIT Kharagpur.</p> <p>2. https://nptel.ac.in/courses/105101084 Soil Mechanics, by prof. Dr. B.V.S. Viswanadham IIT Bombay</p> |
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Course Articulation Matrix (CAM):				U24CE405: Soil Mechanics										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE405.1	2	2	-	1	-	1	-	-	-	-	1	2	-
CO2	U24CE405.2	2	2	2	1	-	1	-	-	-	-	1	2	-
CO3	U24CE405.3	2	2	2	1	-	1	-	-	-	-	1	2	-
CO4	U24CE405.4	2	2	2	1	-	1	-	-	-	-	1	2	-
U24CE405		2	2	2	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	integrate the concepts of soil basic properties, classification and permeability.	SDG 9	Industry, Innovation & Infrastructure	Integrating the concepts of soil engineering builds long-lasting foundations for resilient infrastructure.
CO2	analyzing effective stress, seepage behavior and compaction characteristics.	SDG 9	Industry, Innovation & Infrastructure	Evaluating effective stress, seepage, and compaction provides the foundational engineering data required to design resilient foundations, embankments, and transport infrastructure.
CO3	computing stress distribution and consolidation settlements.	SDG 9	Industry, Innovation & Infrastructure	Computing stress distribution and consolidation settlements is fundamental to ensuring the structural integrity of large-scale infrastructure. Accurate settlement predictions prevent differential settlement—which causes structural cracking, tilting, or catastrophic failure of buildings, bridges, and highways—thereby ensuring the longevity and safety of resilient infrastructure.
CO4	evaluating the shear strength of soil.	SDG 9	Industry, Innovation & Infrastructure	Evaluating shear strength is the core requirement for determining the bearing capacity of foundations and the stability of retaining walls. Accurate evaluation ensures that infrastructure is built to withstand heavy loads and natural forces, preventing catastrophic structural collapse and ensuring long-term structural resilience.

SOFT AND INTERPERSONAL SKILLS LABORATORY

Class: B.Tech. III & IV Semesters		Branch: Common to all Branches	
Course Code:	U24VA406B	Credits:	1
Hours/Week (L-T-P-O-E):	0-0-2-2	CIE:	100 %
Total Number of Teaching Hours:	24 Hrs	ESE:	-

Course Learning Outcomes (COs):

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

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

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

C03: demonstrate clear & respectful communication, leadership, positive attitude and improve interpersonal relationship by actively participating in group discussions, collaborative tasks & mock interviews

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

LIST OF ACTIVITIES

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

Textbook(s):

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

Course Articulation Matrix (CAM):				U24VA306B SOFT AND INTERPERSONAL SKILLS LABORATORY										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA306B.1	-	-	-	-	-	-	-	2	3	-	1		
CO2	U24VA306B.2	-	-	-	-	-	-	2	3	3	-	1		
CO3	U24VA306B.3	-	-	-	-	-	-	-	2	3	-	1		
CO4	U24VA306B.4	-	-	-	-	-	-	1	2	3	-	1		
U24VA306B		-	-	-	-	-	-	1.5	2.25	3	-	1		
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO-SDG ALIGNMENT MATRIX				
CO	CO Statement The student should be able to	Relevant SDG	SDG Description	Mapping Justification
CO 1	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
CO 2	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
CO 3	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
CO 4	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

FLUID MECHANICS LABORATORY			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE407	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 : calculate flow rates and discharge coefficients using flow measuring devices CO2 : analyze the energy losses in pipe system caused due to major and minor losses using Darcy-Weisbach Equation CO3 : examine theoretical fluid flow principles CO4 : interpret efficiency and performance curves for various hydraulic machines			
LIST OF EXPERIMENTS			
1. Determination of coefficient of discharge for given orifice & mouthpiece 2. Determination of coefficient of discharge for given Venturimeter & Orificemeter 3. Determination of coefficient of discharge for triangular & rectangular Notch 4. Estimate coefficients of various head losses in pipes due to major losses 5. Verification of Bernoulli's theorem 6. Analyze the force exerted by a jet on flat, semi-circular and conical vanes 7. Estimate coefficients of various head losses in pipes due to minor losses (sudden enlargement, sudden contraction and bend) 8. Study the efficiency and performance of Pelton Wheel under varying loads 9. Determination of efficiency of Francis turbine under various heads and flows 10. Study the performance characteristics of Centrifugal pump under various heads and discharges 11. Determination of performance characteristics of submersible pump under varying discharge and head 12. Demonstration of Laminar and Turbulent flow using Reynold's apparatus			
Textbook(s): 1. P. N. Modi and S. M. Seth, <i>Hydraulics and Fluid Mechanics Including Hydraulic Machines</i> , Standard Book House, 21st edition, 2011, New Delhi			
Reference Book(S): 1. A. K. Jain, <i>Fluid Mechanics Including Hydraulic Machines</i> , Khanna Publications, 2010. 2. L. Victor Streeter and E. Benjamin Wylie, <i>Fluid Mechanics</i> , McGraw Hill, 1st Metric edition, 1983, Singapore. 3. M. Frank White, <i>Fluid Mechanics</i> , Tata McGraw Hill, Special Indian edition, 2007, New Delhi. 4. K. Subramanya, <i>Theory and Applications of Fluid Mechanics</i> , Tata McGraw Hill, New Delhi. 5. C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, <i>Fluid Mechanics and Machinery</i> , Oxford University Press, 2010, New York. 6. R.L. Daugherty, J.B. Franzini and E.J. Finnemore, <i>Fluid Mechanics with Engineering Applications</i> , Mc Graw Hill, International Student edition, New Delhi.			
Laboratory Manual (for laboratory component):			

Course Articulation Matrix (CAM):				U24CE407 : FLUID MECHANICS LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE407.1	2	2	-	2	-	-	-	1	1	-	1	2	1
CO2	U24CE407.2	2	2	-	2	-	-	-	1	1	-	1	2	1
CO3	U24CE407.3	2	2	-	2	-	-	-	1	1	-	1	2	1
CO4	U24CE407.4	2	2	-	2	1	-	-	1	1	1	1	2	1
U24CE407		2	2	-	2	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	calculate flow rates and discharge coefficients using flow measuring devices	SDG6	Clean Water and Sanitation	Flow measurement techniques are essential for monitoring and managing water resources effectively.
CO2	analyze the energy losses in pipe system caused due to major and minor losses using Darcy-Weisbach Equation	SDG6	Clean Water and Sanitation	Minimizing hydraulic losses improves energy efficiency in pumping and fluid transport systems.
CO3	examine theoretical fluid flow principles	SDG9	Industry, Innovation and Infrastructure	Fundamental understanding of fluid mechanics supports innovation in hydraulic structures and engineering systems.
CO4	interpret efficiency and performance curves for various hydraulic machines	SDG9	Industry, Innovation and Infrastructure	Hydraulic machines such as turbines and pumps contribute to efficient energy and water management systems.

CONCRETE TECHNOLOGY LAB			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE408	Credits:	1

Hours/Week (L-T-P- E):	0-0-2-2	CIE:	60%
Total Number of Teaching/Lab Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1: examine laboratory test results of cement for construction CO2 : interpret laboratory test results of fine aggregate and coarse aggregate CO3: evaluate the properties of fresh and hardened concrete CO4: predict quality of concrete using non-destructive testing LIST OF EXPERIMENTS			
1. Determination of fineness and Specific Gravity of Cement. 2. Standard Consistency, Initial and Final Setting Times of cement 3. Compressive Strength of Cement 4. Bulk Density, Specific gravity, Porosity and Void ratio of Fine Aggregate & Coarse Aggregate 5. Fineness Modulus of Fine and Coarse Aggregates 6. Bulking of Fine Aggregate 7. Workability of fresh concrete- (i) Slump test (ii) Compaction factor test 8. Compressive Strength of Concrete 9. Split tensile strength of concrete 10. Modulus of rupture of concrete 11. Carbonation of concrete 12. Non- Destructive Testing of Concrete			
Textbook(s): 1. M. S. Shetty, A. K. Jain —Concrete Technology (Theory of Practice), 8th ed., New Delhi, S. Chand Company, 2019. 2. M. L. Gambhir, —Concrete Technology, 5th ed., New Delhi: Tata McGraw-Hill, 2013			
Reference Book(S): 1. A. M. Neville, Properties of Concrete, 5th ed., New Delhi: Mc Graw Hill Publications, 2012. 2. A.R. Santha Kumar —Concrete Technology, 1st ed., Oxford Publishers: 2010. 3. IS 4031 (Part 1-Part 5), 1988: Methods of Physical Tests For Hydraulic Cement, , New Delhi: BIS 4. IS 383 (2016): Specification for Coarse and Fine Aggregates from natural sources for concrete 5. IS 10262 (2019): Guidelines for concrete mix design proportioning, BIS, New Delhi. 6. IS 516 (Part 1/Sec 1): 2021: Hardened Concrete - Methods of Test - Testing of Strength of Hardened Concrete Section 1 Compressive, Flexural and Split Tensile Strength (1st Revision)			
Laboratory Manual (for laboratory component): 1. Concrete technology laboratory manual record book (LMRB) prepared by CED, KITSW			

Course Articulation Matrix (CAM):			U24CE408: CONCRETE TECHNOLOGY LABORATORY											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	

Course Articulation Matrix (CAM):				U24CE408: CONCRETE TECHNOLOGY LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE408.1	3	1	1	1	-	1	1	1	2	1	1	2	1
CO2	U24CE408.2	3	2	2	1	-	1	1	1	2	1	1	2	1
CO3	U24CE408.3	3	1	1	1	-	1	1	1	2	1	1	2	1
CO4	U24CE408.4	3	1	1	1	2	1	1	1	2	1	1	2	1
U24CE408		3	1.25	1.25	1	2	1	1	1	2	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	examine laboratory test results of cement for construction	SDG 11	Sustainable Cities and Communities	Proper cement quality control helps construct safe buildings, roads, bridges, and housing. Also reduces risk of structural failures and improves urban sustainability.
CO2	interpret laboratory test results of fine aggregate and coarse aggregate	SDG 12	Responsible Consumption and Production	Proper testing prevents use of poor-quality aggregates and minimizes material wastage, encouraging efficient utilization of natural resources in construction.
CO3	evaluate the properties of fresh and hardened concrete	SDG 13	Climate Action	Optimizing concrete properties can reduce cement consumption and carbon emissions, which promotes use of sustainable concrete materials such as fly ash and slag.
CO4	predict quality of concrete using non-destructive testing	SDG 9	Industry, Innovation and Infrastructure	NDT methods help assess the strength, durability, and safety of structures without damaging them. Supports maintenance and development of reliable and resilient infrastructure.

SOILMECHANICSLABORATORY			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE409	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)

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

CO1 : evaluate soil properties and permeability characteristics

CO2 : analyze compaction characteristics of soils

CO3 : evaluate consolidation settlements in soils

CO4 : evaluate shear strength behavior of soils and predict failure conditions

LIST OF EXPERIMENTS

1. Determination of In-situ Density by: a) Core cutter method b) Sand replacement method
2. Determination of Specific Gravity of Soil Solids
3. Determination of Particle size distribution of soil by Sieve Analysis
4. Determination of Consistency/ Atterberg Limits for given soil sample, namely:
(a) Liquid limit (b) Plastic limit (c) Shrinkage limit
5. Determination of Coefficient of Permeability using: a) Constant head method
b) Falling head method
6. Determination of Optimum Moisture Content (OMC) and Maximum Dry Density (MDD)
using: a) IS light compaction test b) IS heavy compaction test
7. Determination of Shear strength parameters of Soil using Direct Shear Test
8. Determination of Unconfined Compressive strength of Cohesive soils
9. Determination of Coefficient of Consolidation of cohesive soils using one-dimensional consolidation test.
10. Determination of Minimum, Maximum and Relative Densities of Cohesionless soil.
11. Determination of Differential Free Swell.
12. Demonstration of Hydrometer Analysis for Fine Grained Soils
13. Demonstration of Standard penetration test.
(a) Demonstration of Vane shear test (b) Tri-Axial Shear test
14. Demonstration of Plate load test.

Textbook(s):

1. K. R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers, New Delhi, 9th edn., 2013.
2. B. C. Punmia, Er. Ashok K. Jain, Arun K. Jain, "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd, 17th edition, 2017.
3. C. Venkatramaiah, "Geotechnical Engineering", New Age Publications, 2nd edn., 2006.

Reference Book(S):

1. Gopal Ranjan and A S R Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, Revised Second Edition, 2014.
2. Shenbaga R. Kaniraj, "Design Aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill Education Private Limited, New Delhi, 1st edn., 2013.
3. T. W. Lambe and Whitman, "Soil Mechanics", New Age Publications, 1st edn., 1969.

Course Articulation Matrix (CAM):				U24CE408: SOIL MECHANICS LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE408.1	2	2	-	1	-	1	-	-	-	-	1	2	-
CO2	U24CE408.2	2	2	2	1	-	1	-	-	-	-	1	2	-
CO3	U24CE408.3	2	2	2	1	-	1	-	-	-	-	1	2	-
CO4	U24CE408.4	2	2	2	1	-	1	-	-	-	-	1	2	-

Course Articulation Matrix (CAM):			U24CE408: SOIL MECHANICS LABORATORY										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
U24CE408		2	2	2	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	evaluate soil properties and permeability characteristics	SDG 11	Sustainable cities and communities	Basic soil properties (like grain size distribution, Atterberg limits, and moisture content) combined with permeability characteristics dictate how soil responds to heavy rainfall and flooding. Properly evaluating these traits enables the design of resilient urban drainage systems, permeable pavements, and flood-protection dikes, reducing disaster risks in vulnerable urban settlements.
CO2	analyze compaction characteristics of soils	SDG 9	Industry, Innovation & Infrastructure	Evaluating compaction characteristics provides the foundational engineering data required to design resilient foundations, embankments, and transport infrastructure.
CO3	Evaluate consolidation settlements in soils.	SDG 9	Industry, Innovation & Infrastructure	Computing consolidation settlements is fundamental to ensuring the structural integrity of large-scale infrastructure. Accurate settlement predictions prevent differential settlement—which causes structural cracking, tilting, or catastrophic failure of buildings, bridges, and highways—thereby ensuring the longevity and safety of resilient infrastructure.
CO4	evaluate shear strength behavior of soils and predict failure conditions	SDG 9	Industry, Innovation & Infrastructure	Evaluating shear strength is the core requirement for determining the bearing capacity of foundations and the stability of retaining walls. Accurate evaluation ensures that infrastructure is built to withstand heavy loads and natural forces, preventing catastrophic structural collapse and ensuring long-term structural resilience.

ADVANCED SURVEYING LABORATORY			
Class: B. Tech. IV – Semester		Branch: CE	
Course Code:	U24CE410	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 : apply advanced levelling techniques to determine reduced levels and elevation differences under field conditions.			
CO2 : illustrate curve setting, traversing, and analyze Total Station survey data in engineering applications.			
CO3 : evaluate survey parameters using Total Station for area, elevation, gradient, volume and land parcel determination.			
CO4 : create topographic maps and survey outputs by processing Total Station data			
List of Experiments			
1. Fly Levelling with inverted benchmark using digital theodolite.			
2. Differential Levelling with inverted staff readings using digital theodolite.			
3. Setting out compound curve by Rankine's deflection angle method using Theodolite/ Total Station.			
4. Determination of an Omitted Survey Line in a Closed Traverse using Theodolite/ Total Station.			
5. Determination of lengths and directions of consecutive survey lines using total station			
6. Determination of Area of an Irregular Plot Using Coordinate Method			
7. Determination of elevation of remote object using total station.			
8. Determine the gradient and distance between two inaccessible points using Totalstation.			
9. Computation of Earthwork Volume for road/canalsection Using Total Station/Theodolite.			
10. Traversingusing Total Station.			
11. Preparation of Topographic Map Using Total Station Data and AutoCAD.			
12. Demonstration ofDifferential Global Positioning System(DGPS) and its basic field operations.			
<u>Textbook(s):</u>			
1. B.C. Punmia& Ashok kumar Jain, "SurveyingVolume I, II and III", Laxmi Publications,17 th edn.,2016			
<u>Reference Book(S):</u>			
1. S.K. Duggal, "SurveyingVolume1 and II", McGraw Hill Education (India)Pvt.Ltd,2013.			
2. K.R. Arora, "SurveyingVolume I and II", Standard Book House,15 th edn.,2015.			
3. T.P. Kanetker and S.V. Kulkarni, "Surveying and LevellingVolume I and II", PuneVidyarthiGriha Prakashan, 24 th edn.,2014.			
4. 3. R. Subramanian, "Surveying and Levelling", Oxford University Press, New Delhi, 2 nd edn.2007.			
5. R.Agor, "A Textbook of Surveying and Levelling", Khanna Publisher,12 th edn.,2016.			

Laboratory Manual:1. *Advanced Surveying Laboratory Manual*, Department of CE KITSW

Course Articulation Matrix (CAM):				U24CE410 : ADVANCED SURVEYING LAB										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE410 .1	2	2	2	1	2	1	1	1	1	-	-	2	2
CO2	U24CE410 .2	2	2	2	2	2	1	1	1	1	-	2	2	2
CO3	U24CE410 .3	2	2	2	2	2	1	1	1	1	-	2	2	2
CO4	U24CE410 .4	2	2	3	3	3	1	1	1	1	-	2	2	2
U24CE410		2	2	2.25	2	2.25	1	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	Apply advanced levelling techniques to determine reduced levels and elevation differences under field conditions.	SDG 11	Sustainable Cities and Communities	Advanced levelling techniques support sustainable urban planning, drainage systems, transportation networks, and infrastructure development through accurate elevation analysis.
CO2	Illustrate curve setting, traversing, and analyze Total Station survey data in engineering applications.	SDG 9	Industry, Innovation and Infrastructure	Total Station surveying and traversing techniques contribute to precise infrastructure planning, transportation alignment, and modern engineering construction practices.
CO3	Evaluate field survey parameters using Total Station for determination of area, elevations, gradients, and land parcel details in engineering surveying applications	SDG 13	Climate Action	Survey-based evaluation of terrain, gradients, and elevations supports climate-resilient infrastructure planning, flood risk assessment, and sustainable land management.
CO4	Create topographic maps and survey outputs by processing Total Station data using modern surveying and drafting tools.	SDG 9	Industry, Innovation and Infrastructure	Topographic mapping and DGPS-based surveying enhance smart infrastructure development, digital mapping, and sustainable engineering decision-making.

ENVIRONMENTAL STUDIES			
Class: B.Tech. IV Semester		Branch: Common to ME, CE, CSM, CSD, IT, CSN & CSO	
Course Code:	U24CY411	Credits:	0
Hours/Week(L-T-P-O-E):	2-1-0-2-5	CIE:	60%
Total Number of Teaching Hours:	24 Hrs	ESE:	40%
Course Learning Objectives (LOs): <i>This course will develop students' knowledge in /on...</i> LO1: natural resources and their usage more equitably LO2: eco system and the importance of bio diversity conservation LO3: environmental pollution and its control measures LO4: environmental legislation and green methodology			
UNIT-I		UNIT-I	
The Multi disciplinary 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		UNIT-II	
Eco system 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)	
Text book(s): 1. Erach Bharucha, <i>Text Book of Environmental Studies for Under Graduate Courses</i>, 2nd ed., 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 ed., Prentice Hall of India, 1991 3. Anubha Kaushik, C.P. Kaushik, <i>Environmental Studies</i>, 4th ed., New Age International Publishers, 2014 4. R. Rajagopalan, <i>Environmental Studies from crisis to cure</i>, Oxford University Press, 2nd ed., 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):					U24CY411: ENVIRONMENTAL STUDIES									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CY411.1	2	1	2	1	-	2	1	1	1	-	-	-	-
CO2	U24CY411.2	-	-	2	-	-	1	1	1	1	1	-	-	-
CO3	U24CY411.3	1	2	1	-	-	1	1	1	1	1	1	-	-
CO4	U24CY411.4	-	-	1	-	-	1	1	1	1	-	1	-	-
U24CY411		1.50	1.50	1.50	1	-	1.25	1	1	1	1	1	-	-
3-HIGH, 2-MEDIUM, 1-LOW														

TRANSPORTATION ENGINEERING			
Class: B. Tech. IV – Semester(Exit)		Branch: CE	
Course Code:	U24CE412X	Credits:	3
Hours/Week (L-T-P- E):	2-0-2-4	CIE:	60%
Total Number of Teaching Hours:	16 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : Analyse the engineering surveys required for highway alignment			
CO2 : design highway geometric elements as per IRC standards.			
CO3 : interpret traffic flow characteristics through traffic studies.			
CO4 : Design road intersection using IRC method			
CO5 : Analyse the traffic calming measures through traffic control device inventory studies			
CO6 : Evaluate the minim sight distance required for given road.			
CO7 : Determine peak hour volume through traffic studies.			
CO8 : Determine peak hour factor for given intersection and design the intersection.			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Highway Development: History of road construction, road development in India, planning surveys and their interpretation, highway alignment, and engineering surveys required for alignment.			
UNIT-II		4 Hrs	
Geometric Design of Highway: Cross-section elements, sight distances-Stopping Sight Distance [SSD], Overtaking Sight Distance [OSD], and Intermediate Sight Distance [ISD]. Design of horizontal alignment-design speed, horizontal curves, super-elevation, radius of horizontal curves, pavement widening, and transition curves. Design of vertical alignment - gradients and vertical curves.			
UNIT-III		4 Hrs	
Traffic Stream Characteristics and Traffic Surveys: Fundamental parameters of traffic flow-volume, speed, and density and their macroscopic relationships. Traffic capacity limits and Level of Service (LOS) criteria based on mixed-traffic environments. Traffic volume studies, spot speed studies, origin-destination surveys, and time-and-delay studies (field methodologies and data representation formats).			
UNIT-IV		4 Hrs	
Intersection Design: Road traffic accident terminology, causative factors (driver, infrastructure, environment), and collision countermeasures. Types of at-grade junctions; Warrants for signalization. Structural design of isolated traffic signals using Webster’s Method and IRC multi-phase approaches.			

LABORATORY COMPONENT
1. Identification, classification and recording of Traffic control devices along a survey route during off-peak hours 2. Determination of minimum sight distance based on the posted speed on the given major road 3. Determination of peak hour volume through traffic volume studies 4. Determination of traffic speed through speed studies 5. Determination of Peak Hour Factor at an intersection. 6. Demonstration on travel times and delay along different routes with same origin and destination 7. Demonstration on Design of 4-legged rotary intersection.
<u>Textbook(s):</u> 1. S. K. Khanna, C. E. G. Justo, A. Veeraraghavan, <i>Highway Engineering</i>, 10th ed., Roorkee: Nem Chand & Bros, 2022.
<u>Reference Book(S):</u> 1. Murthy, A.S.N., and Mohle, H.R. (1993). <i>Transportation Engineering Basics</i> 2ND ed., Horizon Publishing, Los Angeles, CA.
<u>Web and Video link(s):</u> https://nptel.ac.in/courses/105107220 ; NPTEL Video Lecture on Geometric Design of Highways, by Prof. Rajat Rastogi, IIT Roorkee
<u>Laboratory Manual (for laboratory component):</u> <i>"Highway Engineering Laboratory Manual"</i> , Department of Civil Engineering, KITSW.

Course Articulation Matrix (CAM):				U24CE412X: Transportation Engineering										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE412X.1	3	3	3	1	-	-	-	-	-	-	-	3	-
CO2	U24CE412X.2	3	3	3	2	-	2	-	-	-	-	-	3	2
CO3	U24CE412X.3	3	3	3	2	-	-	-	-	-	-	-	3	3
CO4	U24CE412X.4	2	3	2	3	-	-	-	-	-	-	-	2	3
CO5	U24CE412X.5	3	2	-	3	-	-	-	-	-	-	1	3	-
CO6	U24CE412X.6	3	2	-	3	-	-	-	-	-	-	1	3	-
CO7	U24CE412X.7	3	3	3	3	-	-	-	-	-	-	1	3	2
CO8	U24CE412X.8	3	3	2	3	-	2	-	-	2	-	1	3	3
U24CE412X		3	2.5	2.5	3	0	2	0	0	2.25	1.25	0	3	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	Analyse the engineering surveys required for highway alignment	SDG9	Industry, Innovation and Infrastructure	Scientific highway planning allows for the creation of high quality regional infrastructure capable of transporting different goods and people.
CO2	design highway geometric elements as per IRC standards.	SDG3	Good Health and well being	Designing adequate sight distances (stopping, overtaking, and intermediate sight distances), choosing correct horizontal radii, and calculating proper super-elevation directly reduce road traffic accidents. This aligns with global targets to halve road traffic injuries and fatalities.
CO3	interpret traffic flow characteristics through traffic studies.	SDG11	Sustainable cities and communities.	It provides smooth, accessible, and efficient transport systems within expanding metropolitan areas.
CO4	Design road intersection using IRC method	SDG11	Sustainable cities and communities.	Managing traffic capacity and Level of Service (LOS) using Webster or IRC signal design reduces urban congestion. It provides smooth, accessible, and efficient transport systems within expanding metropolitan areas.
CO5	Analyse the traffic calming measures through traffic control device inventory studies	SDG11	Sustainable cities and communities.	It provides smooth, accessible, and efficient transport systems within expanding metropolitan areas.
CO6	Evaluate the minim sight distance required for given road.	SDG3	Good Health and well being	Designing adequate sight distances (stopping, overtaking, and intermediate sight distances), choosing correct horizontal radii, and calculating proper super-elevation directly reduce road traffic accidents. This aligns with global targets to halve road traffic injuries and fatalities.
CO7	Determine peak hour volume through traffic studies.	SDG11	Sustainable cities and communities.	It provides smooth, accessible, and efficient transport systems within expanding metropolitan areas.
CO8	Determine peak hour factor for given intersection and design the intersection.	SDG11	Sustainable Cities & Communities	Analyzing peak traffic and speeds provides the data needed to prevent congestion, improve road safety, and design more efficient city transport.

ENVIRONMENTAL ENGINEERING			
Class: B. Tech. IV – Semester(Exit)		Branch: CE	
Course Code:	U24CE413X	Credits:	3
Hours/Week (L-T-P- E):	2-0-2-4	CIE:	60%
Total Number of Teaching Hours:	16 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i>			
CO1 : analyse problems related to water quality and quantity			
CO2 : apply methods for purification of water and design water distribution systems			
CO3 : analyse and design the sewage systems			
CO4 : apply methods for purification and disposal of sewage			
CO5 : assess the quality of water for suspended matter			
CO6 : evaluate hardness and chloride content of the water samples			
CO7 : estimate dissolved oxygen concentration in water sample			
CO8 : determine the concentration of degradable organic matter			
THEORY COMPONENT			
UNIT-I		4 Hrs	
Water Demand: types of water demand, per capita demand, factors affecting per-capita demand, design period, population forecasting methods, fire demand.			
Water Quality Parameters: physical, chemical and biological characteristics of water quality, waterborne diseases and their control, quality standards for municipal supplies.			
UNIT-II		4 Hrs	
Water Treatment Process: screening, plain sedimentation, sedimentation aided with coagulation, filtration, disinfection, softening, aeration.			
Water Distribution System: layouts of distribution networks, methods of supply, systems of supply, design of distribution networks, appurtenances in distribution system.			
UNIT-III		4 Hrs	
Sewage Characteristics: physical, chemical and biological characteristics of sewage, bio-chemical oxygen demand and dissolved oxygen, sewerage systems, estimation of dry weather flow, estimation of storm water flow.			
Sewerage System Design: hydraulic design of sewer, hydraulic formulae for design of sewers, minimum and maximum velocity of flow.			
UNIT-IV		4 Hrs	
Sewage Treatment Process: primary treatment, theory and design of screens, grit chamber, skimming tanks, sedimentation tanks.			
Secondary Treatment of Sewage: activated sludge process, sewage filtration, treatment and disposal of sludge, on-site disposal methods (land and water body).			

LABORATORY COMPONENT
- Determination of pH and Alkalinity of water sample - Determination of Acidity of water sample - Determination of Total Solids, Total dissolved solids and Suspended solids of water sample - Determination of Temporary and Permanent Hardness of water sample - Determination of Chloride content of water sample - Determination of Dissolved Oxygen of water sample - Determination of Biological Oxygen Demand of water sample - Determination of Chemical Oxygen Demand of water sample
<u>Textbook(s):</u> P. N. Modi, <i>Water Supply Engineering – Environmental Engineering–I</i>, Standard Book House, 7th edition, 2021, New Delhi. P. N. Modi, <i>Sewage Treatment Disposal and Waste Water Engineering – Environmental Engineering–II</i>, Standard Book House, 17th edition, 2020, New Delhi.
<u>Reference Book(S):</u> - Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, <i>Environmental Engineering</i>, McGraw-Hill International Edition, 1st edition, 1985, New Delhi. B. C. Punmia, A. K. Jain and Arun Kumar Jain, <i>Water Supply Engineering – Environmental Engineering–I</i>, Laxmi Publications, 2nd edition, 2022, New Delhi. B. C. Punmia, A. K. Jain and Arun Kumar Jain, <i>Wastewater Engineering – Environmental Engineering–II</i>, Laxmi Publications, 2nd edition, 2016, New Delhi. - Metcalf and Eddy, <i>Wastewater Engineering: Treatment and Resource Recovery</i>, McGraw-Hill Education, 5th edition, 2014, New Delhi.
<u>Web and Video link(s):</u> https://archive.nptel.ac.in/courses/105/105/105105201/ NPTEL Video Lecture on Water Supply Engineering by Prof. Manoj Kumar Tiwari, IIT Kharagpur. https://nptel.ac.in/courses/105106119 NPTEL Video Lecture on Water & Wastewater Quantity by Prof. C. Venkobachar, Prof. Ligy Philip, Prof. B. S. Murthy, IIT Madras.
<u>Laboratory Manual (for laboratory component):</u> <i>"Environmental Engineering Laboratory Manual"</i>, Department of Civil Engineering, KITSW.

Course Articulation Matrix (CAM):				U24CE412X: Environmental Engineering										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE412X.1	2	1	1	1	1	1	-	1	1	-	1	1	2
CO2	U24CE412X.2	2	1	1	1	1	1	-	1	1	-	1	1	2
CO3	U24CE412X.3	2	1	1	1	1	1	-	1	1	-	1	1	2
CO4	U24CE412X.4	2	1	1	1	1	1	-	1	1	-	1	1	2
CO5	U24CE412X.5	2	2	-	2	1	1	-	1	1	-	1	2	1
CO6	U24CE412X.6	2	2	-	2	1	1	-	1	1	-	1	2	1
CO7	U24CE412X.7	2	2	-	2	1	1	-	1	1	-	1	2	1
CO8	U24CE412X.8	2	2	-	2	1	1	-	1	1	-	1	2	1
U24CE412X		2	1	1	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	analyse problems related to water quality and quantity	SDG6	Clean Water and Sanitation	Analysing water quality and quantity problems directly supports sustainable water resource management, safe drinking water availability, and efficient utilization of water resources.
CO2	apply methods for purification of water and design water distribution systems	SDG9	Industry, Innovation and Infrastructure	Application of water purification methods and design of water distribution systems contributes to providing safe and reliable drinking water supply to communities.
CO3	analyse and design the sewage systems	SDG11	Sustainable Cities and Communities	Analysis and design of sewage systems help improve sanitation infrastructure, reduce environmental pollution, and promote public health protection.
CO4	apply methods for purification and disposal of sewage	SDG6	Clean Water and Sanitation	Applying sewage purification and disposal methods supports wastewater treatment, environmental sustainability, pollution control, and safe sanitation practices.
CO5	assess the quality of water for suspended matter	SDG6	Clean Water and Sanitation	Assessing suspended matter in water helps in monitoring water quality and ensuring safe and clean water for domestic and environmental purposes.
CO6	evaluate hardness and chloride content of the water samples	SDG6	Clean Water and Sanitation	Evaluating hardness and chloride content supports water quality assessment and helps maintain potable water standards and sustainable water management.
CO7	estimate dissolved oxygen concentration in water sample	SDG6	Clean Water and Sanitation	Estimating dissolved oxygen concentration is essential for assessing aquatic ecosystem health and monitoring pollution levels in water bodies.
CO8	determine the concentration of degradable organic matter	SDG6	Clean Water and Sanitation	Determining degradable organic matter concentration aids in evaluating wastewater pollution and improving sewage treatment and environmental protection practices.

DESIGN OF REINFORCED CONCRETE STRUCTURES

Class: B. Tech. IV – Semester (Exit)		Branch: CE	
Course Code:	U24CE414X	Credits:	3
Hours/Week (L-T-P- E):	2-0-2-4	CIE:	60%
Total Number of Teaching Hours:	16 Hrs	ESE:	40%

Course Learning Outcomes (COs)

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

- CO1:** compare the design philosophies of limit state method and its application in flexure
- CO2:** determine the capacities of RCC sections in shear, torsion and their serviceability.
- CO3:** design of one-way, two-way slabs and axially loaded columns.
- CO4:** analyse footings and review the working stress method
- CO5:** compile the structural detailing of R.C.C. beams
- CO6:** develop the detailing plan of various types of slabs
- CO7:** assess the philosophies in designing various types of columns
- CO8:** assess the philosophies in designing various types of footings

THEORY COMPONENT

UNIT-I	4 Hrs
Limit state of collapse in flexure: Introduction, loads on structures, design philosophies, code of practice, Analysis and design of beams, singly, doubly reinforced rectangular and T-beams, IS codal provisions.	
UNIT-II	4 Hrs
Slabs: Loads and their distribution, design of one way simply supported, continuous slabs and two-way slabs, IS Codal provisions.	
UNIT-III	4 Hrs
Short columns: Axially loaded rectangular columns, circular columns with lateral ties and helical reinforcement, interaction curves, design for uni-axial bending moment, IS Codal provisions.	
UNIT-IV	4 Hrs
Footings: Types of footings, design of isolated footing for axially loaded columns, design of combined footing, IS Codal provisions.	

LABORATORY COMPONENT

- Drafting of reinforcement details for R.C.C Simply Supported Beam
- Drafting of reinforcement details for R.C.C Continuous Beam/ Cantilever Beam
- Drafting of reinforcement details for R.C.C Slabs
- Drafting of reinforcement details for R.C.C Tied Column
- Drafting of reinforcement details for R.C.C Spirally Reinforced Column
- Drafting of reinforcement details for R.C.C Isolated Footing/ Combined Footing
- Drafting of reinforcement details for shear reinforcement in R.C.C beams

Textbook(s):

- A. K Jain, "Limit State Design", NemChand Brothers, 7thedn., 2012. Roorkee.

Reference Book(S):

1. S. UnniKrishnaPillai and DevdasMenon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 3rdedn, 2011. New Delhi.
2. B.C. Punmia, "Reinforced Concrete Structures", Laxmi Publishing Company, 8thedn. 2012, New Delhi.
3. Jai Krishna and O. P. Jain, "Plain and Reinforced Concrete", NemChand Brothers, , 8thedn. 2012. Roorkee.
4. IS: 456, "Code of practice for Plain and reinforced concrete", Bureau of Indian standards, New Delhi.
5. IS: 875 (part 1-5), "Code of practice for Design loads", Bureau of Indian standards, NewDelhi.
6. SP:16, "DesignAids for Reinforced Concrete to IS 456, Bureau of Indian standards, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ce03:NPTEL
Concrete Design, By Prof. Arunasis Chakraborty, IIT Guwahati.

Reinforced

Laboratory Manual (for laboratory component):

Structural Detailing laboratory manual, Department of CE, KITSW

Course Articulation Matrix (CAM):				U24CE414X: DESIGN OF REINFORCED CONCRETE -STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE414X.1	1	2	2	-	-	-	1	-	-	-	1	2	1
CO2	U24CE414X.2	1	2	2	-	-	1	1	-	-	-	1	2	1
CO3	U24CE414X.3	1	2	2	-	-	1	1	-	-	-	1	2	1
CO4	U24CE414X.4	1	2	2	-	-	1	1	-	-	-	1	2	1
CO5	U24CE414X.5	2	2	2	2	2	1	1	-	1	-	-	2	2
CO6	U24CE414X.6	2	2	2	2	2	1	1	-	1	-	2	2	2
CO7	U24CE414X.7	2	2	2	2	2	1	1	-	1	-	2	2	2
CO8	U24CE414X.8	2	2	2	3	2	1	1	-	1	-	2	2	2
U24CE414X		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	compare the design philosophies of limit state method and its application in flexure	SD9	Industry, Innovation and Infrastructure	Understanding limit state design philosophy helps students develop safe and efficient structural systems, contributing to resilient and innovative infrastructure design in buildings and public works
CO2	determine the capacities of RCC sections in shear, torsion and their serviceability.	SD9	Industry, Innovation and Infrastructure	Determining the capacities of RCC (Reinforced Cement Concrete) sections in shear, torsion, and serviceability contributes to sustainable infrastructure by ensuring structures are safe, durable, resource-efficient, and resilient
CO3	design of one-way, two-way slabs and axially loaded columns.	SD9	Industry, Innovation and Infrastructure	The design of one-way slabs, two-way slabs, and axially loaded columns Proper structural design ensures safe, durable, resource-efficient, and sustainable infrastructure development.
CO4	analyse footings and review the working stress method	SD9	Industry, Innovation and Infrastructure	Footings are essential structural components that transfer building loads safely to the soil. Proper footing analysis and understanding of structural design methods such as WSM ensure safe, resilient, and long-lasting infrastructure. • Supports durable infrastructure development through sound engineering principles. • Improves structural reliability by analyzing load transfer and soil pressure.
CO5	Compile the structural detailing of R.C.C. beams	SDG 9	Industry, Innovation and Infrastructure	Proper detailing of RCC beams ensures structural safety and durability, contributing to resilient infrastructure development.
CO6	Develop the detailing plan of various types of slabs	SDG 11	Sustainable Cities and Communities	Proper slab detailing ensures building safety for occupants, contributing to safe and resilient communities.
CO7	Assess the philosophies in designing various types of columns, footings and stair case	SDG 12	Responsible Consumption and Production	Optimal design philosophies (LSM vs. WSM) lead to material-efficient structures, reducing waste and promoting responsible resource use.
CO8	Compose working drawings of various types of steel structures	SDG 12	Responsible Consumption and Production	Detailed steel drawings enable accurate material estimation, minimizing waste during fabrication and construction.

V SEMESTER (STREAM -II)(URR24)

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	
1	OE	U24OE501X-SDG	Open Elective -SDGB (Pool - XVI)	2	1	-	3	3
2	PCC	U24CE502	Environmental Engineering	2	1	-	3	3
3	PCC	U24CE503	Highway Engineering	2	1	-	3	3
4	PCC	U24CE504	Design of Reinforced Concrete Structures	2	1	-	3	3
5	PCC	U24CE505	Hydraulics & Hydraulic Machinery	2	1	-	3	3
6	IKSC	U24IK506A	Essence of Indian Traditional Knowledge	2	-	-	2	2
7	PCC	U24CE507	Environmental Engineering Laboratory	-	-	2	2	1
8	PCC	U24CE508	Highway Engineering Laboratory	-	-	2	2	1
9	ELC	U24CE509	Seminar	-	-	2	2	1
Total:				12	5	6	23	20
Additional Learning [@] : Maximum credits allowed for Honours/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				

Sustainable Development Goals Basket (OE-SDGB)		
S.No.	Course Code	Course Title
1.	U24OE501E	Renewable Energy Systems(EED)
2.	U24OE501H	Environment & Climate IoT (CSN)
3.	U24OE501L	Sensors and Actuators for Sustainable Smart Cities and Healthcare (ECIED)
4.	U24OE501Y	Automative Engineering for Sustainable development (MED)
5.	U24OEX01	Any other course approved by BoS Chair and Dean AA

RENEWABLE ENERGY SYSTEMS			
Class: B. Tech. VI – Semester		Branch: EEE	
Course Code:	U24OE501E	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 : evaluate the sources of renewable and conventional energy resources, quantify solar power and judge the applicability of solar energy CO2 : analyze the wind power developed by a wind energy system and the operational difficulties associated with geothermal energy CO3 : analyze the feasibility of harnessing of electric power from oceans and biomass CO4 : select an appropriate energy storage system for a given application and summarize the operating principle of fuel cell			
UNIT-I			9 Hrs
Introduction: Conventional and non-conventional sources of energy – brief description of different renewable energy sources Solar energy: Introduction to prospects of solar PV systems: photovoltaic effect and electrical equivalent circuit of a PV cell, dependence of a PV cell characteristic on temperature, solar cell output characteristics, solar maximum power point tracking (MPPT) using Perturb & Observe algorithm, applications of solar PV systems- street lighting, domestic lighting, solar PV pumping systems			
UNIT-II			9 Hrs
Wind energy: Principles of wind power, evaluation of wind intensity, operation of a wind turbine and wind power curve, different types of wind turbine generators, topography and classification of wind turbines and its applications Geothermal Energy: Origin and types of geothermal energy, operational difficulties, liquid dominated systems			
UNIT-III			9 Hrs
Energy from Oceans: Ocean temperature differences, ocean waves, energy from the waves, introduction of tidal power, basic principle of tidal power, components of tidal power plants Bioenergy: Introduction, bio-mass conversion technologies, photo synthesis, biogas generation, biogas from power plant wastes, methods of maintaining biogas production, utilization of biogas, biogas gasification			
UNIT-IV			9 Hrs
Chemical energy sources: Introduction to fuel cells, principle of operation of fuel cell, classification of fuel cells, advantages, disadvantages and applications of fuel cells Types of energy storage systems: Introduction, mechanical energy storage systems, batteries, ultra-capacitors, super conducting magnetic storage, applications			

Textbook(s):

1. Rai G.D, *Non-Conventional Energy Sources*, 4th ed. New Delhi: Khanna Publishers, 2010.

Reference Book(S):

1. B.H. Khan, *Non-conventional Energy Resources*, 2nd ed. New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2006.
2. Felix A. Farret, M. Godoy Simoes, *Integration of Alternative Sources of Energy*, New Jersey: John Wiley & Sons, 2006.
3. Bansal N. K, Kaleeman, M. Miller, *Renewable Energy Sources and Conversion Technology*, New Delhi: Tata McGraw Hill Education (India) Pvt. Ltd., 2006.
4. Duffie and Beckman, *Solar Energy Thermal Process*, New Jersey: John Wiley & Sons, 2006.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ch40

Course Articulation Matrix (CAM):				U24OE501B: RENEWABLE ENERGY SYSTEMS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501B.1	3	3	2	1	2	2	1	1	1	1	2	3	3
CO2	U24OE501B.2	3	3	2	1	2	2	1	1	1	1	2	3	3
CO3	U24OE501B.3	3	2	2	1	1	3	1	1	1	1	2	2	2
CO4	U24OE501B.4	3	2	2	1	2	2	1	1	1	1	2	3	2
U24OE501B		3	2.5	2	1	1.7 5	2.2 5	1	1	1	1	2	2.7 5	2.5
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement – The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO 1	evaluate the sources of renewable and conventional energy resources, quantify solar power and judge the applicability of solar energy	SDG7	Affordable and Clean Energy	Smart grid concepts promote efficient, reliable, and sustainable electrical energy systems through intelligent monitoring, automation, and integration of clean energy resources.
CO 2	analyze the wind power developed by a wind energy system and the operational difficulties associated with geothermal energy	SDG9	Industry, Innovation and Infrastructure	Smart grid computational tools, optimization methods, artificial intelligence, and automation technologies support innovation and modernization of power infrastructure.
CO 3	analyze the feasibility of harnessing of electric power from oceans and biomass	SDG13	Climate Action	Distributed generation technologies such as renewable energy systems, microgrids, electric vehicles, and storage technologies contribute to reduction of greenhouse gas emissions and support climate-resilient energy systems.
CO 4	select an appropriate energy storage system for a given application and summarize the operating principle of fuel cell	SDG11	Sustainable Cities and Communities	Smart communication technologies, PMUs, WAMS, and intelligent control systems improve reliability, efficiency, and sustainability of urban power distribution systems and smart city infrastructure.

ENVIRONMENTAL AND CLIMATE IOT			
Class: B. Tech. V-Semester		Branch: CSE (IoT)	
Course Code:	U24OE501H	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 fundamental concepts, architecture, components, and sensing technologies used in Environment and Climate IoT systems..			
CO2: analyze the significance of Climate IoT in addressing environmental sustainability and climate change challenges.			
CO3: apply remote sensing and climate iot technologies for monitoring and analyzing environmental and climatic conditions.			
CO4: develop IoT-based solutions for smart agriculture, water management, pollution monitoring, and sustainable smart city applications.			
UNIT-I			9 Hrs
Fundamentals of Environment and Climate IoT: Introduction to IoT, IoT architecture and components, Environment monitoring systems, Climate monitoring and weather analysis, Sensors and actuators for environmental applications- Temperature, Humidity, Gas, Air Quality, Soil moisture, and Water quality sensors, Sensor interfacing and data acquisition techniques, Applications of environment and climate IoT.			
UNIT-II			9 Hrs
Climate IoT Fundamentals and Sustainability Framework: Introduction to climate IoT, Overview of climate IoT, Need for Environmental sustainability, Role of IoT in climate Monitoring, Climate change IoT for environmental			
Sustainability: Climate change challenges, IoT-based environmental protection, Smart environmental applications.			
UNIT-III			9 Hrs
Remote Sensing Technologies for Climate Monitoring: Environmental and Meteorological Satellites for Remote Sensing,GPS Signals for Remote Sensing, Climate IoT Monitoring Systems, Cloud Properties Monitoring, Atmospheric Emissions Monitoring, Monitoring of the Surface of the Earth,Sea State Monitoring, Arctic Measurements, Hurricane Monitoring,Solar Radiation Monitoring.			
UNIT-IV			9 Hrs
Environmental and Climate IoT Applications: Smart agriculture systems, Smart water management, Air pollution monitoring. Forest fire detection systems, Flood monitoring and Disaster management, Smart weather stations, Sustainable smart cities.			
Textbook:			
1. Abdul Salam, <i>Internet of Things for Sustainable Community Development: Wireless Communications, Sensing, and Systems</i> , Springer, 2020.			

Reference Book(S):

1. Sneha Gautam, Chafai Azri, Md. Badiuzzaman Khan, *Environmental Monitoring with AI and IoT: Smart Systems for a Sustainable Future*, CRC Press, 2026. (Chapters 1 to 3)
2. Jamal Mabrouki, Mourade Azrour, *Advanced Systems for Environmental Monitoring, IoT and the Application of Artificial Intelligence*, Springer, 2024. (Chapters 1 to 3)
3. Arshdeep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Universities Press, 2015. (Chapters 1 to 3)
4. Charles Bell, *Building the Internet of Things with Arduino and Raspberry Pi*, Apress, 2016. (Chapters 1 to 3)

Web and Video link:

https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ge33, NPTEL lecture by IIT Kharagpur.

Course Articulation Matrix (CAM):				U24OE501H: ENVIRONMENT AND CLIMATE IOT										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501H.1	2	2	1	-	2	1	2	-	-	1	-	2	1
CO2	U24OE501H.2	2	2	2	1	2	1	2	-	1	1	-	2	2
CO3	U24OE501H.3	2	2	1	2	2	1	2	2	-	1	1	2	2
CO4	U24OE501H.4	2	2	2	2	2	2	2	1	1	2	1	2	2
U24OE501H		2	2	1.5	1.25	2	1.25	2	1.5	1	1.25	1	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	understand the fundamentals of Environment and Climate IoT systems.	SDG 13	Climate Action	Understanding Environment and Climate IoT fundamentals helps students identify climate challenges and develop IoT-based solutions for environmental sustainability and climate action.
CO2	understand the fundamentals of Climate IoT and its applications in environmental sustainability and climate monitoring.	SDG 9	Industry, Innovation and Infrastructure	Communication technologies and IoT networking protocols enable reliable environmental monitoring infrastructure and support innovative smart environmental systems.
CO3	understand remote sensing and Climate IoT technologies for monitoring environmental and climate conditions.	SDG 11	Sustainable Cities and Communities	Cloud computing, analytics, and secure IoT systems support smart city applications, environmental monitoring, and sustainable urban resource management.
CO4	understand Climate IoT applications in smart environmental monitoring and sustainable development.	SDG 15	Life on Land	Smart environmental monitoring solutions help protect ecosystems, monitor pollution, conserve natural resources, and support sustainable environmental management.

SENSORS AND ACTUATORS FOR SUSTAINABLE SMART CITIES AND HEALTH CARE

Class: B.Tech. V Semester		Branch: All branches	
Course Code:	U24OE501L	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: select appropriate sensors & actuators for smart system applications CO2: utilize sustainable smart systems for smart cities, utility & industrial monitoring applications CO3: select appropriate sensors & actuators for smart health care system applications CO4: make use of enabling technologies like IoT, Cloud computing, AIML for sustainable smart cities and healthcare solutions			
UNIT-I			9 Hrs
Introduction: Sustainable development goals (SDGs), Fundamentals of sensing and actuation, Smart technologies; Smart cities- Concept, Characteristics, Challenges; Smart healthcare ecosystem- Concept, Characteristics, Challenges Sensors and Actuators: Sensor characteristics, Classification of sensors- Active, Passive, Analog, Digital sensors, Smart sensors; Actuator characteristics, Electrical actuators; Actuation systems- Automatic valves, Relays, Motor control, HVAC control Interfacing of Sensors and Actuators - Data acquisition systems, Signal conditioning, ADC, DAC, Microcontroller interface			
UNIT-II			9 Hrs
Smart Systems for Sustainable Smart Cities (Block diagram approach): Environmental Monitoring- Air quality monitoring, Water quality monitoring, Weather monitoring, Noise monitoring; Smart infrastructure- Smart lighting, Intelligent traffic management, Smart parking, Smart water distribution, Smart energy metering, Waste management Smart Systems for Utility and Industrial Monitoring (Block diagram approach): Smart grid, Smart agriculture, Structural health monitoring			
UNIT-III			9 Hrs
Sensors and Actuators in Healthcare: Temperature sensors, Blood pressure sensors, ECG sensors, Glucose sensor, Respiration sensor, EMG sensors, EEG sensors, Pulse oximeter, Drug delivery systems, Infusion pumps, Pacemakers, Prosthetic devices, Rehabilitation robots Wearable Healthcare Devices: Fitness trackers, Smart watches, Continuous health monitoring, Fall detection systems Telemedicine: Remote patient monitoring, Role of IoT, Cloud and AI in health care			
UNIT-IV			9 Hrs
IoT and Cloud computing for Sustainable Smart Cities and Healthcare: IoT architecture, Communication Technologies- Wi-Fi, BLE, ZigBee, LoRaWAN, NB-IoT, 5G; Wireless sensor networks, Cloud computing applications; Green IoT and Energy Harvesting Techniques, Data privacy, Cybersecurity AI for Sustainable Smart Cities and Healthcare: Machine learning for sensor data, Smart data			

analytics, Edge AI, Predictive maintenance, Introduction to AI-assisted diagnosis, Predictive healthcare

Textbook(s):

1. Priyanka Mishra and Ghanshyam Singh, *Sustainable, Smart Cities Enabling Technologies, Energy Trends and Potential Applications*, Switzerland, Springer Nature, 2023. (chapters 1,2,3,4,6,7)
2. Jacob Fraden, *Handbook of Modern Sensors: Physics, Designs and Applications*, 5th Edition, Springer, 2016. (Chapters 1,3,4,6 to 15, 17,18)

Reference Book(s):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-on Approach*, Universities Press, 2015.
2. John G. Webster, *Medical Instrumentation: Application and Design*, 4th Edition, Wiley India, 2010.
3. Raj Kamal, *Internet of Things: Architecture and Design Principles*, McGraw-Hill Education, 2017.
4. Ramon Pallas-Areny and John G. Webster, *Sensors and Signal Conditioning*, 3rd Edition, Wiley, 2012.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc26_cs22; NPTEL Video Lecture on Sensors and Actuators by Prof. Hardik Jeetendra Pandya, Professor of Electronic Systems Engineering, IISc Bangalore
2. <https://nptel.ac.in/courses/106105166>; NPTEL Video Lecture on Introduction to Internet of Things by Prof. Sudip Misra, Professor of CSE, IIT Kharagpur
3. https://onlinecourses.nptel.ac.in/noc24_ee68; NPTEL Video Lecture on Embedded Sensing, Actuation and Interfacing Systems, by Prof. Banibrata Mukherjee, Professor of Advanced Technology Development Centre (ATDC), IIT Kharagpur

Course Articulation Matrix (CAM):				U24OE501L: SENSORS AND ACTUATORS FOR SUSTAINABLE SMART CITIES AND HEALTH CARE										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501L.1	2	1	2	1	1	3	2	2	2	1	2	2	1
CO2	U24OE501L.2	2	1	2	1	1	3	2	2	2	1	2	2	1
CO3	U24OE501L.3	2	1	2	1	1	3	2	2	2	1	2	2	1
CO4	U24OE501L.4	2	1	2	1	2	3	2	2	2	1	2	2	1
U24OE501L		2	1	2	1	1.25	3	2	2	2	1	2	2	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

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

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	select appropriate sensors & actuators for smart system applications	SDG4	Quality Education	- Can understand the working principles of sensors, actuators used in Smart systems - Strengthens core engineering competencies, thereby promoting quality technical education and skill development essential for lifelong learning and professional growth
CO2	utilize sustainable smart systems for smart cities, utility & industrial monitoring applications	SDG11	Sustainable Cities and Communities	- Make use of sensor and actuator technologies which enables efficient environmental monitoring, intelligent transportation, smart energy management - Make use of resource optimization to support the development of sustainable, safe, and resilient cities
CO3	select appropriate sensors & actuators for smart health care system applications	SDG3	Good Health and Well-being	- Can understand the working principles of sensors, actuators used in Health care systems - Select appropriate sensors & actuators to develop smart systems for healthcare monitoring devices, diagnostic equipment, and patient safety systems that contribute to improved health and well-being
CO4	make use of enabling technologies like IoT, Cloud computing, AIML for sustainable smart cities and healthcare solutions	SDG9	Industry, Innovation and Infrastructure	develop IoT/AIoT based smart systems which promotes technological innovation, smart infrastructure, digital connectivity, and sustainable industrial solutions for smart city and healthcare applications

DEVELOPMENT			
Class: B. Tech. V		Branch: CE	
Course Code:	U24OE501Y	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 : classify automobiles and explain transmission components and supporting sustainable transportation systems CO2 : examine the working principle of Steering System, braking system, Suspension System and emission control for sustainability. CO3 : illustrate hybrid electric vehicles, drivetrains, and energy storage hybridization for sustainable mobility. CO4 : examine the Energy Storage, and Management Strategies, and current trends in sustainable automobiles.			
UNIT-I			9 Hrs
Automobiles: Introduction, classification and parts; Sustainable Vehicle Structure- chassis layout and frames Transmission system: Requirements, types and elements Clutch- Function, types- friction clutches - single plate, multi-plate, centrifugal and semi-centrifugal; automatic transmission device- fluid flywheel Gear box: Types-sliding mesh, constant mesh, synchromesh and automatic gear box			
UNIT-II			9 Hrs
Steering system: Principle, need, layout, steering gear, steering ratio, steering lock, turning radius, Power steering- hydraulic and electronic Braking system: Classification, principle, requirements; types- disc, hydraulic, power and servo; automatic and antilock braking system Suspension system: Functions, elements, torsion bars, stabilizer bars and shock absorbers; types- rigid axle, solid leaf spring and coil spring, air suspension Emissions and Control: Effects of emissions, Sustainable pollution control, Euro norms, Bharat norms; testing devices, vehicle standard service and maintenance			
UNIT-III			9 Hrs
Sustainable Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies; Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Sustainable power flow control in hybrid drive-train topologies. Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, fuel efficiency analysis. Hybridization: Introduction to hybridization of different energy storage devices, Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics			
UNIT-IV			9 Hrs
Sustainable Energy Storage: Energy Storage Requirements in Hybrid and Electric Vehicles, Sustainable Battery based energy storage and its analysis, Fuel Cell based energy storage and its			

analysis

Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

Current Trends in Sustainable Automobiles: Autonomous, artificial intelligence and machine learning, electric vehicle, hybrid electric vehicle and solar vehicle

Textbook(s):

1. Srinivasan, S, "Automotive Mechanics", 2nd ed., Tata McGraw-Hill, 2003. (Chapters 1 to 6,9,19,20 &26)
2. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011. (Chapters 1, 4 &5)
3. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015. (Chapters 3)

Reference Book(S):

1. Dr. Kirpal Singh, —Automobile Engineering, Vol. I & II, 14th ed., Standard Publishers, NewDelhi, 2017
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
3. R. K. Rajput —Automobile Engineering", 2nd ed., Laxmi Publishers, 2017.
4. Kamaraju Ramakrishna, "Automobile Engineering", 1st ed., PHI Learning, New Delhi, 2016.
5. William H.Crouse and Donald L. Anglin "Automotive Mechanics", 10th ed., Tata McGraw-Hill, 2006
6. Joseph Heitner "Automotive Mechanics Principles and Practices" 2nd ed., CBS Publishers & Distributors Pvt. Ltd, 2004.
7. K M Gupta, Automobile Engineering, Vol. I & II, Delhi, Umesh Publications, 2002.

Web and Video link(s): NPTEL Video Lecture on AUTOMOBILE ENGINEERING

1. <https://elearn.nptel.ac.in/shop/nptel/fundamentals-of-automotive-systems> Professor C. S. Shankar Ram, IIT Madras
2. <https://nptel.ac.in/courses/108106170>NPTEL Video Lecture on Fundamentals of Electric vehicles: Technology & Economics, Professor ofElectrical Engineering, IIT Madras.
3. <https://nptel.ac.in/courses/108103009>Web notes on Introduction to Hybrid and Electric Vehicles by Prof. S. Majhi&Prof. Praveen Kumar,Professor ofElectronics and Electrical Engineering, IIT Guwahati.

Course Articulation Matrix (CAM):				U24OE501Y : AUTOMOTIVE ENGINEERING FOR SUSTAINABLE DEVELOPMENT										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501Y.1	2	1	1	-	-	1	-	1	-	-	1	1	1
CO2	U24OE501Y.2	2	1	1	-	-	1	-	1	-	-	1	1	1
CO3	U24OE501Y.3	2	1	1	-	-	1	-	1	-	-	1	1	1
CO4	U24OE501Y	2	1	1	-	-	1	-	1	-	-	1	1	1
U24OE501Y		2	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

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	<i>Classify automobiles and explain transmission components and supporting sustainable transportation systems</i>	SDG 9	Build resilient infrastructure, promote sustainable industrialization and foster innovation.	Understanding transmission systems enhances knowledge of efficient automotive design components, sustainable transportation technologies, and innovative drivetrain solutions for reliable and sustainable mobility
CO2	<i>examine the working principle of Steering System, braking system, Suspension System and emission control for sustainability</i>	SDG 11	Efficient vehicle systems for safer and more sustainable. And support cleaner urban environments.	Efficient steering, braking, and power transmission systems improve vehicle performance and reduce energy losses. Knowledge of these systems supports the design of fuel-efficient and energy-optimized automobiles, contributing to sustainable transportation and efficient energy utilization.
CO3	<i>Illustrate hybrid electric vehicles, drivetrains, and energy storage hybridization for sustainable mobility.</i>	SDG 12	Ensure sustainable consumption and production patterns.	Studying types of hybrid electric vehicle and its types of components. Knowledge on working principle of hybrid vehicle. Understanding hybrid electric vehicles, advanced drivetrains, and energy storage technologies supports clean energy adoption, sustainable transportation, resource efficiency, and climate action, thereby.
CO4	<i>examine the Energy Storage, and Management Strategies, and current trends in sustainable automobiles.</i>	SDG 7	Promotes efficient energy storage and utilization technologies that support clean and sustainable energy use in transportation.	understanding modern storage technologies and energy management systems, emerging trends in the automotive industry. Knowledge of these technologies enables the development of energy-efficient, environmentally sustainable, and innovative transportation solutions. Effective energy storage and management reduce energy consumption, improve vehicle performance,

ENVIRONMENTAL ENGINEERING			
Class: B.Tech. V -Semester		Branch: CE	
Course Code:	U24CE502	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 : analyse problems related to water quality and quantity CO2 : apply methods for purification of water and design water distribution systems CO3 : analyse and design the sewage systems CO4 : apply methods for purification and disposal of sewage			
UNIT-I			9 Hrs
Water Demand: sources of water supply, types of water demand, percapita demand, factors affecting per-capita demand, factors affecting water losses, fluctuations in water demand and its effects on water supply scheme, design period, population forecasting methods, fire demand. Water Quality Parameters: physical, chemical and biological characteristics of water quality, waterborne diseases and their control, quality standards for municipal supplies.			
UNIT-II			9 Hrs
Water Treatment Process: screening, plain sedimentation, sedimentation aided with coagulation, filtration, disinfection, softening, aeration. Water Distribution System: general requirements, layouts of distribution networks, methods of supply, systems of supply, distribution reservoirs, types, functions, storage capacity of distribution reservoirs, design of distribution networks, appurtenances in distribution system.			
UNIT-III			9 Hrs
Sewage Characteristics: physical, chemical and biological characteristics of sewage, analysis of sewage, bio-chemical oxygen demand and dissolved oxygen profile processes and kinetics involved, sewerage systems, merits and demerits, estimation of dry weather flow, estimation of storm water flow. Sewerage System Design: hydraulic design of sewer, hydraulic formulae for design of sewers, minimum and maximum velocity of flow, materials, joints, shapes, sewer appurtenances.			
UNIT-IV			9 Hrs
Sewage Treatment Process: primary treatment, theory and design of screens, grit chamber, skimming tanks, sedimentation tanks. Secondary Treatment of Sewage: activated sludge process, sewage filtration, oxidation ditch, oxidation ponds, aerated lagoons, rotating biological contactors, treatment and disposal of sludge, on-site disposal methods (land and water body).			
Textbook(s): 1. P. N. Modi, <i>Water Supply Engineering – Environmental Engineering–I</i> , Standard Book House, 7th edition, 2021, New Delhi. 2. P. N. Modi, <i>Sewage Treatment Disposal and Waste Water Engineering – Environmental Engineering–II</i> , Standard Book House, 17th edition, 2020, New Delhi.			
Reference Book(S):			

1. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, *Environmental Engineering*, McGraw-Hill International Edition, 1st edition, 1985, New Delhi.
2. B. C. Punmia, A. K. Jain and Arun Kumar Jain, *Water Supply Engineering – Environmental Engineering–I*, Laxmi Publications, 2nd edition, 2022, New Delhi.
3. B. C. Punmia, A. K. Jain and Arun Kumar Jain, *Wastewater Engineering – Environmental Engineering–II*, Laxmi Publications, 2nd edition, 2016, New Delhi.
4. Metcalf and Eddy, *Wastewater Engineering: Treatment and Resource Recovery*, McGraw-Hill Education, 5th edition, 2014, New Delhi.

Web and Video link(s):

1. [https://archive.nptel.ac.in/courses/105/105/105105201/NPTEL Video Lecture on Water Supply Engineering by Prof.Manoj Kumar Tiwari, IIT Kharagpur.](https://archive.nptel.ac.in/courses/105/105/105105201/NPTEL%20Video%20Lecture%20on%20Water%20Supply%20Engineering%20by%20Prof.Manoj%20Kumar%20Tiwari,%20IIT%20Kharagpur)
2. [https://nptel.ac.in/courses/105106119NPTEL Video Lecture on Water & Wastewater Quantity by Prof.C.Venkobachar, Prof. Ligy Philip, Prof.B.S.Murthy, IIT Madras.](https://nptel.ac.in/courses/105106119NPTEL%20Video%20Lecture%20on%20Water%20&%20Wastewater%20Quantity%20by%20Prof.C.Venkobachar,%20Prof.Ligy%20Philip,%20Prof.B.S.Murthy,%20IIT%20Madras)

Course Articulation Matrix (CAM):				U24CE502: ENVIRONMENTAL ENGINEERING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE502.1	2	1	1	1	1	1	-	1	1	-	1	1	2
CO2	U24CE502.2	2	1	1	1	1	1	-	1	1	-	1	1	2
CO3	U24CE502.3	2	1	1	1	1	1	-	1	1	-	1	1	2
CO4	U24CE502.4	2	1	1	1	1	1	-	1	1	-	1	1	2
U24CE502		2	1	1	1	1	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	analyse problems related to water quality and quantity	SDG6	Clean Water and Sanitation	Analysing water quality and quantity problems directly supports sustainable water resource management, safe drinking water availability, and efficient utilization of water resources.
CO2	apply methods for purification of water and design water distribution systems	SDG9	Industry, Innovation and Infrastructure	Application of water purification methods and design of water distribution systems contributes to providing safe and reliable drinking water supply to communities.
CO3	analyse and design the sewage systems	SDG11	Sustainable Cities and Communities	Analysis and design of sewage systems help improve sanitation infrastructure, reduce environmental pollution, and promote public health protection.
CO4	apply methods for purification and disposal of sewage	SDG6	Clean Water and Sanitation	Applying sewage purification and disposal methods supports wastewater treatment, environmental sustainability, pollution control, and safe sanitation practices.

HIGHWAY ENGINEERING			
Class: B. Tech. V – Semester		Branch: CE	
Course Code:	U24CE503	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 : design highway geometric elements as per IRC standards. CO2 : design intersections and interpret traffic flow characteristics. CO3 : integrate pavement material properties, and traffic loading factors to design the resilient flexible and rigid pavements in accordance with IRC standards. CO4 : analyse flexible and rigid pavement distresses using Benkelman Beam deflection data to recommend structural overlay thicknesses.			
UNIT-I			9 Hrs
Highway Development: History of road construction, road development in India, planning surveys and their interpretation, highway alignment, and engineering surveys required for alignment. Geometric Design of Highway: Cross-section elements, sight distances- Stopping Sight Distance [SSD], Overtaking Sight Distance [OSD], and Intermediate Sight Distance [ISD]. Design of horizontal alignment- design speed, horizontal curves, super-elevation, radius of horizontal curves, pavement widening, and transition curves. Design of vertical alignment - gradients and vertical curves.			
UNIT-II			9 Hrs
Traffic Stream Characteristics and Traffic Surveys: Fundamental parameters of traffic flow- volume, speed, and density and their macroscopic relationships. Traffic capacity limits and Level of Service (LOS) criteria based on mixed-traffic environments. Traffic volume studies, spot speed studies, origin-destination surveys, and time-and-delay studies (field methodologies and data representation formats). Intersection Design: Road traffic accident terminology, causative factors (driver, infrastructure, environment), and collision countermeasures. Types of at-grade junctions; Warrants for signalization. Structural design of isolated traffic signals using Webster's Method and IRC multi-phase approaches.			
UNIT-III			9 Hrs
Pavement Materials and Mix Design: Soil index properties, classification, California Bearing Ratio (CBR), compaction, and sub-grade soil strength. Road aggregate desirable properties and tests. Bituminous binders (types, tests, and grading), bituminous mix requirements, constituents, and design. Pavement quality concrete materials and requirements. Design guide lines for Pavements: Design factors for flexible and rigid pavements; IRC 37 guidelines for design of flexible pavements using standard. IRC 58 guidelines for rigid			

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design highway geometric elements as per IRC standards.	SDG3	Good Health and Well-being	Designing safe road geometry directly prevents crashes. This outcome supports the global goal of cutting road traffic deaths and injuries.
CO2	design intersections and interpret traffic flow characteristics.	SDG11	Sustainable Cities and Communities	Optimization of traffic signal timings reduces congestion and delay. This keeps traffic moving smoothly and creates efficient transport systems for growing urban areas.
CO3	integrate pavement material properties, and traffic loading factors to design the resilient flexible and rigid pavements in accordance with IRC standards.	SDG9	Industry, Innovation and Infrastructure	Using standard IRC methods to design pavements ensures strong, reliable roads that can support heavy freight.
CO4	analyse flexible and rigid pavement distresses using Benkelman Beam deflection data to recommend structural overlay thicknesses.	SDG9	Industry, Innovation and Infrastructure	Testing road condition helps target specific repairs with overlays, stretching the road's lifespan and avoiding expensive, full reconstructions.

DESIGN OF REINFORCED CONCRETE STRUCTURES			
Class: B. Tech. V – Semester		Branch: CE	
Course Code:	U24CE504	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: compare the design philosophies of limit state method and its application in flexure CO2: determine the capacities of RCC sections in shear, torsion and their serviceability. CO3: design of one-way, two-way slabs and axially loaded columns. CO4: analyse footings and review the working stress method			
UNIT-I			9 Hrs
Fundamentals of Limit State Design: Introduction, loads on structures, design philosophies, code of practice, grades of concrete, stress-strain curves of concretes, mild steel and TOR steel, characteristic loads and strengths, partial safety factors, IS codal provisions. Limit state of collapse in flexure: Analysis and design of beams, singly, doubly reinforced rectangular and T-beams, IS codal provisions.			
UNIT-II			9 Hrs
Limit state of collapse in Shear and torsion: Types of shear, design shear strength of concrete beams, design of beams for shear, torsional shear stress for rectangular sections, reinforcement for torsion, bond, anchorage, development length, IS codal provisions. Limit state of serviceability: Short term deflection for beams, long term deflection due to creep, differential shrinkage, IS Codal provisions.			
UNIT-III			9 Hrs
Slabs: Loads and their distribution, design of one way simply supported, continuous slabs and two-way slabs, IS Codal provisions. Short columns: Axially loaded rectangular columns, circular columns with lateral ties and helical reinforcement, interaction curves, design for uni-axial bending moment, IS Codal provisions.			
UNIT-IV			9 Hrs
Footings: Types of footings, design of isolated footing for axially loaded columns, design of combined footing, IS Codal provisions. Working stress method of design: Design principles, under reinforced, balanced and over- reinforced beams, analysis and design of rectangular beams, design for shear, IS Codal provisions.			
Textbook(s): 1. A. K Jain, "Limit State Design", NemChand Brothers, 7 th edn.,2012. Roorkee.			
Reference Book(S): 1. S. UnniKrishnaPillai and DevdasMenon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 3 rd edn, 2011. New Delhi. 2. B.C. Punmia, "Reinforced Concrete Structures", Laxmi Publishing Company, 8 th edn. 2012, New Delhi. 3. Jai Krishna and O. P. Jain, "Plain and Reinforced Concrete", NemChand Brothers, , 8 th edn. 2012. Roorkee.			

4. IS: 456, "Code of practice for Plain and reinforced concrete", Bureau of Indian standards, New Delhi.
5. IS: 875 (part 1-5), "Code of practice for Design loads", Bureau of Indian standards, New Delhi.
6. SP:16, "Design Aids for Reinforced Concrete to IS 456, Bureau of Indian standards, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ce03:NPTel *Reinforced Concrete Design*, By Prof. Arunasis Chakraborty, IIT Guwahati.

Course Articulation Matrix (CAM):				U24CE504: DESIGN OF REINFORCED CONCRETE - STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE504.1	1	2	2	-	-	-	1	-	-	-	1	2	1
CO2	U24CE504.2	1	2	2	-	-	1	1	-	-	-	1	2	1
CO3	U24CE504.3	1	2	2	-	-	1	1	-	-	-	1	2	1
CO4	U24CE504.4	1	2	2	-	-	1	1	-	-	-	1	2	1
U24CE504		1	2	2	-	-	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
CO 1	compare the design philosophies of limit state method and its application in flexure	SD9	Industry, Innovation and Infrastructure	Understanding limit state design philosophy helps students develop safe and efficient structural systems, contributing to resilient and innovative infrastructure design in buildings and public works.
CO 2	determine the capacities of RCC sections in shear, torsion and their serviceability.	SD9	Industry, Innovation and Infrastructure	Determining the capacities of RCC (Reinforced Cement Concrete) sections in shear, torsion, and serviceability contributes to sustainable infrastructure by ensuring structures are safe, durable, resource-efficient, and resilient
CO 3	design of one-way, two-way slabs and axially loaded columns.	SD9	Industry, Innovation and Infrastructure	The design of one-way slabs, two-way slabs, and axially loaded columns Proper structural design ensures safe, durable, resource-efficient, and sustainable infrastructure development.
CO 4	analyse footings and review the working stress method	SD9	Industry, Innovation and Infrastructure	Footings are essential structural components that transfer building loads safely to the soil. Proper footing analysis and understanding of structural design methods such as WSM ensure safe, resilient, and long-lasting infrastructure. • Supports durable infrastructure development through sound engineering principles. • Improves structural reliability by analyzing load transfer and soil pressure.

HYDRAULICS & HYDRAULIC MACHINERY			
Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE505	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 : calculate stresses due to turbulent flow and infer water hammer in pipes CO2 : summarize the concepts of boundary layer theory and flow around submerged bodies CO3 : analyse open channel flow and hydraulic jump CO4 : evaluate the characteristics of turbines and pumps			
UNIT-I			9 Hrs
Turbulent flow in pipes: characteristics of turbulent flow, shear stress due to turbulence, reynolds stresses, prandtl's mixing length theory, universal velocity distribution laws, nikuradse's experiment, karman- prandtl resistance equation, variation of friction factor with reynold's number-moody's chart. Water hammer in pipes: water hammer phenomenon, gradual and sudden closure of valves, expression for pressure rise considering elasticity of pipe, pressure relieving devices			
UNIT-II			9 Hrs
Boundary layer theory: introduction, boundary layer growth over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, integral momentum equation for boundary layer, separation of boundary layer and its control. Flow around submerged bodies: basic concepts and expressions of Drag and lift, drag and lift forces on sphere and cylinder.			
UNIT-III			9 Hrs
Open channel flow: introduction, classification and characteristics of open channel flow, manning's and chezy's equations, most economical rectangular, triangular, circular and trapezoidal sections, velocity distribution in channel section. Hydraulic jump: energy concepts in open channel flow, specific energy curve, critical depth, critical velocity, condition for critical, subcritical and super critical flows, expression for depth of hydraulic jump, loss of energy due to hydraulic jump, channel transitions, equation for gradually varied flow, classification of surface profiles, rapidly varied flow.			
UNIT-IV			9 Hrs
Hydraulic machines: impact of jet, force on a stationary, moving flat plate, hydraulic turbines, heads and efficiencies, classification, pelton wheel, francis turbines, specific speed, draft tube, cavitation phenomenon, characteristic curves, selection of turbines. Pumps: introduction, centrifugal pump, heads and efficiencies, specific speed, characteristic curves, net positive suction head, priming, selection and operational difficulties, reciprocating pump, single and double acting reciprocating pumps, coefficient of discharge and slip, use of air vessels and characteristic curves.			
Textbook(s):			

1. P. N. Modi and S. M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulic Machines", Standard Book House, Rajsons Publications Pvt. Ltd., 23rdedn., 2022.

Reference Book(S):

1. A. K. Jain, *Fluid Mechanics Including Hydraulic Machines*, Khanna Publications, 14th Edn. 2018.
2. VenTe Chow, *Open Channel Hydraulics*, Blackburn Publisher, 2009 Edition.
3. Victor L. Streeter, E. Benjamin Wylie and Keith W. Bedford, *Fluid Mechanics*, McGraw Hill, Singapore, 9thedn., 1998
4. K. Subramanya, *Theory and Applications of Fluid Mechanics*, Tata McGraw Hill, 2nd Edition 2002.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ce30. NPTEL Video Lecture on Hydraulic Engineering by Prof. Mohammad Saud Afzal, IIT Kharagpur

Course Articulation Matrix (CAM):				U24CE505: HYDRAULICS & HYDRAULIC MACHINERY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE505.1	2	2	1	1	1	1	-	-	-	-	-	2	1
CO2	U24CE505.2	2	2	1	1	1	1	-	-	-	-	-	2	1
CO3	U24CE505.3	2	2	1	1	1	1	-	-	-	-	-	2	1
CO4	U24CE505.4	2	2	1	1	1	1	-	-	-	-	-	2	1
U24CE603		2	2	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	calculate stresses due to turbulent flow and infer water hammer in pipes	SDG9	Industry, Innovation and Infrastructure	Understanding turbulent flow and water hammer helps in the design of safe, durable, and efficient pipeline systems used in industrial and water infrastructure projects.
CO2	summarize the concepts of boundary layer theory and flow around submerged bodies	SDG9	Industry, Innovation and Infrastructure	Knowledge of boundary layer behavior and flow around bodies supports the development of efficient hydraulic structures, transport systems, and engineering innovations
CO3	analyse open channel flow and hydraulic jump	SDG6	Clean Water and Sanitation	Analysis of open channel flow and hydraulic jumps is essential for the design and management of canals, spillways, irrigation systems, and water distribution networks.
CO4	evaluate the characteristics of turbines and pumps	SDG7	Affordable and Clean Energy	Evaluating turbines and pumps contributes to efficient energy conversion, hydropower generation, and sustainable water lifting systems, promoting clean and affordable energy solutions.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE			
Class: B.Tech. V- Semester	Branch: V SEM (CE, ME, IT, CSN, CSM, CSO, CSD) VI SEM (CSE, EEE, ECE, ECV)		
Course Code:	U24IK506BA	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. Priyadarajan 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 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.

ENVIRONMENTAL ENGINEERING LABORATORY			
Class: B. Tech. V – Semester		Branch: CE	
Course Code:	U24CE507	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 : assess the quality of water for suspended matter CO2 : evaluate hardness and chloride content of the water samples CO3 : estimate dissolved oxygen concentration in water sample CO4 : determine the concentration of degradable organic matter			
LIST OF EXPERIMENTS			
a. Determination of pH and Alkalinity of water sample b. Determination of Acidity of water sample c. Determination of Total Solids, Total dissolved solids and Suspended solids of water sample d. Determination of Conductivity of water sample e. Determination of Temporary and Permanent Hardness of water sample f. Determination of Optimum Coagulant dosage of water sample using Jar test g. Determination of Chloride content of water sample h. Determination of Dissolved Oxygen of water sample i. Determination of Biological Oxygen Demand of water sample j. Determination of Chemical Oxygen Demand of water sample k. Determination of Break-point Chlorination l. Determination of Sulphates			
<u>Textbook(s):</u> 1. P. N. Modi, <i>Water Supply Engineering – Environmental Engineering–I</i> , Standard Book House, 7th edition, 2021, New Delhi. 2. P. N. Modi, <i>Sewage Treatment Disposal and Waste Water Engineering – Environmental Engineering–II</i> , Standard Book House, 17th edition, 2020, New Delhi.			
<u>Reference Book(S):</u> 1. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, <i>Environmental Engineering</i> , McGraw-Hill International Edition, 1st edition, 1985, New Delhi. 2. B. C. Punmia, A. K. Jain and Arun Kumar Jain, <i>Water Supply Engineering – Environmental Engineering–I</i> , Laxmi Publications, 2nd edition, 2022, New Delhi. 3. B. C. Punmia, A. K. Jain and Arun Kumar Jain, <i>Wastewater Engineering – Environmental Engineering–II</i> , Laxmi Publications, 2nd edition, 2016, New Delhi. 4. Metcalf and Eddy, <i>Wastewater Engineering: Treatment and Resource Recovery</i> , McGraw-Hill Education, 5th edition, 2014, New Delhi.			
<u>Laboratory Manual (for laboratory component):</u> 1. <i>Environmental Engineering Laboratory Manual</i> , Department of Civil Engineering, KITSW.			

Course Articulation Matrix (CAM):				U24CE507 : ENVIRONMENTAL ENGINEERING LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE507.1	2	2	-	2	1	1	-	1	1	-	1	2	1
CO2	U24CE507.2	2	2	-	2	1	1	-	1	1	-	1	2	1
CO3	U24CE507.3	2	2	-	2	1	1	-	1	1	-	1	2	1
CO4	U24CE507.4	2	2	-	2	1	1	-	1	1	-	1	2	1
U24CE507		2	2	-	2	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	assess the quality of water for suspended matter	SDG6	Clean Water and Sanitation	Assessing suspended matter in water helps in monitoring water quality and ensuring safe and clean water for domestic and environmental purposes.
CO2	evaluate hardness and chloride content of the water samples	SDG6	Clean Water and Sanitation	Evaluating hardness and chloride content supports water quality assessment and helps maintain potable water standards and sustainable water management.
CO3	estimate dissolved oxygen concentration in water sample	SDG6	Clean Water and Sanitation	Estimating dissolved oxygen concentration is essential for assessing aquatic ecosystem health and monitoring pollution levels in water bodies.
CO4	determine the concentration of degradable organic matter	SDG6	Clean Water and Sanitation	Determining degradable organic matter concentration aids in evaluating wastewater pollution and improving sewage treatment and environmental protection practices.

HIGHWAY ENGINEERING LABORATORY			
Class: B. Tech. V – Semester		Branch: CE	
Course Code:	U24CE508	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%

Branch: CE

1

60%

40%

Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to,</i> CO1 : evaluate the mechanical properties of road aggregates. CO2 : analyze the physical and rheological properties of bituminous binders. CO3 : propose optimal bituminous mixes using Marshall Method. CO4 : Interpret traffic behavior, and appraise junction configurations.

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

- CO1 :** evaluate the mechanical properties of road aggregates.
- CO2 :** analyze the physical and rheological properties of bituminous binders.
- CO3 :** propose optimal bituminous mixes using Marshall Method.
- CO4 :** Interpret traffic behavior, and appraise junction configurations.

CO1 :	evaluatethe mechanical properties of road aggregates.
CO2 :	analyze the physical and rheological properties of bituminous binders.
CO3 :	propose optimal bituminous mixes using Marshall Method.
CO4 :	Interpret traffic behavior, and appraise junctionconfigurations.

- CO2: analyze the physical and rheological properties of bituminous binders.
- CO3: propose optimal bituminous mixes using Marshall Method.
- CO4: Interpret traffic behavior, and appraise junction configurations.

CO3: propose optimal bituminous mixes using Marshall Method.

CO4: Interpret traffic behavior, and appraise junction configurations.

CO4: Interpret traffic behavior, and appraise junction configurations.

LIST OF EXPERIMENTS	

8. Determination of abrasion value for aggregate
9. Determination of impact value for aggregate
10. Determination of shape indices for aggregate
11. Determination of specific gravity of aggregate & bitumen
12. Determination of soundness test on aggregates
13. Determination of ductility value and flash point for bitumen
14. Determination of softening point and penetration value for bitumen
15. Determination of viscosity for bitumen
16. Determination of bitumen content using extraction test
17. Determination of flow value through Marshall stability test
18. Determination of peak hour volume through traffic volume studies
19. Demonstration for of traffic speed studies
20. Demonstration of Intersection Design for Road Safety.
21. Demonstration on Design of 4-legged rotary intersection

Textbook(s): 1. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, <i>Highway Material Testing</i>, Roorkee: Nem Chand and Bros Publications, 2014.

1. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, *Highway Material Testing*, Roorkee: Nem Chand and Bros Publications, 2014.

Laboratory Manual (for laboratory component):

1. "*Highway Engineering Laboratory Manual*", Department of Civil Engineering, KITSW.

1. "*Highway Engineering Laboratory Manual*", Department of Civil Engineering, KITSW.

Course Articulation Matrix (CAM):				U24CE508: HIGHWAY ENGINEERINGLABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE508.1	3	2	-	3	-	-	-	-	-	-	1	3	-
CO2	U24CE508.2	3	2	-	3	-	-	-	-	-	-	1	3	-
CO3	U24CE508.3	3	3	3	3	-	-	-	-	-	-	1	3	2
CO4	U24CE508.4	3	3	2	3	-	2	-	-	2	-	1	3	3
U24CE508		3	2.5	2.5	3	0	2	0	0	2.25	1.25	0	3	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	evaluate the mechanical properties of road aggregates.	SDG 9	Industry, Innovation & Infrastructure	Testing aggregate strength and quality ensures roads are built with durable materials, leading to highly reliable infrastructure.
CO2	analyze the physical and rheological properties of bituminous binders.	SDG9	Industry, Innovation & Infrastructure	Testing binder properties allows students to select the best asphalt grade for local weather and traffic, preventing early cracking and rutting. This outcome helps to prevent premature pavement distresses like rutting or cracking, thereby resulting in resilient infrastructure networks.
CO3	propose optimal bituminous mixes using Marshall Method.	SDG9	Industry, Innovation & Infrastructure	Optimizing the asphalt mix ensures maximum stability and regulated flow, creating high-performance surfaces that withstand heavy wheel loads. Thereby resulting in resilient infrastructure.
CO4	Interpret traffic behavior, and appraise junction configurations.	SDG11	Sustainable Cities & Communities	Analyzing peak traffic and speeds provides the data needed to prevent congestion, improve road safety, and design more efficient city transport.

SEMINAR

Class: B. Tech. V – Semester		Branch: CE	
Course Code:	U24CE509	Credits:	1
Hours/Week (L-T-P-E):	0-0-2-2	CIE:	100%
Total Number of Teaching Hours:	-	ESE:	-

Course Learning Outcomes (COs)

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

CO1 :select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines/conference proceedings

CO2 :demonstrate the skills for performing a literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report

CO3 :create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic

CO4 :write a “seminar paper” in scientific journal style & format from the prepared seminar report

Student has to give an independent seminar on the state-of-the-art technical topics relevant to their program of study, which would supplement and complement the program assigned to each student.

Guidelines:

1. The HoD shall constitute a Department Seminar Evaluation Committee (DSEC)
2. DSEC shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format, and (iv)effective seminar presentation
3. There shall be only Continuous Internal Evaluation (CIE) for seminar
4. The CIE for seminar is as follows:

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

- . **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.
- a. **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by DSEC.
- b. **Anti-Plagiarism Check:** The seminar report should clear the plagiarism check as per the Anti-Plagiarism (including AI Plagiarism) policy of the institute.
- c. **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.
- d. The student has to register for the Seminar as a supplementary examination in the following cases:
 - i. The student is absent for oral presentation and viva-voce
 - ii. The student fails to submit the report in prescribed format
 - iii. The student fails to fulfill the requirements of seminar evaluation as per specified guidelines.
- iv. The CoE shall send a list of students registered for supplementary to the HoD concerned
- v. The DSEC, duly constituted by the HoD, shall conduct seminar evaluation and send the

award list to the CoE within the stipulated time

Course Articulation Matrix (CAM):		U24CE509: SEMINAR												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE509.1	2	2	-	2	2	1	1	-	1	-	3	1	1
CO2	U24CE509.2	2	3	1	3	2	1	1	1	2	-	3	1	1
CO3	U24CE509.3	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	U24CE509.4	1	2	1	2	2	1	2	1	3	-	2	1	1
U24CE509		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	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 9	Industry, Innovation and Infrastructure	Selection of current technical topics from research and professional sources encourages awareness of emerging engineering developments, technological innovation and infrastructure-oriented advancements.
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 survey, gap identification, technical analysis and report preparation support research-based learning, innovation-oriented thinking and systematic understanding of engineering developments.
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	Effective presentation of technical knowledge with awareness of social impact supports responsible engineering communication and promotes solutions relevant to societal needs and sustainable communities.
CO4	write a "seminar paper" in scientific journal style & format from the prepared seminar report	SDG 9	Industry, Innovation and Infrastructure	Scientific writing and structured technical documentation help disseminate engineering knowledge, promote innovation-based learning and support communication of technology-oriented developments.

VI SEMESTER (STREAM-II)(URR24)

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE	U24OE601X -S&EB	Open Elective - S&EB (from Pool - XVIII)	2	1	-	3	3
2	PEC	U24CE602	Program Elective -I / MOOCs-I	2	1	-	3	3
3	PCC	U24CE603	Water Resources and Irrigation Engineering	2	1	-	3	3
4	PCC	U24CE604	Design of Steel Structures	2	1	-	3	3
5	PCC	U24CE605	Foundation Engineering	2	1	-	3	3
6	IKSC	U24IK606B	Universal Human Values - II	2	-	-	2	2
7	HSMC	U24MH607	Technical English	-	-	2	2	1
8	PCC	U24CE608	Structural Detailing Laboratory	-	-	2	2	1
9	ELC	U24CE609	Mini Project	-	-	2	2	1
Total:				12	5	6	23	20
Additional Learning®:Maximum credits allowed for Honours/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				

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

Exit Option to Qualify B. Voc in CE: Any Two (02) Courses during the 2 - Months internship									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24CE610X	Estimation & Valuation	2	-	2	-	4	3
2	PCC	U24CE611X	Advanced Concrete Technology	2	-	2	-	4	3
3	PCC	U24CE612X	Traffic Engineering	2	-	2	-	4	3
4	PCC	U24CE613X	Any other course approved by BoS Chair and Dean AA	2	-	2	-	4	3

(OR)

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

Exit Option to Qualify B. Voc in CE: Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE610X	Finishing School program for fresh Civil Engineering Graduates https://nac.edu.in/finishing-school/	-	-	6	-	6	3
2	SEC	U24SE611X	Digital Photogrammetry and Remotesensing - https://www.surveyofindia.gov.in/pages/courses-offered	-	-	6	-	6	3
3	SEC	U24SE612X	Practical Aspects of Construction Management (PACM) - Site Engineer (Construction Management Training Institute - https://cmti.co.in/civil-engineering-certification-courses.html	-	-	6	-	6	3
4	SEC	U24SE613X	NITI Aayog Internship - https://www.niti.gov.in/internship	-	-	6	-	6	3
5	SEC	U24SE614X	Any other skill based course approved by BoS Chair and Dean AA	-	-	6	-	6	3

Note to HoDs on PCC: Under PCC the departments shall plan appropriate courses upto 6th semester overing GATE syllabus).

Design Thinking			
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 :	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):		U24OE601A- Design Thinking												
CO		PO 1	PO 2	PO3	PO4	P O5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PS O1	PS O2
CO1	U24OE601A.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601A.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601A.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601A.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601A		1.2 5	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <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 validating innovative solutions	SDG 3	Good Health and Well-being	Human-centered design improves usability, safety, and user well-being.
		SDG 11	Sustainable Cities and Communities	Supports identification of sustainable and community-oriented solutions.
CO3	develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies	SDG 9	Industry, Innovation and Infrastructure	Promotes innovation, product development, and technological advancement.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization and sustainable product development.
CO4	evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

Innovative Product Design & Development

Class: B. Tech. – VI -Semester

Branch: Common to All

Course Code:	U24OE601B	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <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.			

Course Articulation Matrix (CAM):		U24OE601B- Innovative Product Design & Development												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO1	U24OE601B.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601B.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601B.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601B.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601B		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

Course Outcome and SDG Goal Mapping:

CO-SDG Alignment Matrix				
CO	CO Statement <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 and Production	Encourages efficient resource utilization and sustainable product development.
CO4	design and build prototype performance using structural validation, risk analysis, and engineering metrics	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

ENTREPRENEURSHIP

Class: B. Tech. – VI -Semester			Branch: Common to All	
Course Code:		U24OE601C	Credits:	3

Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to...</i>			
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.			

- <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):		U24OE601C- Entrepreneurship												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO1	U24OE601C.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601C.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601C.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601C.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601C		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement <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 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. – VI -Semester		Branch: Common to All	
Course Code:	U24OE601D	Credits:	3
Hours/Week (L-T-P- E):	2-1-0-3	CIE:	60%
Total Number of Teaching Hours:	36 Hrs	ESE:	40%
Course Learning Outcomes (COs) <i>After completion of this course, the students should be able to...</i> 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.			

<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):				U24OE601D- Design Studio										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P O7	PO 8	PO 9	P O10	PO 11	PSO 1	PSO 2
CO1	U24OE601D.1	2	2	1	1	1	1	-	1	1	-	1	-	-
CO2	U24OE601D.2	1	2	2	2	1	1	1	1	1	-	1	-	-
CO3	U24OE601D.3	1	2	3	2	2	1	1	1	1	1	1	-	-
CO4	U24OE601D.4	1	1	3	2	2	2	1	2	2	2	2	-	-
U24OE601D		1.25	1.75	2.25	1.75	1.5	1.25	1	1.25	1.25	1.5	1.25	-	-
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	Course Outcome	Mapped SDGs		Justification
CO1	deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques.	SDG 4	Quality Education	Promotes experiential and innovation-based learning by equipping learners with problem-solving, research, and intellectual property skills essential for the 21st century
		SDG 9	Industry, Innovation and Infrastructure	Fosters innovation capacity by encouraging the development of novel technologies, strengthening industry-oriented research, and supporting sustainable technological advancement.
CO2	apply system-level architecture and feasibility models to design technical solutions.	SDG 3	Good Health and Well-being	Supports the design of reliable healthcare technologies and systems that enhance accessibility, efficiency, and overall well-being
		SDG 11	Sustainable Cities and Communities	Facilitates the creation of smart, resilient, and resource-efficient infrastructure solutions that improve urban sustainability and quality of life.
CO3	build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools.	SDG 9	Industry, Innovation and Infrastructure	Promotes technological innovation and strengthens engineering capabilities by accelerating product development and industry-relevant solutions.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization, iterative design, and sustainable product development practices that minimize waste and optimize production processes.
CO4	validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan.	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven employment, and sustainable economic growth through market-oriented solution development.
		SDG 9	Industry, Innovation and Infrastructure	Strengthens industry-academia innovation ecosystems by facilitating the translation of validated technologies into scalable solutions.
		SDG 17	Partnerships for the Goals	Encourages collaboration among academia, industry, government, and end users to co-create impactful and sustainable innovations.

ADVANCED ANALYSIS OF STRUCTURES

Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE602A	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 :** analyse three and two hinged arches
- CO2 :** evaluate internal forces for cables and suspension bridges under different loadings
- CO3 :** apply flexibility matrix method to estimate internal forces for beams and frames
- CO4 :** apply stiffness matrix method to determine internal forces for beams and frames

UNIT-I	9 Hrs
Three Hinged Arches: Principle of arch action, Eddy's theorem, Circular and parabolic arches - Determination of horizontal thrust, Bending moment, Normal thrust, Radial shear force, Influence line diagrams Two Hinged Arches: Principle involved in analysis of two hinged arches, Circular and parabolic arches - Determination of horizontal thrust, Bending moment, Normal thrust, Radial shear force, Influence line diagrams	
UNIT-II	9 Hrs
Cables: Forces in cables subjected to point loads and uniformly distributed load, Cables with supports at same levels and different levels, Length of cable, Different support conditions, Influence line diagrams Suspension Bridges: Simple suspension bridges with two hinged and three hinged stiffening girders, Bending moment and shear force diagrams, Influence line diagrams	
UNIT-III	9 Hrs
Flexibility Matrix Method for Beams: Determination of internal and external static indeterminacy for different types of structures, Analysis of beams up to second degree of static indeterminacy, Bending moment and shear force diagrams Flexibility Matrix Method for Frames: Rectangular portal frames – Second degree of static indeterminacy; Bending moment and shear force diagrams, Analysis of statically indeterminate plane trusses up to second degree	
UNIT-IV	9 Hrs
Stiffness Matrix Method for Beams: Determination of kinematic indeterminacy for different types of structures, Analysis of continuous beams up to second degree of kinematic indeterminacy, Bending moment and shear force diagrams Stiffness Matrix Method for Frames: Rectangular portal frames up to second degree of kinematic indeterminacy, Bending moment and shear force diagrams, Analysis of statically indeterminate plane trusses up to second degree of kinematic indeterminacy	
Textbook(s): 1. C.S. Reddy, <i>Basic Structural Analysis</i>, 3rd ed. New Delhi: Tata McGraw Hill Education Pvt. Ltd., 2017. (Chapters 2, 8 and 10) 2. G.S. Pandit and S.P. Gupta, <i>Structural Analysis -A Matrix Approach</i>, 2nd ed. New Delhi: McGraw Hill Education Pvt. Ltd., 2017. (Chapters 1, 4, 5, 6 and 7)	
Reference Book(S):	

1. J.S. Przemieniecki, *Theory of Matrix Structural Analysis*, 3rd ed. Columbia: Dover Publications Inc., 2018.
2. Weaver and Gere, *Matrix analysis of framed structures*, 5th ed. New Delhi: CBS Publishers and distributors Pvt. Ltd., 2018.
3. Praveen Nagarajan, *Matrix Methods of Structural Analysis*, New Delhi: CRC Press, 2018.
4. Sujit Kumar Roy and Subrata Chakrabarty, *Fundamentals of structural analysis with computer analysis and applications*, revised ed. New Delhi: S. Chand and Company Ltd., 2012.

1. [https://www.youtube.com/playlist?list=PLAE2D920B08D74108NPTEL](https://www.youtube.com/playlist?list=PLAE2D920B08D74108NPTELVideoLectureonNPTEL) Video Lecture Series on Structural Analysis II (Arches, Cables & Force Method) by Prof. P. Banerjee, Department of Civil Engineering, IIT Bombay
2. <https://nptel.ac.in/courses/105101086NPTEL> Course on Structural Analysis II (Force Method, Influence Lines, Indeterminate Structures) by Prof. P. Banerjee, IIT Bombay
3. https://onlinecourses.nptel.ac.in/noc25_ce110/previewNPTEL Course on Advanced Structural Analysis (Flexibility & Stiffness Matrix Methods) by Dr. Devesh Punera, IIT Bhubaneswar
4. <https://nptel.ac.in/courses/105105180NPTEL> Course on Matrix Method of Structural Analysis (Flexibility & Stiffness Matrix for Beams, Frames and Trusses) by Prof. Amit Shaw and Prof. Biswanath Banerjee, IIT Kharagpur

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	analyse three and two hinged arches	SDG 9	Industry, Innovation and Infrastructure	Analysis of three and two hinged arches reduces bending moments in long-span structures, enabling efficient design of bridges, industrial halls, and large-span infrastructure essential for sustainable industrial development.
CO2	evaluate internal forces for cables and suspension bridges under different loadings	SDG 9	Industry, Innovation and Infrastructure	Evaluation of internal forces in cables and suspension bridges provides the analytical foundation for designing long-span bridge systems that are critical components of resilient and sustainable transport infrastructure.
CO3	apply flexibility matrix method to estimate internal forces for beams and frames	SDG 11	Sustainable Cities and Communities	The flexibility matrix method enables systematic analysis of indeterminate beams and frames, supporting the design of robust and material-efficient urban structures for safe, resilient, and sustainable communities.
CO4	apply stiffness matrix method to determine internal forces for beams and frames	SDG 11	Sustainable Cities and Communities	The stiffness matrix method forms the basis of modern computer-aided structural analysis used in designing complex urban frames and buildings, contributing to safe, resilient, and resource-efficient construction in growing cities.

TRAFFIC ENGINEERING AND URBAN MOBILITY			
Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE602B	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 : summarize traffic characteristics using modern data methods. CO2 : design signalized and unsignalized intersections. CO3 : analyze traffic accidents for road safety. CO4 : categorize mass transport systems for urban mobility			
UNIT-I			9 Hrs
Traffic Characteristics and Control Devices: Human-vehicle-environment system, relationship between speed, travel time, volume, density and capacity. Traffic signs, Road markings, Roadway delineators, hazard markers, object markers, speed breakers, rumble strips, barricaders and channelisers, Traffic Attenuators. Traffic Data Analysis: Traffic study components and types of data; Volume, Speed, Travel time and delay studies. Intersection, Pedestrian studies and Parking surveys. Overview of GPS, Instrumented Vehicles, Image Processing, Bluetooth, Infrared, Drone based traffic data collection.			
UNIT-II			9 Hrs
Unsignalized Intersections: Types of at grade intersections types, factors affecting design, data requirement, parameters selection, intersection controls, estimation of conflict points, uncontrolled intersection analysis, sight distance requirements, roundabouts and design methodologies, capacity of roundabouts. Signalized Intersections: Warrants for signalization, saturation flow rate and capacity, Signal timing design using Webster's and IRC methods including amber time estimation. Basic concepts of control delay and signal coordination.			
UNIT-III			9 Hrs
Traffic Safety and Accident Analysis: Accident terminology, causative factors- road, vehicle, driver, skidding, speed, and weather. Collection of accident data; Statistical methods for analysis of accident data. Traffic management and preventive measures; Introduction to road safety audit. Parking Facility Design: Parking demand estimation and influencing factors; type of parking system, design parameters for on-street parking- parking angles and aisle width, and basic off-street parking layouts.			
UNIT-IV			9 Hrs
Urban Transportation Planning: Urbanization, urban class groups, transportation problems identification, and impacts. The generalized urban transport system planning process and travel characteristics. Policies for urban transportation. Mass Transit Systems: Types of transit systems, public, private, para-transit transport. Mass and rapid transit systems, Bus Rapid Transit System (BRTS) and Metro rails – comparative analysis of capacity, operational merits and institutional coordination.			
Textbook(s): 1. Highway Engineering by S.K.Khanna, C.E.G. Justo and A. Veerragavan, 10th edition. 2. Traffic Engineering and Transport Planning, Kadiyali, L.R., Khanna Publishers, 9th Edition (Second Reprint 2025). 3. Traffic Engineering, Roger P. Roess, Elena S. Prassas and William R. McShane, Prentice Hall, 4th Edition, 2010.			

Reference Book(S):

1. Nicholas J. Garber, Lester A. Hoel, Principles of Traffic and Highway Engineering, Cengage Learning India, 2nd Edition, 2010.
2. Indian Highway Capacity Manual (INDO-HCM), Chandra, Satish, Gangopadhyay, S, Velmurugan, S, Ravinder, Kayitha, CSIR-CRRI, 2017.

Web and Video link(s):

<https://nptel.ac.in/courses/105105215> NPTEL Video Lecture on Traffic Engineering by Prof. Bhargab Maitra, Professor of CED, IIT Kharagpur.

Course Articulation Matrix (CAM):				U24CE602B:TRAFFIC ENGINEERING AND URBAN MOBILITY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE602B.1	3	3	-	2	2	-	-	-	-	-	1	3	-
CO2	U24CE602B.2	2	3	2	2	-	3	-	-	1	-	-	3	2
CO3	U24CE602B.3	3	3	3	2	-	2	-	-	-	-	-	3	-
CO4	U24CE602B.4	2	2	1	-	-	3	-	-	-	-	2	2	3
U24CE602B		2.5	2.75	2	2	2	2.67	-	0	1	0	1.5	2.75	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	summarize traffic characteristics using modern data methods.	SDG9	Industry, Innovation & Infrastructure	This outcome deals how to use modern tech – like drones, Bluetooth, and GPS – to upgrade traditional traffic tracking into smart transportation systems. By building these advanced, tech-driven networks, it directly supports in creating resilient infrastructure.
CO2	design signalized and unsignalized intersections.	SDG9	Industry, Innovation & Infrastructure	Intersections are major road bottlenecks. This outcome teaches students to optimize traffic signals for smoother passenger and freight travel, supporting the goal of building smart, sustainable infrastructure.
CO3	analyze traffic accidents for road safety.	SDG3	Good Health & Well-being	Road accidents are a leading cause of death and injury worldwide. This outcome is useful to analyze accident data and design smart traffic safety solutions. This directly supports SDG Target 3's goal to drastically cut global traffic injuries and fatalities.
CO4	categorize mass transport systems for urban mobility	SDG11	Sustainable Cities & Communities	By studying mass transit like Metros and Bus Rapid Transit Systems (BRTS), students learn how to solve major city traffic congestion.

U24CE602C: GROUND IMPROVEMENT TECHNIQUES

Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE602C	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 : To introduce the need, classification, selection criteria, dewatering methods, preloading and vertical drain techniques used for improving weak and compressible soils. CO2 : To develop understanding of shallow compaction, deep densification and liquefaction mitigation techniques used for loose granular soils and seismic ground improvement. CO3 : To explain soil stabilization, sustainable binders, grouting, deep soil mixing and stone column techniques used for improving strength, stiffness and settlement behaviour. CO4 : To introduce geosynthetics, reinforced soil systems, soil nailing, ground anchors and emerging sustainable ground improvement techniques used in modern geotechnical practice.			
UNIT-I			9 Hrs
Fundamentals of Ground Improvement: Problematic soils; objectives of ground improvement; classification of ground improvement techniques; improvement of strength, stiffness, compressibility, permeability and liquefaction resistance; factors affecting selection of ground improvement method based on soil type, groundwater condition, loading condition, depth of treatment, cost, constructability and sustainability. Dewatering, Preloading and Vertical Drains: Dewatering methods; sumps and interceptor ditches; well points; deep wells; vacuum well points; preloading and surcharging; staged construction; sand drains; prefabricated vertical drains; vacuum consolidation; field monitoring using settlement plates and piezometers.			
UNIT-II			9 Hrs
Compaction and Deep Densification Techniques: Principles of field compaction; shallow compaction equipment; factors affecting field compaction; field compaction control; dynamic compaction; rapid impact compaction; vibro-compaction/vibro-flotation; compaction piles; blasting densification; selection of densification method based on soil gradation, fines content, groundwater level and depth of improvement. Ground Improvement for Liquefaction Mitigation: Liquefaction and quicksand condition; factors affecting liquefaction; damage potential of liquefaction; liquefaction mitigation using densification, drainage, stone columns, grouting and reinforcement.			
UNIT-III			9 Hrs
Soil Stabilization and Sustainable Binders: Mechanical stabilization; lime stabilization; cement stabilization; fly ash stabilization; stabilization of expansive soils; use of industrial by-products such as fly ash, GGBS, rice husk ash, cement kiln dust and construction-demolition waste; low-carbon binders; strength, durability, field quality control and environmental considerations. Grouting, Deep Mixing and Stone Columns: Objectives of grouting; types of grouts; permeation grouting; compaction grouting; jet grouting; post-grout verification; deep soil mixing; dry and wet mixing methods; soil-cement columns; soil-lime columns; stone columns; vibro-replacement; encased stone columns; load transfer mechanism; bearing capacity improvement, settlement reduction, applications and limitations.			
UNIT-IV			9 Hrs
Geosynthetics and Reinforced Soil Systems: Concept of reinforced soil; soil-reinforcement interaction;			

geotextiles, geogrids, geomembranes, geonets and geocomposites; functions of geosynthetics: separation, filtration, drainage, reinforcement and containment; mechanically stabilized earth walls; reinforced soil slopes; basal reinforcement for embankments on soft ground; geosynthetics in roads, railways, landfills and erosion control.

In-Situ Reinforcement and Emerging Sustainable Techniques: Soil nailing; ground anchors and tiebacks; applications in slopes, excavations and retaining systems; introduction to bio-mediated ground improvement; microbial induced carbonate precipitation; biopolymers; electro-osmosis; ground freezing; sustainability assessment of ground improvement methods considering carbon footprint, material consumption, spoil generation, groundwater impact, constructability and long-term performance.

Textbook(s):

1. Purushothama Raj, P., **Ground Improvement Techniques**, 3rd Edition, Laxmi Publications, New Delhi, 2023. ISBN: 9788131805947.
2. Kirsch, K. and Bell, A. (Eds.), **Ground Improvement**, 3rd Edition, CRC Press / Taylor & Francis, 2012. **Print ISBN:** 9780415599214.
3. Hausmann, M. R., **Engineering Principles of Ground Modification**, McGraw-Hill, 1990. ISBN: 9780070272798.

Reference Book(S):

1. FHWA, **Ground Modification Methods Reference Manual, Volumes I and II**, Geotechnical Engineering Circular No. 13, Federal Highway Administration, U.S. Department of Transportation, 2017. **Publication Nos.:** FHWA-NHI-16-027 and FHWA-NHI-16-028.
2. Gopal Ranjan and Rao, A. S. R., **Basic and Applied Soil Mechanics**, 3rd Edition, New Age International Publishers, 2016. ISBN: 9788122440393.
3. Moseley, M. P. and Kirsch, K. (Eds.), **Ground Improvement**, 2nd Edition, Spon Press / Taylor & Francis, 2004. ISBN: 9780415274555.

Course Articulation Matrix (CAM):				U24CE602C: GROUND IMPROVEMENT TECHNIQUES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE602C.1	3	2	2	2	1	2	2	-	1	1	2	3	2
CO2	U24CE602C.2	3	3	2	2	1	2	2	-	1	1	2	3	2
CO3	U24CE602C.3	3	3	3	2	1	2	3	-	1	1	2	3	2
CO4	U24CE602C.4	3	2	3	2	1	3	3	-	1	1	2	3	3
U24CE602C		3.00	2.50	2.50	2.00	1.00	2.25	2.50	-	1.00	1.00	2.00	3.00	2.25
3 - HIGH, 2 - MEDIUM, 1 - LOW														

Course Articulation Matrix (CAM) Justification

CO	Mapped PO/PSO	Justification
CO	PO1, PO2, PO3,	CO1 requires students to apply geotechnical engineering knowledge to identify

1	PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	problematic ground conditions and select suitable improvement methods. It involves interpretation of soil and groundwater conditions, evaluation of constructability, cost, safety and environmental impact, and selection of technically feasible solutions for field conditions.
CO 2	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO2 deals with compaction, densification and liquefaction mitigation. Students are expected to understand the behaviour of loose granular soils, evaluate suitable densification techniques and relate soil improvement methods to seismic safety, field performance and construction control.
CO 3	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO3 involves stabilization, sustainable binders, grouting, deep mixing and stone columns. These methods require understanding of soil improvement mechanisms, material behaviour, strength gain, settlement reduction, field quality control, durability and environmental suitability.
CO 4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO4 focuses on geosynthetics, reinforced soil, soil nailing, ground anchors and emerging sustainable techniques. It connects modern ground improvement practice with infrastructure safety, slope and retaining system stability, resource efficiency, sustainability and field applicability.

CO-SDG Matrix (CSM) Justification

CO	Mapped SDG	Justification
CO1	SDG 9, SDG 11, SDG 12	CO1 supports proper selection of ground improvement methods for safe and durable infrastructure. It also encourages resource-efficient and sustainable decision-making based on soil conditions, groundwater conditions, cost, constructability and environmental impact.
CO2	SDG 9, SDG 11, SDG 13	CO2 contributes to resilient infrastructure by addressing compaction, densification and liquefaction mitigation. These methods are important for safer buildings, embankments, industrial facilities and transportation corridors in earthquake-prone and loose sand deposits.
CO3	SDG 9, SDG 11, SDG 12	CO3 promotes improvement of weak and problematic soils using stabilization, grouting, deep mixing and stone columns. The inclusion of industrial by-products and low-carbon binders supports responsible material use and sustainable construction practices.
CO4	SDG 9, SDG 11, SDG 12, SDG 13	CO4 supports the use of geosynthetics, reinforced soil and sustainable ground improvement systems that reduce material consumption, improve slope and embankment performance, support resilient infrastructure and reduce environmental burden.

WATER SHED MANAGEMENT			
Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE602D	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: summarize characteristics and social-aspects of watershed management. CO2: appraise rural and urban watershed management and erosion control measures. CO3: recommend ground water harvesting and conservation strategies. CO4: prioritize ecosystem and grassland management for sustainability.			
UNIT-I			9 Hrs
Elements of Watershed management: Definition, Objectives and need for watershed development, Characteristics of Watershed - Size, shape, Physiographic, Slope, Climate, Drainage, Land use, Vegetation, Geology and Soils, Hydrology, Hydrogeology and Socioeconomic, Watershed management. Social Aspects of Watershed Management: Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations.			
UNIT-II			9 Hrs
Watershed management: Basic principles of watershed management, Maps and Models of Participatory Rural Appraisal programmes, Storm water management, flood routing through drainage system, channels and reservoir, flood control and reservoir operation, modern techniques in watershed management- Applications of RS and GIS in Watershed Management. Erosion Control Measures on Agricultural Land: Soil Erosion and control measures, Contour cultivation, Contour bunding, Graded bunds, Bench terracing, Grassed water ways, Mechanical erosion control measures for non-agricultural land, Contour trenching, Gully control measures, Vegetative control measures, Check dams, Brush dams, semi-permanent gully, Control structures.			
UNIT-III			9 Hrs
Water Harvesting and Conservation: Rainwater harvesting, Catchment harvesting, harvesting structures, Soil moisture conservation, Check dams, Artificial recharge, Farm Ponds, Percolation tanks. Groundwater Management in Watershed: Types of aquifers, vertical distribution of groundwater, Conjunctive use of surface and groundwater.			
UNIT-IV			9 Hrs
Ecosystem Management: Role of ecosystem, Crop husbandry, Soil enrichment, inter mixed and strip-cropping, Cropping pattern, Sustainable agriculture, Bio-mass management, Dry land agriculture, Silvi pasture, Horticulture, Social forestry and Afforestation. Grassland Management: Joint forestry management Monitoring and evolution of watershed, Planning of watershed management activities, Preparation of Action plan, administrative requirements.			

Textbook(s):

1. J. V. S. Murthy “Watershed Management”, New Age International Publishers, New Delhi, 2nd edn.

Reference Book(S):

1. R. Awurbs and W. P. James, “Water Resource Engineering”, Prentice Hall Publishers, 1st edn., 2001.
2. Rajesh Rajora, “Integrated watershed management”, Rawat publications, 2nd edn., 1998.
3. D. K. Majumdar, “Irrigation and Water Management”, Printice Hall of India, 2nd edn., 2005.

Web and Video link(s):
<https://nptel.ac.in/courses/105101010>

<https://nptel.ac.in/courses/105101010>

Course Articulation Matrix (CAM):				U24CE602D: WATER SHED MANAGEMENT										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE602D.1	2	2	2	2	1	2	-	1	1	-	2	1	2
CO2	U24CE602D.2	2	2	2	2	1	2	-	1	1	1	2	2	2
CO3	U24CE602D.3	2	2	2	2	1	2	-	1	1	1	2	1	2
CO4	U24CE602D.4	2	2	2	2	1	2	-	1	1	1	2	2	2
U24CE602D		2	2	2	2	1	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	summarize characteristics and social-aspects of watershed management.	SDG 15: Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, combat desertification, halt and reverse land degradation and biodiversity loss	Watershed characteristics (soil, vegetation, land use, slope) directly relate to land health. Social aspects like community participation and integrated development are essential for sustainable land management and combating degradation.
CO2	appraise rural and urban watershed management and erosion control measures.	SDG 2: Zero Hunger	End hunger, achieve food security, improved nutrition and promote sustainable agriculture	Erosion control measures (contour bunding, terracing, gully control, check dams) preserve topsoil and soil fertility, directly enhancing agricultural productivity and food security for rural communities.
CO3	recommend ground water harvesting and conservation strategies.	SDG 6: Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all	Rainwater harvesting, check dams, percolation tanks, farm ponds, artificial recharge, and conjunctive use of surface and groundwater directly address sustainable freshwater management and water-use efficiency.
CO4	prioritize ecosystem and grassland management for sustainability.	SDG 13: Climate Action	Take urgent action to combat climate change and its impacts	Afforestation, social forestry, biomass management, and grassland management increase carbon sequestration, reduce land degradation, and build climate resilience in vulnerable ecosystems and agricultural regions.

ADVANCED DATA STRUCTURES			
Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE602E	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 : develop programs using binary trees, binary search trees to optimize database queries.			
CO2 : utilize balanced search trees such as B-trees, B+-trees, red black and Splay trees in solving the problems on Database management			
CO3 : organize and retrieve the data using Interval tree, Hash tree, Tries, sorting and searching in solving the problems like auto complete.			
CO4 : organize and retrieve the data using Graphs and different types of spanning trees used for GPS navigation.			
THEORY COMPONENT			
UNIT-I			9 Hrs
Trees: Introduction, types of trees.			
Binary Tree: Creating a binary tree, traversing a binary tree: preorder, inorder, postorder and spiral order recursive traversals.			
Binary Search Tree: Operations-Insertion, deletion, search, recursive and non-recursive traversal. Threaded binary trees			
UNIT-II			9 Hrs
AVL Trees: AVL trees operations– Insertion, Deletion and Traversal.			
Multiway Search Trees: Introduction tom-way search trees. Operations on B-Trees-Insertion, deletion, search. B+-trees.			
Red-Black Trees: Properties, operations, applications. splay trees.			
UNIT-III			9 Hrs
Interval Tree, Hash tree.			
Tries: Trie structure. Operations on Tries, Applications of Tree indexing.			
Searching and Internal Sorting: Fibonacci search, quick sort, merge sort, heap sort, bitonic generator sort; time complexities of above searching and sorting techniques.			
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 manipulations, String compression -Run Length Encoding.			
String Matching Algorithms-Naive Algorithm, (Knuth Morris Pratt) Algorithm, Boyer Moore Algorithm, Rabin Karp Algorithm.			
Textbook(s):			
1. DebasisSamanta, Classic Data Structures, 2nd ed., New Delhi: Prentice Hall India			

2009. (Chapters 3 to 8)

Reference Book(S):

1. Thareja, R. (2014). *Data structures using C* (2nd ed.). New Delhi: Oxford University Press.
2. Balagurusamy, E. (2017). *Data structure using C* (1st ed.). New Delhi: McGraw Hill Education.
3. Gilberg, R. F., & Forouzan, B. A. (2007). *Data structures: A pseudocode approach with C* (2nd ed.). New Delhi: Cengage Learning.

Web and Video link(s):

<https://nptel.ac.in/courses/106106130>; NPTEL Video Lecture on Advanced Data Structures by Prof. Narayanaswamy, Professor of Computer Science and Engineering, IIT Madras.

Course Articulation Matrix (CAM):				U24CE602E: ADVANCED DATA STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE602E.1	2	2	2	2	1	1	1	1	1	1	1	2	2
CO2	U24CE602E.2	2	2	2	2	1	1	1	1	1	1	1	2	2
CO3	U24CE602E 5.3	2	2	2	2	1	1	1	1	1	1	1	2	2
CO4	U24CE602E.4	2	2	2	2	1	1	1	1	1	1	1	2	2
U24CE602E		2	2	2	2	1	1	1	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	Develop programs using binary trees, binary search trees to optimize database queries	SDG 9	Industry, Innovation & Infrastructure	Efficient data structures improve database query performance, supporting innovation in IT infrastructure.
CO2	Utilize balanced search trees (B-Trees, B+-Trees, Red-Black, Splay Trees) in solving DBMS problems	SDG 8	Decent Work & Economic Growth	Balanced trees enable scalable database systems, fostering digital economy growth and resilient infrastructure.
CO3	Organize and retrieve data using Interval Trees, Hash Trees, Tries, Sorting & Searching for autocomplete problems	SDG 4	Quality Education	Enhances educational tools (autocomplete, indexing) and supports innovation in search technologies.
CO4	Organize and retrieve data using Graphs and Spanning Trees for GPS navigation	SDG 11	Sustainable Cities & Communities	Graph algorithms optimize GPS navigation, contributing to sustainable urban mobility and smart infrastructure.

WATER RESOURCES AND IRRIGATION ENGINEERING			
Class: B. Tech. VI- Semester		Branch: CE	
Course Code:	U24CE603	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: analyse irrigation methods, soil–water–plant relationships, and canal design principles for efficient distribution and management of irrigation water. CO2: analyse diversion headworks using seepage theories and design weirs. CO3: design cross-drainage works and analyse hydropower plant components and load characteristics. CO4: apply the principles of design and analysis of canal falls and fall structures for efficient energy dissipation in irrigation canals.			
UNIT-I			9 Hrs
Methods of Irrigation: necessity and scope of irrigation, benefits and ill effects, types of irrigation, methods of applying water to crops, soil-water-plant relationship, soil moisture, field capacity, permanent wilting point, function of irrigation water, duty, delta, irrigation frequency, water requirements of crops, irrigation efficiencies, crop rotation. Canal Irrigation: classification of canals, canal alignment, channel design based on Kennedy's theory & Lacey's regime theory, channel cross-section in cutting and filling, balancing depth, necessity of canal lining, canal outlets.			
UNIT-II			9 Hrs
Diversion Head works: components, layout of diversion head work, weirs and barrages, Bligh's creep theory, Lane's theory and Khosla's theory on design of weirs on permeable foundations, divide wall, fish ladder, under sluice, silt ejectors and silt excluders, upstream and downstream protection measures. Design of Weir: vertical drop weir – hydraulic calculations for fixing various elevations, design of weir wall, design of impervious aprons, design of inverted filter and d/s talus.			
UNIT-III			9 Hrs
Cross - drainage works: necessity, types of cross-drainage works and selection, design principles of aqueduct and siphon aqueduct, bank connections, bed and bank protection, river training works, groynes and guide banks. Hydropower Engineering: introduction – source of energy, flow duration and power duration curves, load curves, load factor, utilization and capacity factor - hydropower plants, classification, layout and components, power house general layout and its classifications based on location, penstock and water hammer effect.			

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	analyse irrigation methods, soil-water-plant relationships, and canal design principles for efficient distribution and management of irrigation water.	SDG 6	Clean Water and Sanitation	Efficient irrigation methods and canal design promote sustainable water management and improve agricultural water-use efficiency.
CO2	analyse diversion headworks using seepage theories and design weirs.	SDG 9	Industry, Innovation and Infrastructure	Design of diversion headworks and weirs supports development of reliable and resilient water infrastructure systems.
CO3	design cross-drainage works and analyse hydropower plant components and load characteristics.	SDG 7	Affordable and Clean Energy	Hydropower plant analysis and design contribute to sustainable and renewable energy generation.
CO4	apply the principles of design and analysis of canal falls and fall structures for efficient energy dissipation in irrigation canals.	SDG 9	Industry, Innovation and Infrastructure	Design of canal falls and energy dissipation structures ensures efficient and safe conveyance of irrigation water resources.

DESIGN OF STEEL STRUCTURES			
Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE604	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: distinguish design philosophies in steel structures and analyse bolted connections CO2: design different types of steel sections subjected to tension & compression CO3: determine the design capacity of steel flexural members & column bases CO4: evaluate the strength of eccentric bolted & welded connections			
UNIT-I			9 Hrs
Principles of Limit State Design: Types of structural steel, Advantages, Design Philosophies-Working stress, Limit state, Ultimate load methods, Ultimate and serviceability limit states, Loads and load combinations, Partial safety factors Bolted Connections: Types of bolted connections, Lap and butt connection, Assumptions made in analysis, Failure of bolted connections, Efficiency of joints and Strength of plate connections.			
UNIT-II			9 Hrs
Tension Members: Types of tension members, Behaviour of tension members, Net sectional area, Analysis of tension members, Sectional efficiency, Design of tension members, Splices in tension members Compression Members: Types of column sections, Behaviour of compression member, Classification of cross sections, Slenderness for flexural buckling, Design considerations, Analysis and Design of compression member, Design of built-up compression member.			
UNIT-III			9 Hrs
Flexural Members: Types of sections for beams, Behaviour of beams in flexure, Classification of beam cross sections, Plastic moment carrying capacity of section, Stability of beams, Failure modes, Design criteria for beams, Effective span of beams, Design moment and shear strength, Built up beam sections Column Bases: introduction, types of column basis, Design of slab base, Gusseted base, bolted connection and Grillage foundation			
UNIT-IV			9 Hrs
Eccentric Connections: Beam Column Connections, Bolted Framed connections, Un-Stiffened and Stiffened seat connections, Bolted bracket connections. Welded Connections: Welding, Methods of welding, Types of welded joints, Specifications for fillet welded joints, Strength of fillet welds, Stresses due to individual forces, Combination of stresses, Design of joint			

Textbook(s):

1. S.K. Duggal, Limit state design of steel structures, 3rd edn. New Delhi: Tata McGraw-Hill Education, 2019.

Reference Book(S):

1. N. Subramanian, Design of Steel Structures: By Limit State Method as Per IS: 800-2007, 5thedn. New Delhi:Oxford University Press, 2018.
2. M.L. Gambhir, Fundamentals of Structural steel design, New Delhi: Tata McGraw-Hill Education, 2013.
3. S. S. Bhavikatti, Design of Steel Structures: By Limit State Method as Per IS: 800-2007, 3rd ed. New Delhi: International Publishing House Pvt. Ltd, 2012.
4. IS 800:2007 General construction in steel - Code of practice, 3rd ed. New Delhi: Bureau of Indian standards, 2007.
5. SP: 6 (1-7) Handbook for structural engineers, New Delhi: Bureau of Indian standards.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ce58;NPTEL *Design of Structural Systems, By Prof. T. Jothi Saravanan, IIT Bhubaneswar.*

Course Articulation Matrix (CAM):				U24CE604: DESIGN OF STEEL STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE604.1	1	2	2	-	-	1	1	-	-	-	1	2	1
CO2	U24CE604.2	1	2	2	-	-	1	1	-	-	-	1	2	1
CO3	U24CE604.3	1	2	2	-	-	1	1	-	-	-	1	2	1
CO4	U24CE604.4	1	2	2	-	-	1	1	-	-	-	1	2	1
U24CE604		1	2	2	-	-	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	distinguish design philosophies in steel structures and analyse bolted connections	SDG9	Industry, Innovation and Infrastructure	The study of steel structure design philosophies and bolted connection analysis contributes primarily by enabling safe, resilient, and efficient infrastructure systems
CO2	design different types of steel sections subjected to tension & compression	SDG9	Industry, Innovation and Infrastructure	The study of steel structure design philosophies and bolted connection analysis contributes primarily by enabling safe, resilient, efficient infrastructure systems, and reducing environmental impacts through material-efficient structural design
CO3	determine the design capacity of steel flexural members & column bases	SDG 11		Determining the design capacity of steel flexural members and column bases primarily contributes by ensuring safe, efficient, and resilient structures. through safer urban infrastructure
CO4	evaluate the strength of eccentric bolted & welded connections	SDG 11	Sustainable Cities and Communities	The evaluation of strength of eccentric bolted and welded connections Properly designed connections reduce risk of structural failures and collapse. Enhances safety and durability of urban buildings and public infrastructure.

FOUNDATION ENGINEERING			
Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE605	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: To introduce subsurface investigation methods, field tests and foundation selection criteria for different soil and loading conditions.			
CO2: To develop understanding of bearing capacity, settlement and design principles of shallow foundations including isolated, combined and raft foundations.			
CO3: To explain the load carrying capacity, settlement, group action and field testing of pile foundations.			
CO4: To introduce earth pressure, slope stability, expansive soil foundations and well/caisson foundations used in practical geotechnical engineering.			
UNIT-I			9 Hrs
Subsurface Exploration: Objectives and stages of subsurface investigation; methods of boring; spacing and depth of boreholes; types of samplers; disturbed and undisturbed sampling; sample disturbance; Standard Penetration Test; static and dynamic cone penetration tests; plate load test; interpretation of field test data.			
Foundation Selection and Bearing Capacity Basics: Types of foundations; types of loads on foundations; factors governing choice of foundation; bearing capacity definitions; general, local and punching shear failure; safe bearing capacity, net safe bearing capacity and allowable bearing pressure; field determination of bearing capacity.			
UNIT-II			9 Hrs
Bearing Capacity of Shallow Foundations: Terzaghi's bearing capacity theory; Skempton's bearing capacity equation for clays; IS Codal approach; effect of size, shape, depth of embedment, water table.			
Settlement and Design of Shallow Foundations: Settlement of foundations; elastic settlement; consolidation settlement; settlement in sands and clays; permissible settlement; proportioning of isolated footings; combined footings; strap footings; raft foundations; contact pressure distribution below footings and rafts; design considerations for shallow foundations.			
UNIT-III			9 Hrs
Single Pile Capacity and Pile Load Tests: Pile foundations; classification of piles; load transfer mechanism; load carrying capacity of single piles in sand and clay using static formulae; dynamic formulae; Engineering News Record formula and Hiley formula; negative skin friction; pile load tests; interpretation of pile load test results.			
Pile Groups and Laterally Loaded Piles: Group action of piles; pile group efficiency; pile groups in sand and clay; settlement of pile groups; block failure of pile groups; basic concepts of laterally loaded piles; pile foundation design considerations; simple numerical problems.			

Course Articulation Matrix (CAM) Justification

CO	Mapped PO/PSO	Justification
CO 1	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO1 requires students to apply soil mechanics and foundation engineering knowledge to interpret subsurface investigation data, evaluate field test results and select suitable foundation systems for practical site conditions.
CO 2	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO2 involves analysis and design of shallow foundations by considering bearing capacity, settlement, serviceability, safety, economy and practical construction requirements.
CO 3	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO3 requires students to analyse single piles, pile groups, negative skin friction, pile settlement and lateral loading behaviour for safe deep foundation applications.
CO 4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2	CO4 involves earth pressure, slope stability, expansive soil foundations and well foundations, which require geotechnical analysis, safety evaluation, constructability awareness and sustainable infrastructure decision-making.

CO-SDG Matrix (CSM) Justification

CO	Mapped SDG	Justification
CO1	SDG 9, SDG 11	CO1 deals with subsurface investigation and foundation selection, which are essential for safe, economical and resilient infrastructure development in urban and rural construction projects.
CO2	SDG 9, SDG 11, SDG 12	CO2 involves shallow foundation analysis and design, contributing to durable infrastructure, safer buildings, efficient material use and sustainable construction practices.
CO3	SDG 9, SDG 11	CO3 focuses on pile foundations used for bridges, high-rise buildings, industrial structures and weak soil sites, supporting resilient infrastructure and safer communities.
CO4	SDG 9, SDG 11, SDG 13	CO4 covers earth pressure, slope stability, expansive soils and well foundations, which are directly related to infrastructure safety, disaster resilience, climate-sensitive geotechnical design and stable transportation corridors.

UNIVERSAL HUMAN VALUES - II			
Class: B. Tech. VI – Semester		Branch: ALL BRANCHES	
Course Code:	U24IK606B	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: describe harmony within the individual by understanding the distinct roles of the self and the body CO2 : analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society. CO3: explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfilment among all orders of nature. CO4: apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being.			
UNIT-I			6 Hrs
Course Introduction - Need, Basic guidelines, Content and Process for value education Self-exploration: ‘Natural acceptance’ and Experiential validation, Basic human aspirations, Right understanding, Relationship and Physical facility, fulfilment of aspirations, Understanding happiness and prosperity, Harmony at various levels Understanding Harmony in the Human Being: Harmony in myself, Understanding human being, Understanding the harmony of self with the body, Harmony in self; Health; Program for self and health			
UNIT-II			6 Hrs
Understanding Harmony in the Family: Harmony in human - human Relationship, Understanding values in human-human relationship, Meaning of Justice (universal values in relationships), Mutual happiness Understanding Harmony in the Society: Harmony in the society, Visualizing a universal harmonious order in society- Undivided society, Universal order- from family to world family			
UNIT-III			6 Hrs
Understanding Harmony in the Nature: Whole existence as coexistence, Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Recyclability and Self-regulation in nature, Understanding Harmony in the Existence: Understanding existence as co-existence of mutually interacting units in all- pervasive space; Holistic perception of harmony at all levels of existence.			
UNIT-IV			6 Hrs
Professional Ethics: People friendly and eco-friendly production systems, Appropriate technologies and management patterns. Case Studies: Case studies of typical holistic technologies, Management models and production systems			

Textbooks:

1. R .R. Gaur, R. Sangal and G. P. Bagaria, *Human Values and Professional Ethics*, New Delhi Excel Books, 2010.

Reference Book(S):

1. A.Nagaraj,*Jeevan Vidya:EkParichaya*,Raipur:JeevanVidyaPrakashan, Amarkantak, 2018.
2. A.N.Tripathi,*Human Values*,New Age InternationalPublisher,3rded.,NewDelhi, 2019.
3. M.Govindrajan,S.Natrajan&V.S.SenthilKumar,*EngineeringEthics(includesHuman Values)*, PHI Learning Pvt. Ltd., 12thed., Haryana, 2011.
4. Jayshree Suresh, B. S. Raghavan, *Human Values & Professional Ethics*, 4thed., S. Chand & Co. Ltd.,New Delhi, 2012.

AdditionalResources:

1. AsetofDVDscontaining-VideoofTeachers"OrientationProgram-PPTsofLectures and Practice Sessions (*Audio-visual material for use in the practice sessions*)

Web and Video link(s):

1. <https://fdp-si.aicte-india.org/UHVII.php>

Course Articulation Matrix					U24IK606B Universal Human Values - II									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IK606B.1	2	1	-	-	-	1	-	3	-	-	-	1	1
CO2	U24IK606B.2	-	2	-	-	-	3	-	3	2	2	-	-	1
CO3	U24IK606B.3	1	2	-	-	-	2	3	2	-	-	-	1	1
CO4	U24IK606B.4	1	2	-	-	-	3	3	3	2	2	3	2	1
U24IK606B		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.

TechnicalEnglish			
Class:B.Tech.VI-Semesters		Branch: Common to all Branches	
Course Code:	U24MH607	Credits:	1
Hours/Week(L-T-P-E):	0-0-2-2	CIE:	100
Total Number of Teaching Hours:	24Hrs	ESE:	-
Course Learning Outcomes(COs) After completion of this course, the students should be able to,			
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, interpretv is ual information, and producec lear and well-structured technical reports. CO4: develop the ability to perform wellin interviews and present effectively with clarity of Speech and appropriate accent.			
Activity-1			2hrs
Phonetic Foundations, Authentic Audio-Visual Comprehension & Vocabulary Enhancement: SpeechSounds- Phonemes (Vowels and consonant sounds), word stress, syllables - their role and importance in spoken English, Authentic Audio-Visual Comprehension: Movie Clips - Screening of a short native-speaker clip - context comprehension, focus attention on accent features and key expressions, Vocabulary: Word Formation-Prefixes-Suffixes. Activity: Practice pronunciation through Read- Record-Reflect, analyze audio-visual content for comprehension and expression usage.			
Activity-2			2hrs
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			2hrs
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	2hrs
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	2hrs
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	2hrs
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	2hrs
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	2hrs
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	2hrs
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	2hrs
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	2hrs

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

2hrs

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

Textbook(s):

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. Meenakshi Raman & Sangeetha Sharma, “Technical Communication: Principles and Practice”, 3rd Edition, New Delhi; New York: Oxford University Press, 2004

Reference Book(S):

1. Nishit K. Sinha, “Verbal Ability and Reading Comprehension for the CAT”, 3rd Edition Pearson India Education Services Pvt. Ltd., Chennai
2. HarperCollins, “Collins COBUILD English Grammar” Third Edition, HarperCollins 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.

Web and Video link(s):

1. Learn/Practice English with MOVIES (Lesson #1) Title: The Incredibles <https://www.youtube.com/watch?v=5SfQhkMsUFk&list=PLA71NLNvxTzig5dqfGl8DGBLOvUI08yXg&index=2>
2. Learn English with WRECK-IT RALPH <https://www.youtube.com/watch?v=wVhG59zh4uQ&list=PLA71NLNvxTzig5dqfGl8DGBLOvUI08yXg&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=biCrllhZrC4>
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>

<u>LaboratoryManual</u>(forlaboratorycomponent): 1. TechnicalEnglishManualpreparedbythefacultyofEnglish,KITSW.

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| <p><u>Laboratory Manual</u>(for laboratory component):</p> <ol style="list-style-type: none"> 1. Technical English Manual prepared by the faculty of English, KITSW. |
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Course Articulation Matrix(CAM):				U24MH607: Technical English										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24MH607.1	-	-	-	-	-	-	-	-	2	-	2	-	-
CO2	U24MH607.2	-	-	-	-	-	-	-	2	2	-	2	-	-
CO3	U24MH607.3	-	-	-	-	-	-	-	-	2	-	2	-	-
CO4	U24MH607.4	-	-	-	-	-	-	-	2	2	-	2	-	-
U24MH607		-	-	-	-	-	-	-	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	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.	SDG4	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 promote quality education
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	SDG4	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	SDG4	Quality Education	This aligns with SDG-4 as it enhances effective presentation skills and perform well in interviews

STRUCTURAL DETAILING LABORATORY			
Class: B. Tech. VI - Semester		Branch: CE	
Course Code:	U24CE608	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: compile the structural detailing of R.C.C. beams CO2: develop the detailing plan of various types of slabs CO3: assess the philosophies in designing various types of columns, footings and stair case CO4: compose working drawings of various types of steel structures			
LIST OF EXPERIMENTS			
Preparation of working drawings using AutoCAD for the following structural elements as per SP34.			
8. Drafting of reinforcement detailsfor R.C.C Simply Supported Beam 9. Drafting of reinforcement detailsfor R.C.C Continuous Beam/Cantilever Beam 10. Drafting of reinforcement detailsfor R.C.C Slabs 11. Drafting of reinforcement detailsfor R.C.C Tied Column 12. Drafting of reinforcement detailsfor R.C.C Spirally Reinforced Column 13. Drafting of reinforcement detailsfor R.C.C Isolated Footing/ Combined Footing 14. Drafting of reinforcement detailsfor shear reinforcement in R.C.C beams 15. Drafting of reinforcement detailsfor R.C.C. stair case. 16. Structural detailing of steel beam-column connection 17. Structural detailing of steel beam -beam connection 18. Structural detailing of Built-up Column 19. Structural detailing of Grillage Foundation			
<u>Text Books:</u> 1. B.C. Punmia, A.K. Jain, <i>R.C.C Designs</i> , 10th ed. New Delhi: Laxmi publishers, 2015.			
<u>Reference Book(S):</u> 1. Hand book on Concrete Reinforcement and Detailing-SP 34 :1987, Bureau of Indian Standards, New Delhi, 1987. 2. S. MahaboobBasha, <i>Structural Engineering Drawing</i> , Radiant Publishing House, New Delhi, 2018. 3. Arya and Ajmani, <i>Design of steel structures</i> , 5th ed,Nem Chand and Bros, Roorkee, 1992. 4. S. Kanthimathinathan, <i>Manual for Detailing of Steel Structures</i> , International Publishing House Pvt. Ltd., New Delhi, 2016.			
<u>Laboratory Manual (for laboratory component):</u> 1. <i>Structural Detailing laboratory manual</i> , Department of CE, KITSW			

Course Articulation Matrix (CAM):				U24CE608 : STRUCTURAL DETAILING LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE608.1	2	2	2	2	2	1	1	-	1	-	-	2	2
CO2	U24CE608.2	2	2	2	2	2	1	1	-	1	-	2	2	2
CO3	U24CE608.3	2	2	2	2	2	1	1	-	1	-	2	2	2
CO4	U24CE608.4	2	2	2	3	2	1	1	-	1	-	2	2	2
U24CE608		2	2	2	2	2	1	1	-	1	-	2	2	2
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Name	Mapping Justification
CO1	Compile the structural detailing of R.C.C. beams	SDG 9	Industry, Innovation and Infrastructure	Proper detailing of RCC beams ensures structural safety and durability, contributing to resilient infrastructure development.
CO2	Develop the detailing plan of various types of slabs	SDG 11	Sustainable Cities and Communities	Proper slab detailing ensures building safety for occupants, contributing to safe and resilient communities.
CO3	Assess the philosophies in designing various types of columns, footings and stair case	SDG 12	Responsible Consumption and Production	Optimal design philosophies (LSM vs. WSM) lead to material-efficient structures, reducing waste and promoting responsible resource use.
CO4	Compose working drawings of various types of steel structures	SDG 12	Responsible Consumption and Production	Detailed steel drawings enable accurate material estimation, minimizing waste during fabrication and construction.

MINI PROJECT

Class: B. Tech. VI – Semester		Branch: CE	
Course Code:	U24CE609	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	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:

- The HoD shall constitute a *Department Mini Project Evaluation Committee (DMPEC)*
- 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
- There shall be only continuous Internal Evaluation (CIE) for miniproject
- 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

- 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
- 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*
- Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DMPEC*
- Anti-Plagiarism Check:** The seminar report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

- (e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *DMPEC* as per the schedule notified by the department
- (f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact
- (g) The student has to register for the Mini project as supplementary examination in the following cases:
- he/she is absent for oral presentation and viva-voce
 - he/she fails to submit the report in prescribed format
 - he/she fails to fulfill the requirements of Mini project 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 Mini project evaluation and send the award list to the CoE within the stipulated time

Course Articulation Matrix (CAM):				U24CE609 Mini Project										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE609.1	3	3	2	3	3	2	1	2	1	2	2	2	1
CO2	U24CE609.2	2	2	2	3	2	1	1	1	2	1	3	1	1
CO3	U24CE609.3	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	U24CE609.4	1	2	1	2	2	1	2	1	3	1	2	1	1
U24CE609		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
CO 1	apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship	SDG 9	Industry, Innovation and Infrastructure	This CO directly emphasizes experimentation, modern tools, working models, innovation and entrepreneurship, which strongly align with technological development, industrial innovation and infrastructure-oriented engineering solutions.
CO 2	demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report	SDG 9	Industry, Innovation and Infrastructure	Literature review, gap identification, problem analysis and technical documentation support research-based innovation and systematic development of engineering solutions.
CO 3	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	This CO includes communication of technical knowledge and awareness of social impact, which supports the development and presentation of engineering solutions relevant to societal needs and sustainable communities.
CO 4	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 9	Industry, Innovation and Infrastructure	Scientific writing, technical reporting and video pitching help disseminate innovative engineering ideas, promote technology-oriented communication and support the transfer of project outcomes toward practical application.

ESTIMATION AND VALUATION			
Class: B.Tech. VI –Semester (Exit)		Branch: Civil Engineering	
Course Code:	U24CE610X	Credits:	3
Hours/Week (L-T-P- E):	2-0-2-4	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: measure quantities pertaining to civil engineering works			
CO2: estimate quantities and propose tender documents for construction projects			
CO3: determine rate analysis and valuation report for a building			
CO4: distinguish types of contract and estimate miscellaneous civil engineering works			
UNIT-I			6Hrs
Estimation of Quantities, Specifications and Rate analysis:: Different types of estimates, Methods of estimation - Centre line, Individual wall method; Objectives of specifications, Specifications for earth work excavation, Concrete, Damp proof course(DPC), Form work, Brick masonry, Flooring, Painting and Wood work, Schedule of rates, Rate analysis for cement concrete, DPC, Brick masonry, Plastering, Flooring, Painting			
UNIT-II			6Hrs
Valuation: Objectives, Market value, Book value, Assessed value, Mortgage value, Replacement value, Capital cost, Cost escalation, Sinking fund, Depreciation methods, Preparation of valuation report for residential building.			
UNIT-III			6Hrs
Contracts: General requirements of contract, Types of contracts, Conditions, Termination of contract, Departmental procedures for execution of works			
UNIT-IV			6Hrs
Miscellaneous Estimates: Preparation of detailed and abstract estimate for septic tank with soak pit, Slab culvert, Road project.			

Textbook(s):

1. B.N.Dutta, *Estimating and Costing in Civil Engineering*, 27th ed. New Delhi: UBS Publishers, 2014.

ReferenceBook(s):

- 1.D.D.Kohli and R.C.Kohli, *A TextBookofEstimatingandCosting (Civil)*, 13thed. NewDelhi: S. Chand and Company Ltd., 2004.
- 2.G.S.Birdie, *A TextBookofEstimatingandCostingforCivilEngineering*, 6thed. NewDelhi: Dhanpat Rai publishing company (P) Ltd., 2014.
- 3.M. Chakraborty, *Estimating, Costing, Specification and Valuation in Civil Engineering*, 29thed. Kolkata: Chakraborty Publishers, 2006.
- 4.Bureau of Indian Standards, SP27: 1987(R2003): *Hand book of Method of Measurement of Buildings Works*, NewDelhi: Reaffirmed 2003.

WebandVideolink(s):

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou20_cs11 Video Lecture on Building cost estimation simplified by Prof. Shruti Samuel, Indira Gandhi National Open University.

Course Articulation Matrix (CAM):				U24CE610X ESTIMATION AND VALUATION										
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	U24CE610X.1	3	2	1	-	2	-	-	-	-	-	-	3	2
CO2	U24CE610X.2	3	3	2	1	2	-	-	1	1	2	1	3	2
CO3	U24CE610X.3	3	3	2	1	2	1	1	-	-	1	2	3	2
CO4	U24CE610X.4	2	3	2	1	1	1	-	2	2	2	1	3	2
U24CE610X		2.75	2.75	1.75	1	1.75	1	1	1.5	1.5	1.66	1.33	3	2
3-HIGH,2-MEDIUM,1-LOW														

CO	CO Statement – <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	Measure quantities pertaining to civil engineering works	SDG 9	Industry, Innovation and Infrastructure	Quantity surveying and measurement practices support accurate planning and efficient utilization of construction resources for sustainable infrastructure development.
CO2	Estimate quantities and propose tender documents for construction projects	SDG 11	Sustainable Cities and Communities	Preparation of estimates and tender documents promotes planned urban infrastructure, transparent project execution, and sustainable construction practices.
CO3	Determine rate analysis and valuation report for a building	SDG 12	Responsible Consumption and Production	Rate analysis and valuation encourage efficient utilization of materials, cost optimization, economic sustainability, and responsible resource management in construction projects.
CO4	Distinguish types of contract and estimate miscellaneous civil engineering works	SDG 16	Peace, Justice and Strong Institutions	Understanding contracts, tendering procedures, and legal provisions promotes transparency, accountability, and ethical engineering practices in public infrastructure projects.

ADVANCED CONCRETE TECHNOLOGY			
Class: B. Tech. VI - Semester(Exit)		Branch: CE	
Course Code:	U24CE611X	Credits:	3
Hours/Week (L-T-P- E):	2-0-2-4	CIE:	60%
Total No of Teaching Hours:	16 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 :	design concrete mix proportions using suitable methods such as the Erntroy-Shacklock and particle packing techniques		
CO2 :	develop self-curing and self-compacting concrete using suitable admixtures as per EFNARC specifications		
CO3 :	apply quality control and quality assurance techniques for concrete as per IS codal provisions		
CO4 :	assess the strength and durability of concrete structures using non-destructive testing methods		
CO5:	analyze the effect of water-cement ratio and fine/coarse aggregate proportions on the strength of concrete		
CO6 :	determine concrete mix proportions using the ACI method and correlate cube and cylinder strength		
CO7:	assess the strength of concrete using non-destructive testing methods such as the rebound hammer and ultrasonic pulse velocity tests		
CO8:	evaluate the durability of concrete against carbonation-induced deterioration		
THEORY COMPONENT			
UNIT-I			4 Hrs
Proportioning of Concrete: Entroy Shaklok method, Particle packing theory, Nan-Su method for self-compacting concrete			
UNIT-II			4 Hrs
Self Curing and Self Compacting Concrete: Need and development of self curing and self-compacting concrete, Admixtures and aggregates, EFNARC specifications for self-compacting concrete, Applications of self curing and self-compacting concrete, Tests on self compacting concrete			
UNIT-III			4 Hrs
Quality Control of Concrete: Quality assurance, Quality control, Quality management and quality audit-statistical quality control, Acceptance criteria, IS codal provisions			
UNIT-IV			4 Hrs
Non-Destructive Testing: Strength assessment, Rebound hammer test, Ultra sonic pulse velocity test, Validate with core sampling and testing			
LABORATORY COMPONENT			

CO-SDG Alignment Matrix				
CO	CO Statement <i>The student should be able to...</i>	Relevant SDG	SDG Description	Mapping Justification
CO1	design concrete mix proportions using suitable methods such as the Erntroy-Shacklock and particle packing techniques	SDG 9	Industry, Innovation and Infrastructure	Scientific proportioning methods, including particle packing and nano-based approaches, optimize material use and drive innovation in concrete mix design, supporting resilient infrastructure development.
CO2	develop self-curing and self-compacting concrete using suitable admixtures as per EFNARC specifications	SDG 12	Responsible Consumption and Production	Self-curing concrete reduces water consumption needed for curing, and self-compacting concrete minimizes material wastage and energy use during placement, supporting responsible and efficient use of resources.
CO3	apply quality control and quality assurance techniques for concrete as per IS codal provisions	SDG 11	Sustainable Cities and Communities	Robust quality control, quality assurance and adherence to IS codal provisions ensure safe, durable buildings and infrastructure, reducing failure risk and supporting sustainable urban development.
CO4	assess the strength and durability of concrete structures using non-destructive testing methods	SDG 9	Industry, Innovation and Infrastructure	NDT methods help assess the strength, durability, and safety of structures without damaging them. Supports maintenance and development of reliable and resilient infrastructure.

CO5	analyze the effect of water-cement ratio and fine/coarse aggregate proportions on the strength of concrete	SDG 12	Responsible Consumption and Production	Understanding the influence of water-cement ratio and aggregate proportions helps optimize material use, minimizing wastage of cement and aggregates in construction.
CO6	determine concrete mix proportions using the ACI method and correlate cube and cylinder strength	SDG 9	Industry, Innovation and Infrastructure	Standardized mix design procedures and strength correlation studies improve the reliability and efficiency of concrete production, supporting quality-driven innovation in the construction industry.
CO7	assess the strength of concrete using non-destructive testing methods such as the rebound hammer and ultrasonic pulse velocity tests	SDG 9	Industry, Innovation and Infrastructure	Hands-on non-destructive testing skills enable assessment of structure strength and safety without damage, supporting maintenance of reliable and resilient infrastructure.
CO8	evaluate the durability of concrete against carbonation-induced deterioration	SDG 13	Climate Action	Carbonation testing assesses concrete durability against CO ₂ -induced degradation, informing design choices that extend structure lifespan. Reduces lifecycle emissions from premature repair or reconstruction, supporting climate-resilient infrastructure.

PAVEMENT ENGINEERING			
Class: B. Tech. VI – Semester(Exit)		Branch: CE	
Course Code:	U24CE612X	Credits:	3
Hours/Week (L-T-P- E):	2-0-2-4	CIE:	60%
Total Number of Teaching Hours:	16 Hrs	ESE:	40%
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1 : evaluate pavement material properties.			
CO2 : design the resilient flexible and rigid pavements in accordance with IRC standards			
CO3 : analyse flexible and rigid pavement distresses			
CO4 : Evaluate structural condition of flexible pavement using Benkelman Beam and recommend structural overlay thicknesses.			
CO5 : Evaluate the mechanical properties of road aggregates.			
CO6 : Analyze the soundness of aggregate			
CO7 : analyze the properties of bituminous binders.			
CO8 : propose optimal bituminous mixes using Marshall Method.			
THEORY COMPONENT			
UNIT-I			4 Hrs
Pavement Materials and Mix Design: Soil index properties, classification, California Bearing Ratio (CBR), compaction, and sub-grade soil strength. Road aggregate desirable properties and tests. Bituminous binders (types, tests, and grading), bituminous mix requirements, constituents, and design. Pavement quality concrete materials and requirements.			
UNIT-II			4 Hrs
Design guide lines for Pavements: Design factors for flexible and rigid pavements; IRC 37 guidelines for design of flexible pavements using standard. IRC58 guidelines for rigid pavement. Numerical problems on design traffic, and thickness of pavements.			
UNIT-III			4 Hrs
Pavement Distress Analysis: Structural and functional pavement distress identification criteria. Failure modes- flexible pavements and rigid pavements.			
UNIT-IV			4 Hrs
Pavement Evaluation: Structural evaluation of existing flexible pavements using the Benkelman Beam Deflection method. Bituminous overlay configurations using IRC 81 guidelines. Distresses and maintenance measures in rigid pavements.			
LABORATORY COMPONENT			
1. Determination of specific gravity of aggregate & bitumen			
2. Determination of soundness test on aggregates			
3. Determination of ductility value and flash point for bitumen			
4. Determination of softening point and penetration value for bitumen			
5. Determination of viscosity for bitumen			
6. Determination of bitumen content using extraction test			
7. Determination of flow value through Marshall stability test			

Textbook(s):

1. S. K. Khanna, C. E. G. Justo, A. Veeraraghavan, *Highway Engineering*, 10th ed., Roorkee: Nem Chand & Bros, 2022.

Reference Book(S):

1. E. J. Yoder and M. W. Witezak, *Principles of Pavement Design*, 2nd ed., New York: John Wiley & Sons, Inc., 2012.
2. L. R. Kadiyali, *Principles of Highway Engineering*, 9th ed., New Delhi: Khanna Publishers, 2017.
3. **IRC 37 (2018)**: Guidelines for the Design of Flexible Pavements.
4. **IRC 58 (2015)**: Guidelines for the design of plain jointed rigid pavements for highways.
5. **IRC 81 (1997)**: Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique.
6. **IRC SP 88 (2019)**: Manual on Road Safety Audit.
7. **MoRTH code**: Fifth revision (2013).

Web and Video link(s):

<https://nptel.ac.in/courses/105105107>; NPTEL Video Lecture on Introduction to Transportation Engineering by Dr. K.S.Reddy, Dr. Bhargab Maitra, IIT Kharagpur.

<https://nptel.ac.in/courses/105107220> ; NPTEL Video Lecture on Geometric Design of Highways, by Prof. Rajat Rastogi, IIT Roorkee

<https://nptel.ac.in/courses/105107219>.; NPTEL Video Lecture on Pavement Materials (Under Pavement Engineering), by Prof. Nikhil Saboo, IIT Roorkee.

<https://nptel.ac.in/courses/105106221> ; NPTEL Video Lecture on Analysis and Design of Bituminous Pavements, by M.R. Nivitha, Neethu Roy, A. Padmarekha and J. Muralikrishnan, IIT Madras.

Laboratory Manual (for laboratory component):
"Highway Engineering Laboratory Manual", Department of Civil Engineering, KITSW.

Course Articulation Matrix (CAM):				U24CE612X: Pavement Engineering											
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	U24CE612X.1	3	3	3	1	-	-	-	-	-	-	-	3	-	
CO2	U24CE612X.2	3	3	3	2	-	2	-	-	-	-	-	3	2	
CO3	U24CE612X.3	3	3	3	2	-	-	-	-	-	-	-	3	3	
CO4	U24CE612X.4	2	3	2	3	-	-	-	-	-	-	-	2	3	
CO5	U24CE612X.5	3	2	-	3	-	-	-	-	-	-	1	3	-	
CO6	U24CE612X.6	3	2	-	3	-	-	-	-	-	-	1	3	-	
CO7	U24CE612X.7	3	3	3	3	-	-	-	-	-	-	1	3	2	
CO8	U24CE612X.8	3	3	2	3	-	2	-	-	2	-	1	3	3	
U24CE612X		3	2.5	2.5	3	0	2	0	0	2.25	1.25	0	3	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	evaluate pavement material properties.	SDG12	Responsible consumption and production	Testing physical properties of the aggregate ensures that only durable, high-quality rocks are utilized in pavement construction. This prevents early structural road degradation, minimizing aggregate consumption .
CO2	design the resilient flexible and rigid pavements in accordance with IRC standards	SDG9	Industry, Innovation and Infrastructure	Pavement design using standardized IRC methods allows for the creation of resilient, reliable, and high-quality regional infrastructure capable of carrying heavy freight loads.
CO3	analyse flexible and rigid pavement distresses	SDG9	Industry, Innovation and Infrastructure	Using standard IRC methods to design pavements ensures strong, reliable roads that can support heavy freight.
CO4	Evaluate structural condition of flexible pavement using Benkelman Beam and recommend structural overlay thicknesses.	SDG9	Industry, Innovation and Infrastructure	Testing road condition helps target specific repairs with overlays, stretching the road's lifespan and avoiding expensive, full reconstructions.
CO5	Evaluate the mechanical properties of road aggregates.	SDG 9	Industry, Innovation & Infrastructure	Testing aggregate strength and quality ensures roads are built with durable materials, leading to highly reliable infrastructure.
CO6	Analyze the soundness of aggregate	SDG 9	Industry, Innovation & Infrastructure	Testing aggregate strength and quality ensures roads are built with durable materials, leading to highly reliable infrastructure.
CO7	analyze the properties of bituminous binders.	SDG9	Industry, Innovation & Infrastructure	Testing binder properties allows students to select the best asphalt grade for local weather and traffic, preventing early cracking and rutting. This outcome helps to prevent premature pavement distresses like rutting or cracking, thereby resulting in resilient infrastructure networks.
CO8	propose optimal bituminous mixes using Marshall Method.	SDG9	Industry, Innovation & Infrastructure	Optimizing the asphalt mix ensures maximum stability and regulated flow, creating high-performance surfaces that withstand heavy wheel loads. Thereby resulting in resilient infrastructure.

VII SEMESTER (STREAM -II)(URR24)

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	
1	OE	U24OE701X -MB	Open Elective -MB	2	1	-	3	3
2	PEC	U24CE702	Program Elective - II/ MOOCs-II	2	1	-	3	3
3	PCC	U24CE703	Prestressed concrete	2	1		3	3
4	PCC	U24CE704	Estimation & Valuation	1	-	4	5	3
5	PCC	U24CE705	Construction Management and Equipment	2	1	-	3	3
6	PCC	U24CE706	Civil Engineering Software Applications Laboratory	-	-	2	2	1
7	PCC	U24CE707	Building Information Modelling Laboratory	-	-	2	2	1
8	ELC	U24CE708	Internship Evaluation	-	-	2	2	1
9	ELC	U24CE709	Major Project Phase-1 / Industrial Internship -1	-	-	8	8	4
Total:				09	4	18	31	22
Additional Learning [@] :Maximum credits allowed for Honours /Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	26

ManagementCoursesBasket(OE-MB)

S.No.	Course Code	CourseTitle
1.	U24OE701A-MB	ManagementEconomicsandAccountancy
2.	U24OE701B-MB	EngineeringFinance
3.	U24OE701C-MB	OrganisationalBehaviour
4.	U24OE701D-MB	E-CommerceandDigitalMarketing
5.	U24OE701Z-MB	Anyothercourseapproved byBoSChairand DeanAA

MANAGEMENT ECONOMICS AND ACCOUNTANCY			
Class: B. Tech. VII Semester		Branch: CSE,ECE,ECI,EEE/ CSN,CSO,CSM,CSD,IT,CE,ME	
Course Code:	U24OE701A-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 : comprehend the basic concepts of management, functions of management			
CO2 : distinguish between micro & macroeconomics & forms of business organizations			
CO3 : pass journal entries & post them into ledgers, prepare profit & loss accounts and assesses the financial position through the balance sheet			
CO4 : evaluate financial statements with a the help of various ratios and reveal the financial health of the organization			
UNIT-I			9 Hrs
Introduction to Management: Concept of Management, Features of Management, Importance of Management, Nature and Scope of Management, Fayol’s Administrative Management, Taylor’s Scientific Management			
Functions of Management: Planning- Concept of Planning, Nature of Planning, Importance of Planning, Planning Process, Types of Planning; Organizing-Concept of Organizing, Organization Structure- line and staff, Advantages of Organizing; Staffing - Meaning, Functions of Human Resources Management; Directing- Elements of Directing- Supervision; Leadership- Nature; Motivation - Nature, Types; Communication- Process, Types, Barriers to effective communication; Co-ordination- Definition, Steps to achieve effective coordination; Controlling- Definition, Process			
UNIT-II			9 Hrs
Economics: Meaning and definition, Scope, Micro and Macro Economics, Methods of Economics			
Forms of Business Organization: Sole Proprietor ship, Partnership firm - Types of Partners, Limited Liability Partnership (LLP), Joint Stock Company - Features, Types, Merits and demerits, Cooperative society			
UNIT-III			9 Hrs
Introduction to Financial Accounting: Accounting concepts and conventions, Double Entry System and Book Keeping, Overview of accounting cycle, Journal-meaning, Journalizing, Ledger - Meaning, Ledger posting, Balancing; Cash book (Single column), Preparation of Trial balance			
Final Accounts: Trading Account, profit and loss account and Balance Sheet with simple adjustments			
UNIT-IV			9 Hrs
Financial Statement Analysis: Introduction to Financial Statement Analysis, Ratio Analysis, Introduction, Types of Ratios, Analysis and Interpretation of Liquidity Ratios, Profitability ratios, Activity Ratios, and Capital structure Ratios (simple problems)			

Textbook(s):

1. L.M.Prasad, *Principles and Practices of Management*, Sultan Chand & Sons Educational Publishers, 11th edition.2025, New Delhi. (Part -I to Part-VI)
2. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th edition, 2014. (Chapter-3)
3. R. Narayana Swamy, *Financial Accounting – A Managerial Perspective*, Prentice Hall of India, 7th edition, 2023,new Delhi.(Chapter VI)

Reference Book(S):

1. Harold Koontz and Heinz Weihrich, Essentials of Management, 6th ed. New Delhi: Tata Mc Graw Hill Publications, 2015.
2. Maheshwari, S. N., & Maheshwari, S. K. (2024). Financial Accounting (7th ed.). Vikas Publishing House Pvt. Ltd, 2024.

Web and Video link(s):

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	PSO 1	PSO2
CO1	U24MB601A-MB U24MB701A-MB	-	3	3	2	-	2	2	3	3	3	3		
CO2	U24MB601A-MB U24MB701A-MB	-	2	2	-	-	2	3	3	3	3	3		
CO3	U24MB601A-MB U24MB701A-MB	-	1	2	1	-	2	3	2	3	3	3		
CO4	U24MB601A-MB U24MB701A-MB	-	2	2	2	-	1	2	-	3	2	3		
		-	2	2.2 5	1.6 7	-	1.7 5	2.5	2.6 7	3	2.7 5	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	comprehend the basic concepts of management	SDG 4	Quality Education	Understanding the management concepts and managerial function will help the students to take effective and efficient decisions and able to solve work place problems.
CO2	distinguish between micro & macro-economics & forms of business organizations	SDG 8	Decent Work and Economic Growth	Economics concepts will help to promote sustained, inclusive and sustainable economic growth, and different forms of organizations will provide knowledge about creating full and productive employment and decent work for all
CO3	pass journal entries & post them into ledgers, prepare profit & loss accounts and assesses the financial position through the balance sheet	SDG 17	Partnerships for the goals	accounting concepts and conventions will promote a universal, rules-based, open, non-discriminatory and equitable application of
CO4	evaluate financial statements with a the help of various ratios and reveal the financial health of the organization	SDG 8	Decent Work and Economic Growth.	Evaluating financial statements through ratio analysis reveals the financial health of an organization, enabling better decision-making, efficient resource utilization, and sustainable growth.

ENGINEERINGFINANCE			
Class: B.Tech.VI/VII-Semester		Branch: CSE, ECE, ECI, EEE/CSN, CSO, CSM, CSD, IT, CE, and ME	
Course Code:	U24OE701B-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)			
<i>After completion of this course, the students should be able to,</i>			
CO1:	explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.		
CO2:	apply capital budgeting techniques including inflation adjusted Net Present Value/Internal Rate Return for project evaluation and selection.		
CO3:	analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects.		
CO4:	evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.		
UNIT-I			9 Hrs
Fundamentals of Engineering Finance Engineering Finance – Meaning, Definition, and Scope; Role of Finance in Engineering – Importance for engineers in decision making and cost control; Ethics in Engineering Finance – Transparency, Cost estimation honesty, Avoidance of financial conflicts of interest; Financial Management – Meaning, Functions, Objectives (profit maximization v/s. wealth maximization), Sources of Finance, Time value of Money			
UNIT-II			9 Hrs
Investment Decisions Investment Decisions- Types of Investment projects, Investment evaluation criteria; Methods of capital budgeting – Discounted cash flow techniques v/s. non discounted cash flow techniques, Inflation adjusted NPV and IRR, Comparison and selection of mutually exclusive engineering projects			
UNIT-III			9 Hrs
Cost-Volume-Profit Analysis Cost concepts- Fixed, Variable, Marginal, Sunk, Opportunity costs, Direct and Indirect costs; Breakeven analysis – Meaning, Assumptions, Graphical and Mathematical determination of breakeven point; Make or buy decisions using breakeven analysis; Application of breakeven analysis in engineering projects			
UNIT-IV			9 Hrs
Replacement Decisions and Valuation of engineering assets Replacement analysis – Meaning, Need, Defender v/s. Challenger concept; Economic service life; Valuation of equipment's and physical assets - Depreciation definition, Depreciation fund; Methods of depreciation - straight line, Declining balance, Sum of the years-digits, Sinking fund and Service output method, Application of depreciation methods on equipment's and physical asset with the passage of time.			

Textbook(s):

1. M Y Khan and P K Jain, *Financial Management*, Tata McGraw Hill 5th edition, ISBN:978-0-07-065614-7 (*Unit-I in part 1 of section 1,2&3 and Unit-II in part 3 of 9&10*).
2. R. Panneerselvam, *Engineering Economics*, PHI Learning 2nd edition, ISBN:978-81-203-4837-0(*Unit-III in Chapter 1&16 and Unit-IV in Chapter 8& 9*).

Reference Book(S):

1. F.K. Crundwell, *Finance for Engineers: Evaluation and Funding of Capital Projects*, Springer London Ltd, Atlantic Publishers and Distributors (P) Ltd., ISBN: 978-1849967082, 2010.
2. Robert L. Kosowski, Salih N. Neftci, *Principles of financial engineering*, Academic press, Atlantic Publishers and Distributors (P) Ltd. 3rd edition, ISBN: 978-0123869685, 2014.
3. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th edition, ISBN: 9788126510887, 2014.
4. Prasanna Chandhra, *Financial Management: Theory and Practice*, Tata McGraw 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.

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*, TataMc GrawHillEducation (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.

CourseArticulationMatrix(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 U24OE701B-MB	2	-	-	-	-	-	2	-	-	2	2		
CO2	U24OE601B-MB U24OE701B-MB		3			2						3		
CO3	U24OE601B-MB U24OE701B-MB			2					2		2			
CO4	U24OE601B-MB U24OE701B-MB			2	2		2				2	2		
		2	3	2	2	2	2		2		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	Explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.	SDG 4 And SDG 16	Quality Education and Peace, Justice and Strong Institutions	Promotes financial literacy, ethical decision-making, and professional responsibility essential for quality education and transparent institutional practices.
CO2	Apply capital budgeting techniques including inflation adjusted NPV/IRR for project evaluation and selection.	SDG 8 And SDG 9	Decent Work and Economic Growth And Industry, Innovation and Infrastructure	Supports economically viable investment decisions, efficient resource allocation, industrial growth, and sustainable infrastructure development.
CO3	Analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects.	SDG 9 And SDG 12	Industry, Innovation and Infrastructure and Responsible Consumption and Production	Encourages cost efficiency, optimized production planning, and responsible utilization of resources in engineering and industrial projects
CO4	Evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.	SDG 8 And SDG 12	Decent Work and Economic Growth and Responsible Consumption and Production	Promotes sustainable asset management, economic efficiency, lifecycle optimization, and responsible use of engineering resources.

ORGANIZATIONAL BEHAVIOUR			
Class: B. Tech. VII – Semester		Branch: CSE, ECE, ECI, EEE/CSN, CSO, CSM,CSD,IT,CE,ME	
Course Code:	U24OE701C-MB	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;			

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, importance, influencing factors, and communication processes of Organizational Behaviour.	SDG 4	Quality Education	Understanding organizational behaviour and communication processes helps students develop professional knowledge, communication, and workplace learning skills.
CO2	Analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation.	SDG 3	Good Health and Well-being	Analysing emotions, stress, motivation, and attitudes promotes mental well-being, self-management, and healthy work practices.
CO3	Examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings.	SDG 16	Peace, Justice and Strong Institutions	Studying leadership, conflict management, teamwork, and group dynamics supports inclusive, cooperative, and effective organizational practices
CO4	Evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour.	SDG 8	Decent Work and Economic Growth	Evaluating organizational culture, innovation, quality of work life, and change management supports productive employment and sustainable organizational growth.

E-COMMERCE & DIGITAL MARKETING			
Class: B. Tech. VII – Semester		Branch:CSE,ECE,ECI,EEE/CSN,CSO,CSM,CSD,IT,CE,ME	
Course Code:	U24OE701D-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: 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

Textbook(s):

- Reference Book(S):**

- Web and Video link(s):**

Course Articulation Matrix (CAM):				E-COMMERCE & DIGITAL MARKETING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE601D-MB U24OE701D-MB	2	2	1		2	1			1		2		
CO2	U24OE601D-MB U24OE701D-MB	2	2	1	1	2	2	1		1	1	1		
CO3	U24OE601D-MB U24OE701D-MB	2	2	2	1	2	1	1	1	2	1	2		
CO4	U24OE601D-MB U24OE701D-MB	2	2	2	2	2	1	1	2	2	2	2		
		2	2	1.5	1.3	2	1.25	1	1.5	1.5	1.3	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 concepts, scope, types, functions, framework, opportunities, and limitations of E-Commerce, and analyse its role in modern business and electronic transactions.	SDG 8	Decent Work and Economic Growth	E-Commerce promotes entrepreneurship, digital business growth, employment opportunities, and innovation in the global economy
CO2	Analyse e-payment systems, e-finance operations, e-banking, e-trading, and the legal framework governing e-commerce transactions.	SDG 9	Industry, Innovation and Infrastructure	Digital payment systems and e-banking strengthen technological infrastructure, financial inclusion, and innovation in digital industries.
CO3	Evaluate digital marketing practices, emerging trends, and consumer behaviour in the online environment.	SDG 12	Responsible Consumption and Production	Digital marketing helps organizations understand consumer behaviour and promote sustainable and responsible consumption patterns.
CO4	Analyse digital marketing channels and design effective online marketing plans.	SDG 17	Partnerships for the Goals	Digital marketing channels improve global communication, collaboration, networking, and partnerships among businesses and stakeholders

ADVANCED CONCRETE TECHNOLOGY (PE-2)			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE702A	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 : interpret the behaviour of cement and gradation of aggregates CO2 : design concrete mixes using suitable methods and discuss applications of special concretes CO3 : categorize high performance, self-curing and self-compacting concretes CO4 : apply quality control and NDT methods for strength assessment			
UNIT-I			9 Hrs
Cement and Admixtures: Chemical composition, Bogue's compounds, Heat of hydration, Influence of compound composition on properties of cement, Mineral and Chemical admixtures, Relevant IS codal specifications Aggregates: Classification of aggregates, Particle shape, Texture, Gradation, Fineness modulus, Grading curves, Gap graded aggregates, Combined grading, Alkali aggregate reaction, Alkali silica reaction, Soundness of aggregate, Recycled aggregates, Relevant IS codal specifications			
UNIT-II			9 Hrs
Proportioning of Concrete: Entropy-Shakloek method, Particle packing theory, Nan-Su method for self-compacting concrete Special Concretes: Self compacting concrete, Light weight concrete, Cellular concrete, Geopolymer concrete, Fibre reinforced concrete, Uses and applications			
UNIT-III			9 Hrs
High Performance Concrete: High performance concrete in fresh and hardened state, Durability, Carbonation test, Chloride potential test, Half-cell potentiometer test, Fire damage assessment Self Curing and Self Compacting Concrete: Need and development of self curing and self-compacting concrete, Admixtures and aggregates, EFNARC specifications for self-compacting concrete, Applications of self curing and self-compacting concrete, Tests on self compacting concrete			
UNIT-IV			9 Hrs
Quality Control of Concrete: Quality assurance, Quality control, Quality management and quality audit-statistical quality control, Acceptance criteria, IS codal provisions Non-Destructive Testing: Strength assessment, Rebound hammer test, Ultra sonic pulse velocity test, Validate with core sampling and testing			
<u>Textbook(s):</u> 1. A.M. Neville, <i>Properties of Concrete</i> , 4th ed. Longman House, United Kingdom: English Language, Book society, 2015.			

Reference Book(S):

1. M. S. Shetty, *Concrete Technology (Theory and Practice)*, 7th ed.: S. Chand Company, New Delhi 2014.
2. M.L. Gambhir, *Concrete Technology*, 5th ed.: Tata McGraw Hill Publishers, New Delhi 2016.
3. R.N. Raikar, *Diagnosis and treatment of structures in distress*, 4th ed.: R and D Centre of Structural Designers and Consultants Pvt. Ltd., Mumbai 1994.
4. Ken W. Day, James Aldred, Barry Hudson, *Concrete Mix Design, Quality Control and Specifications*, 3rd ed. Florida: CRC Press (Taylor and Francis group), 2016.
5. IS 10262: 2019, *Concrete Mix Proportioning Guidelines*, 2nd revision,: Bureau of Indian Standards, New Delhi 2019.
6. IS 383: 2019, *Coarse and Fine Aggregate for Concrete*,: Bureau of Indian Standards, New Delhi 2019.
7. IS 456: 2000 *Plain and Reinforced Concrete- Code of Practice*, 5th amendment,: Bureau of Indian Standards, New Delhi 2019.
8. EFNARC, *Specifications and Guidelines for Self Compacting Concrete*, Norfolk, UK: EFNARC, 2002.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105106176> NPTEL Video Lecture on Civil Engineering - Advanced Concrete Technology by Dr. Manu Santhanam IIT Madras.

1. <https://nptel.ac.in/courses/105106176> NPTEL Video Lecture on Civil Engineering - Advanced Concrete Technology by Dr. Manu Santhanam IIT Madras.

Course Articulation Matrix (CAM):				U24CE702A ADVANCED CONCRETE TECHNOLOGY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE702A.1	2	1	1	1	-	1	1	1	-	1	1	2	1
CO2	U24CE702A.2	2	1	1	1	-	1	1	1	1	1	1	2	1
CO3	U24CE702A.3	2	2	2	1	-	1	1	1	1	1	1	2	1
CO4	U24CE702A.4	2	1	1	1	2	1	1	1	1	1	1	2	1
U24CE702A		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	interpret the behaviour of cement and gradation of aggregates	SDG 12	Responsible Consumption and Production	The constituent materials and behaviour of fresh concrete play a crucial role in sustainable construction. By incorporating supplementary cementitious materials, recycled aggregates, and efficient water management practices, the concrete industry can significantly contribute to global sustainability objectives..
CO2	design concrete mixes using suitable methods and discuss applications of special concretes	SDG 11	Sustainable Cities and Communities	High Strength Concrete mix design involves careful selection of materials, low water-cement ratio, and suitable admixtures to achieve superior strength and durability. Special concretes such as SCC, geopolymer concrete, and fiber reinforced concrete improve sustainability and performance in modern construction..
CO3	categorize high performance, self-curing and self-compacting concretes	SDG 9	Industry, Innovation and Infrastructure	High Performance Concrete, Self-Curing Concrete, and Self-Compacting Concrete are important categories of modern special concretes. HPC provides durable infrastructure, self-curing concrete conserves water, and SCC improves construction efficiency. These technologies strongly support sustainable development, particularly SDG 9.
CO4	apply quality control and NDT methods for strength assessment	SDG 9	Industry, Innovation and Infrastructure	NDT methods help assess the strength, durability, and safety of structures without damaging them. Supports maintenance and development of reliable and resilient infrastructure.

PAVEMENT DESIGN			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE702B	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 : summarize materials and factors affecting pavement design CO2 : analyse stresses and deflections in flexible and rigid pavements CO3 : design flexible pavements using IRC:37 guidelines. CO4 : design rigid pavements using IRC guidelines.			
UNIT-I			9 Hrs
Pavement Types and Materials: Types and component parts of pavement; basic characteristics of materials used in pavements. Factors Affecting Pavement Design: Variables considered in pavement design; classification of axle types, standard and legal axle loads, tyre pressure, contact pressure, ESWL, EWLF, and EAL concepts; traffic analysis: ADT, AADT, truck factor, growth factor, lane distribution factor, directional distribution factor, and vehicle damage factor.			
UNIT-II			9 Hrs
Flexible Pavements: Layered system concepts; stress solution for one, two, and three-layered systems; fundamental design concepts; stress analysis in flexible pavements. Rigid Pavements: Westergaard's theory and assumptions; joints in rigid pavements; stresses due to curling, stresses, and deflections due to loading, frictional stresses; stresses in dowel bars and tie bars, dowel group action; stress analysis in rigid pavements.			
UNIT-III			9 Hrs
Flexible pavement design IRC 37 guidelines and Asphalt Institute's design methods with HMA and other base combinations. AASHTO method of flexible pavement design;- introduction to mechanistic-empirical pavement design guide. Design of flexible pavement shoulders.			
UNIT-IV			9 Hrs
Design of Rigid Pavements: IRC method of plain jointed, reinforced, continuously reinforced rigid pavement design; AASHTO method of rigid pavement design- design of rigid pavement shoulders and design of conventional and thin white topping;			
Textbook(s): 1. E.J. Yoder, M.W. Witczak; Principles of Pavement Design, Wiley India Pvt. Ltd., New Delhi, India, 2011, Second Edition. 2. Huang, Y.H., Pavement Analysis and Design, Dorling Kindersley (India) Pvt. Ltd., New Delhi, India, 2008, Second Edition.			

Reference Book(S):

1. AI MSI-1: Thickness Design – Asphalt Pavements for Highways and Streets, Manual Series No. 1, Asphalt Institute, Kentucky, USA, 1999, Ninth Edition.
2. IRC:37-2018, Guidelines for the Design of Flexible Pavements, Indian Roads Congress, New Delhi, India, 2018, Fourth Revision.
3. IRC:58-2015, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, Indian Roads Congress, New Delhi, India, 2015, Fourth Revision.
4. IRC:118-2015, Guidelines for Design and Construction of Continuously Reinforced Concrete Pavement, Indian Roads Congress, New Delhi, India, 2015.
5. IRC: SP76-2015, Guidelines for Conventional and Thin White topping, Indian Roads Congress, New Delhi, India, 2015, First Revision.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105106221> ; NPTEL Video Lecture on Analysis and Design of Bituminous Pavements, by M.R. Nivitha, Neethu Roy, A. Padmarekha and J. Muralikrishnan, IIT Madras.
2. <https://nptel.ac.in/courses/105104098> ; NPTEL Course on Advanced Transportation Engineering (Pavement Analysis, Rigid Pavement Design – Westergaard's Theory, ESWL, EAL, Dowel Bars, Traffic Parameters) by Prof. A. Das & Prof. Partha Chakraborty, IIT Kanpur.
3. <https://www.concretepavements.org/2026/03/04/global-access-to-premier-rigid-pavement-design-course-now-available-online/> analysis and design of rigid pavements by Dr. Sushobhan Sen, Professor, IIT Gandhinagar

Course Articulation Matrix (CAM):				U24CE702B: PAVEMENT DESIGN										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE702B.1	2	2	2	1	-	2	-	-	-	-	-	2	-
CO2	U24CE702B.2	2	2	2	2	-	2	-	-	-	-	-	2	2
CO3	U24CE702B.3	2	2	2	2	-	2	-	-	-	-	-	2	2
CO4	U24CE702B.4	2	2	2	3	-	2	-	-	-	-	-	2	2
U24CE702B		2	2	2	2	0	2	0	0	0	0	0	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	summarize materials and factors affecting pavement design	SDG 11	Sustainable Cities and Communities	Determining correct design traffic (ADT, AADT, lane and directional distribution factors) prevents over- or under-design of urban roads
CO2	analyse stresses and deflections in flexible and rigid pavements	SDG 9	Industry, Innovation and Infrastructure	Understanding pavement types, materials, and layer stress distribution underpins the design of quality, reliable, and sustainable road infrastructure.
CO3	design flexible pavements using IRC:37 guidelines.	SDG 9	Industry, Innovation and Infrastructure	Applying IRC:37-2018, Asphalt Institute MS-1, and AASHTO flexible pavement design methods ensures structurally sound, load-resilient roads.
CO4	design rigid pavements using IRC guidelines.	SDG 12	Responsible Consumption and Production	White-topping (thin concrete overlay on existing bituminous surface) recycles the existing pavement structure, reducing raw material consumption and construction waste.

EARTH RETAINING STRUCTURES			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE702C	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 earth pressure theories to analyse lateral earth pressure and design gravity retaining walls.			
CO2 : analyse cantilever retaining walls and sheet pile walls under simple field conditions.			
CO3 : explain the behaviour, construction sequence and basic design principles of braced excavations and soil nailing systems.			
CO4 : select reinforced soil and sustainable retaining systems considering safety, constructability, economy and environmental aspects.			
UNIT-I			9 Hrs
Earth Pressure Theories: at-rest, active and passive earth pressure; rankine's earth pressure theory; coulomb's earth pressure theory; earth pressure due to surcharge and water table; simple numerical problems.			
Gravity Retaining Walls: definition, components and applications of gravity retaining walls; preliminary proportioning; calculation of lateral earth pressure; stability checks against sliding, overturning and bearing pressure; drainage and construction considerations; simple complete design problem.			
UNIT-II			9 Hrs
Cantilever Retaining Walls: definition, components and applications of cantilever retaining walls; preliminary dimensions; active earth pressure on wall; stability checks against sliding, overturning and bearing capacity failure; basic structural design concept of stem, heel and toe; drainage and construction considerations; simple complete design problem.			
Sheet Pile Walls: types and uses of sheet pile walls; cantilever sheet pile walls; anchored sheet pile walls; earth pressure distribution in sands and clays; depth of embedment concept; free earth support method; simple design problem.			
UNIT-III			9 Hrs
Braced Excavations: need for braced cuts; sheeting, struts, walers and bracing systems; apparent earth pressure diagrams for sands and clays; strut loads; stability against bottom heave and boiling; construction precautions.			
Soil Nailing: concept and applications of soil nailing; components of soil nail walls; construction sequence; nail inclination and spacing concept; facing systems; drainage requirements; basic stability considerations; advantages, limitations and field applications.			
UNIT-IV			9 Hrs
Reinforced Soil Retaining Walls: concept of soil reinforcement; mechanically stabilized earth walls; geotextiles, geogrids and metallic strip reinforcement; components of reinforced soil walls; external stability checks; internal stability concepts; construction sequence; advantages and limitations.			
Sustainable Retaining Systems and Selection Criteria: selection of retaining systems based on height, soil type, groundwater, space availability, constructability, cost, maintenance and environmental impact; gabion walls, vegetated facings and material-efficient systems; failure modes; monitoring and maintenance.			
Textbook(s):			

- Reference Book(S):**

- Web and Video link(s):**

Course Articulation Matrix (CAM):				U24CE401: FLUID MECHANICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE702C.1	3	2	1	-	1	1	-	-	1	-	2	3	1
CO2	U24CE702C.2	3	3	2	1	1	2	1	-	1	1	2	3	2
CO3	U24CE702C.3	3	2	2	1	1	2	1	-	1	1	2	3	2
CO4	U24CE702C.4	2	2	3	1	2	3	2	-	2	2	2	3	3
U24CE702C		2.75	2.25	2.00	1.00	1.25	2.00	1.33	-	1.25	1.33	2.00	3.00	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	apply earth pressure theories to analyse lateral earth pressure and design gravity retaining walls.	SDG9	Industry, Innovation and Infrastructure	Earth pressure analysis and retaining wall design contribute to safe and resilient infrastructure development for transportation, foundations, and earth-retaining structures.
CO2	analyse cantilever retaining walls and sheet pile walls under simple field conditions.	SDG11	Sustainable Cities and Communities	Retaining and sheet pile walls support safe urban development by ensuring stability of excavations, embankments, and infrastructure in populated areas.
CO3	explain the behaviour, construction sequence and basic design principles of braced excavations and soil nailing systems.	SDG9	Industry, Innovation and Infrastructure	Braced excavations and soil nailing systems improve the safety and efficiency of underground and infrastructure construction projects.
CO4	select reinforced soil and sustainable retaining systems considering safety, constructability, economy and environmental aspects.	SDG12	Responsible Consumption and Production	Sustainable retaining systems encourage efficient use of construction materials, environmentally responsible practices, and economical design solutions.

HYDRAULIC STRUCTURES			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE702D	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 planning, storage capacity, sedimentation effects, and stability aspects of reservoirs and gravity dams for safe and efficient water resources management. CO2 : apply the design principles, seepage control measures, stability requirements, and energy dissipation systems of earth dams and spillways for safe hydraulic structures. CO3 : analyze the design principles and hydraulic performance of head regulators and cross regulators, including floor design, uplift pressures, and protection works. CO4 : analyze the design and hydraulic performance of aqueducts and siphon aqueducts, including waterways, transitions, troughs, and uplift pressures.			
UNIT-I			9 Hrs
Storage Works-Reservoirs: Types of reservoirs, selection of site for reservoir, zones of storage of a reservoir, reservoir yield, estimation of capacity of reservoir using mass curve- Reservoir Sedimentation – Life of Reservoir. Types of dams, factors affecting selection of type of dam, factors governing selection of site for a dam. Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile, and practical profile of a gravity dam, limiting height of a low gravity dam, Factors of Safety - Stability Analysis, Foundation for a Gravity Dam, drainage and inspection galleries.			
UNIT-II			9 Hrs
Earth dams: types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam, seepage through earth dam-graphical method, measures for control of seepage. Spillways: types of spillways, Design principles of Ogee spillways - Spillway gates. Energy Dissipaters and Stilling Basins Significance of Jump Height Curve and Tail Water Rating Curve - USBR and Indian types of Stilling Basins.			
UNIT-III			9 Hrs
Regulation works: head regulators and cross regulators, design principles of head regulator and cross regulator. Design of Head regulators head regulator – crest levels, conditions of flow for design, cistern level, length of downstream floor, cut-offs, total floor length, uplift pressures and floor thickness, protection works.			
UNIT-IV			9 Hrs
Aqueduct: design of drainage waterway, design of canal waterway, design of bed levels, design of transitions, design of trough, and uplift on bottom floor of barrel. Siphon Aqueduct: siphon aqueduct – design of drainage waterway, design of canal waterway, design of bed levels, design of transitions, design of trough, and uplift on bottom floor of barrel.			

Textbook(s):														
1. S. K. Garg, <i>Irrigation Engineering and Hydraulic Structures</i> , 33 rd ed. New Delhi: Khanna Publishers, 2019.														
Reference Book(S):														
1. K. R. Arora, <i>Irrigation, Water Power and Water Resources Engineering</i> , 3 rd ed. New Delhi: Standard Publications, 2002.														
2. B. C. Punmia, <i>Irrigation and Water Power Engineering</i> , 16 th ed. New Delhi: Standard Publishers, 2009.														
3. G. L. Asawa, <i>Irrigation Engineering</i> , 4 th ed. New Delhi: New Age Publications, 2005.														
Web and Video link(s):														
1. https://nptel.ac.in/courses/126105010 NPTEL Video Lecture on Irrigation and drainage by Prof. Damodhara Rao Mailapalli, IIT Kharagpur.														
2. https://nptel.ac.in/courses/105105110 ? NPTEL Video Lecture on Water Resources Engineering by Dr. Dhrubajyoti sen, IIT Kharagpur														

Course Articulation Matrix (CAM):				U24CE401: FLUID MECHANICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE702D.1	2	2	2	1	1	2	1	-	-	1	1	2	1
CO2	U24CE702D.2	2	2	2	1	1	2	1	-	-	1	1	2	1
CO3	U24CE702D.3	2	2	2	1	1	2	1	-	-	1	1	2	1
CO4	U24CE702D.4	2	2	2	1	1	2	1	-	-	1	1	2	1
U24CE401		2	2	2	1	1	2	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	analyze the planning, storage capacity, sedimentation effects, and stability aspects of reservoirs and gravity dams for safe and efficient water resources management.	SDG6	Clean Water and Sanitation	Reservoir planning and dam stability analysis support sustainable storage, conservation, and regulated supply of water resources for domestic, agricultural, and industrial needs.
CO2	apply the design principles, seepage control measures, stability requirements, and energy dissipation systems of earth dams and spillways for safe hydraulic structures.	SDG11	Sustainable Cities and Communities	Spillways and seepage control measures reduce flood risks and enhance the resilience and safety of communities located near hydraulic structures.
CO3	analyze the design principles and hydraulic performance of head regulators and cross regulators, including floor design, uplift pressures, and protection works.	SDG9	Industry, Innovation and Infrastructure	Regulators and canal control structures are essential irrigation infrastructures that ensure efficient water distribution and operational safety.
CO4	analyze the design and hydraulic performance of aqueducts and siphon aqueducts, including waterways, transitions, troughs, and uplift pressures.	SDG9	Industry, Innovation and Infrastructure	Aqueducts and siphon aqueducts are major cross-drainage infrastructures that enable efficient and safe conveyance of irrigation water across natural obstacles.

OOP through Java			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE702E	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 will develop knowledge in,</i> CO1 : fundamentals of object oriented and java programming CO2 : classes, objects and inheritance for implementing object-oriented concepts CO3 : concepts of polymorphism, interfaces and packages CO4 : exception handling, string handling, input and output operations			
THEORY COMPONENT			
UNIT-I			9 Hrs
Fundamentals of Object-Oriented Programming: Programming paradigms, Basic concepts of Object-Oriented paradigm (OOP), benefits and applications of OOP. Basics of Java Language: Java language Features, Java Programming Structure, Java Tokens, JVM, Constants, Variables, Data types, Scope of variables, Type Casting, Operators and Expressions, Branching and looping statements, Arrays.			
UNIT-II			9 Hrs
Classes and Objects: Defining a class, Field declaration, Method declaration, Creating object, Accessing Class Members, Constructors, garbage collection, Static members, Nested and inner classes, Command line arguments, Wrapper classes. Inheritance: Extending a class, Defining subclasses, Subclass constructor, Multilevel inheritance, Hierarchical inheritance, Access controls, this and super keywords.			
UNIT-III			9 Hrs
Polymorphism: Overloading methods, Overloading constructors, Overriding Methods, Dynamic method dispatch, Abstract classes, FinalKeyword. Interfaces: Defining an interface, Implementing interfaces, Nested Interfaces, Variables in interfaces, Extending interfaces Packages: Packages, java API packages, Using System Packages, Naming Conventions, Creating Packages, Accessing Packages, Adding a class to package, Hiding classes, StaticImport.			
UNIT-IV			9 Hrs
Exception handling: Fundamentals, Exception types, Uncaught exceptions, Using try and catch, Multiple catch clauses, Explicit exceptions with throw, throws and finally keywords. String Handling: String constructors, String length, String operations, Character extraction, String comparison, Searching strings, Modifying a string, Changing string cases, Joining strings. I/O: I/O Basics, Reading console Input, Writing console output, Reading and writing files.			

Textbook(s):

1. Herbert Schildt, *JAVA The Complete Reference*, 9thed., McGraw-Hill Education India Pvt.Ltd ,2014.
2. E.Balagurusamy, *Programming with JAVA: A Primer*, 5thed., McGraw-Hill Publication Ltd,2014.

Reference Book(S):

1. P. Radha Krishna, *Object Oriented Programming through JAVA*, Universities press,2011.
2. Herbert Schildt, *JAVA The Complete Reference*, 9thed., McGraw-Hill Education India Pvt. Ltd.,2011.
3. Kathy Sierra, Bert Bates, *Head First Java*, 2nded., O'Reilly Publications,2005.
4. UttamK.Roy, *Advanced JAVA Programming*, Oxford Publications,2015.

Web and Video link(s):

<https://nptel.ac.in/courses/106106130>; NPTEL Video Lecture on Advanced Data Structures by Prof. Narayanaswamy, Professor of Computer Science and Engineering, IIT Madras.

Course Articulation Matrix (CAM):		U24CE702E : OOP through Java												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE702E.1	2	2	2	1	2	1	1	2	1	2	1	1	1
CO2	U24CE702E.2	2	2	2	1	2	1	-	2	1	2	1	1	1
CO3	U24CE702E 5.3	2	2	2	1	2	1	-	2	1	2	1	1	1
CO4	U24CE702E.4	2	2	2	1	2	1	1	2	1	2	1	1	1
U24CE702E		2	2	2	2	1	2	1	1	2	1	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	Fundamentals of object-oriented and Java programming	SDG 4	Quality Education	Builds foundational programming knowledge, empowering students with modern computing skills essential for education and employability.
CO2	Classes, objects and inheritance for implementing OOP concepts	SDG 9	Industry, Innovation & Infrastructure	Object-oriented design supports scalable software systems, fostering innovation in IT infrastructure and industry applications.
CO3	Concepts of polymorphism, interfaces and packages	SDG 8	Decent Work & Economic Growth	Advanced OOP features enable modular, reusable, and efficient software development, supporting digital economy growth.
CO4	Exception handling, string handling, input/output operations	SDG 11	Sustainable Cities & Communities	Robust error handling and data processing are critical for reliable systems in smart cities, navigation, and community applications.

PRESTRESSED CONCRETE

Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE703	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: appraise the concept of Prestressing in concrete			
CO2: evaluate losses in prestress and analyse the sections			
CO3: design prestressed concrete members in flexure and shear.			
CO4: estimate the transfer stresses in prestressed concrete			
UNIT-I			9 Hrs
Elements of Prestressed concrete: Historical development, concepts of pre-stressing, terminology, advantages, applications of prestressed concrete, pre-tensioning and post-tensioning. Prestressing Systems: Hoyer, Freyssinet, Magnelblaton and Lee-Mc call system, material properties, need for high strength steel and high strength concrete.			
UNIT-II			9 Hrs
Analysis of Sections: Stress, strength, load balancing concepts, effect of loading on the tensile stresses in tendons, effect of tendon profile on deflections, factors influencing deflections, calculation of short term and long-term deflections. Losses in Prestress: Loss of prestress in pre-tensioned and post-tensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss.			
UNIT-III			9 Hrs
Design for Flexure: Allowable stresses, elastic design of simple beams having rectangular and I-section for flexure, kern lines, cable profile and cable layout. Design for Shear: Shear and principal stresses, shear improvement techniques, horizontal, sloping and vertical prestressing, analysis of rectangular beam and I-section, design of shear reinforcement, Indian code provisions.			
UNIT-IV			9 Hrs
Transfer of Prestress: Transmission of prestressing force by bond, transmission length, flexural bond stresses, IS code provisions, anchorage zone stresses in post-tensioned members, stress distribution in end block. Methods of transfer: Analysis by approximate method, Guyon and Magnel method, anchorage zone reinforcement.			
<u>Textbook(s):</u>			
1. N. Krishna Raju, Prestressed concrete, 6th ed., Tata Mc Graw Hill Education Pvt. Ltd. 2018. New Delhi			
<u>Reference Book(S):</u>			
1. S. Ramamrutham, Prestressed concrete, 5th edn., Dhanpat Rai publications Pvt. Ltd. 2013. New			

Delhi

2. T.Y.Lin, Design of prestressed concrete structures, 3rd ed., Wiley India Pvt. Ltd., 2010. Mumbai
3. G.S. Ramaswamy, Modern prestressed concrete design, Arnold Heinimen, 2007. New Delhi
4. N. Rajagopalan, Prestressed Concrete, 2nd ed., Narosa publishers, 2010. New Delhi
5. S. K. Mallic and A. P. Gupta, Prestressed concrete, 4th ed., Oxford and IBH publishing Co. Pvt. Ltd., 1987.
6. IS 1343: 2012, Code of Practice for Prestressed Concrete, 2nd edn., Bureau of Indian Standards, 2012. New Delhi

Web and Video link(s):

https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed124, NPTEL Video Lecture on Precast and Prestressed Concrete By Dr. Perumalla Venkata Mallikarjun Rao, NIT Puducherry,

Course Articulation Matrix (CAM):				U24CE703: PRESTRESSED CONCRETE										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE703.1	1	2	2	-	-	-	1	1	1	-	1	2	1
CO2	U24CE703.2	1	2	2	-	-	-	1	1	1	-	1	2	1
CO3	U24CE703.3	1	2	2	-	-	-	1	1	1	-	1	2	1
CO4	U24CE703.4	1	2	2	-	-	-	1	1	1	-	1	2	1
U24CE703		1	2	2	-	-	-	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 Prestressing in concrete	SDG9	Industry, Innovation and Infrastructure	Understanding prestressing concepts supports the development of advanced, durable, and innovative infrastructure systems, aligning with sustainable industrial growth and resilient construction practices.
CO2	evaluate losses in prestress and analyse the sections	SDG9	Industry, Innovation and Infrastructure	Evaluating prestress losses and analysing structural sections improves the efficiency, safety, and performance of infrastructure, contributing to resilient engineering solutions.
CO3	design prestressed concrete members in flexure and shear.	SDG11	Sustainable Cities and Communities	Designing safe and efficient prestressed concrete members contributes to sustainable urban infrastructure, ensuring stronger and more resilient buildings and transportation systems.
CO4	estimate the transfer stresses in prestressed concrete.	SDG11	Industry, Innovation and Infrastructure	Estimating transfer stresses enhances structural reliability and quality in construction, supporting the creation of sustainable and resilient infrastructure.

ESTIMATION AND VALUATION			
Class: B.Tech. VII -Semester		Branch: Civil Engineering	
Course Code:	U24CE704	Credits:	3
Hours/Week (L-T-P- E):	1-0-4-5	CIE:	60(%)
Total Number of Teaching Hours:	36 Hrs	ESE:	40(%)
Course Learning Outcomes (COs)			
After completion of this course, the students should be able to,			
CO1: measure quantities pertaining to civil engineering works			
CO2:estimate quantities and propose tender documents for construction projects			
CO3: determine rate analysis and valuation report for a building			
CO4: distinguish types of contract and estimate miscellaneous civil engineering works			
UNIT-I			9Hrs
Quantity Surveying: Scope of quantity survey, Units of measurement, Methods of measurement for excavation, Concrete, Brick masonry, Steel, Wood work.			
Measurements: Essentials of estimation, Advantages, Estimation of isolated, Step foundation, Volumeof earth work at same level by mid-section, Mean sectional area, Prismoidal methods, Importance, Maintenance of measurement book			
UNIT-II			9Hrs
Estimation of Quantities: Different types of estimates, Methods of estimation - Centre line, Individual wall method; Calculation of quantities of brick work, RCC, PCC, Plastering, White washing and painting, Estimate of wood work for doors and frames, Preparation of detailed and abstract estimate for framed structures, Bar bending schedule			
Tenders: Types of tender, Tender notice, Earnest money, Security deposit, Liquidated damages, Arbitration,Escalation, Costing and preparation of tender document.			
UNIT-III			9 Hrs
Specifications and Rate analysis: Objectives of specifications, Specifications for earth work excavation, Concrete, Damp proof course(DPC), Form work, Brick masonry, Flooring, Painting and Wood work, Schedule of rates, Rate analysis for cement concrete, DPC, Brick masonry, Plastering, Flooring, Painting			
Valuation: Objectives, Market value, Book value, Assessed value, Mortgage value, Replacement value, Capital cost, Cost escalation, Sinking fund, Depreciation methods, Preparation of valuation report for residential building.			
UNIT-IV			9Hrs
Contracts: General requirements of contract, Types of contracts, Conditions, Termination of contract, Departmental procedures for execution of works			
Miscellaneous Estimates: Preparation of detailed and abstract estimate for septic tank with soak pit, Slab culvert, Road project.			

<u>Textbook(s):</u> 2. B.N.Dutta, <i>Estimating and Costing in Civil Engineering</i> , 27 th ed. New Delhi: UBS Publishers, 2014.
<u>Reference Book(s):</u> 1. D.D.Kohli and R.C.Kohli, <i>A Text Book of Estimating and Costing (Civil)</i> , 13 th ed. New Delhi: S. Chand and Company Ltd., 2004. 2. G.S.Birdie, <i>A Text Book of Estimating and Costing for Civil Engineering</i> , 6 th ed. New Delhi: Dhanpat Rai publishing company (P) Ltd., 2014.

- 3.M. Chakraborty, *Estimating, Costing, Specification and Valuation in Civil Engineering*, 29th ed. Kolkata: Chakraborty Publishers, 2006.
4. Bureau of Indian Standards, SP27: 1987(R2003): *Hand book of Method of Measurement of Buildings Works*, New Delhi: Reaffirmed 2003.

Web and Video link(s):

2. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou20_cs11 Video Lecture on Building cost estimation simplified by Prof. Shruti Samuel, Indira Gandhi National Open University.

CourseArticulationMatrix(CAM):				U24CE704ESTIMATION AND VALUATION										
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	U24CE704.1	3	2	1	-	2	-	-	-	-	-	-	3	2
CO2	U24CE704.2	3	3	2	1	2	-	-	1	1	2	1	3	2
CO3	U24CE704.3	3	3	2	1	2	1	1	-	-	1	2	3	2
CO4	U24CE704.4	2	3	2	1	1	1	-	2	2	2	1	3	2
U24CE704		2.75	2.75	1.75	1	1.75	1	1	1.5	1.5	1.66	1.33	3	2
3-HIGH,2-MEDIUM,1-LOW														

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CO	CO Statement – The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO 1	Measure quantities pertaining to civil engineering works	SDG 9	Industry, Innovation and Infrastructure	Quantity surveying and measurement practices support accurate planning and efficient utilization of construction resources for sustainable infrastructure development.
CO 2	Estimate quantities and propose tender documents for construction projects	SDG 11	Sustainable Cities and Communities	Preparation of estimates and tender documents promotes planned urban infrastructure, transparent project execution, and sustainable construction practices.
CO 3	Determine rate analysis and valuation report for a building	SDG 12	Responsible Consumption and Production	Rate analysis and valuation encourage efficient utilization of materials, cost optimization, economic sustainability, and responsible resource management in construction projects.
CO 4	Distinguish types of contract and estimate miscellaneous civil engineering works	SDG 16	Peace, Justice and Strong Institutions	Understanding contracts, tendering procedures, and legal provisions promotes transparency, accountability, and ethical engineering practices in public infrastructure projects.

CONSTRUCTION MANAGEMENT AND EQUIPMENT			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE705	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: integrate the process of construction management and planning CO2: optimize construction project duration and cost CO3: justify applications of various construction equipment CO4: apply norms for quality and safety aspects in construction			
UNIT-I			9 Hrs
Construction Management: Stages of construction project, construction team and their functions, functions of construction management, planning, organizing, staffing, directing, controlling and coordinating, construction activities, processes, workers, estimating, schedule, productivity and mechanized construction, construction documents. Preliminary Project Planning: Site layout, Infrastructure development - security, office and residence, power, water, access roads, drainage, illumination, storage yards, workshop, garage, parking, testing facilities, medical care, firefighting facilities, communication and fuel station facilities.			
UNIT-II			9 Hrs
Project Scheduling: methods of scheduling, bar charts/GANTT chart, milestone charts, network analysis, limitations and advantages, network and its development, work breakdown structure, network techniques, activity, event, network diagram by Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), time estimates, floats and slacks. Cost Management: direct and indirect cost of project, cost slope and crashing of activities, resource allocation, levelling and smoothing.			
UNIT-III			9 Hrs
Construction Equipment: classification of equipment, power shovel, back hoe, dragline, clamshell, bulldozers, scrapers, tractors, smooth wheel rollers, sheep foot rollers and pneumatic rollers, dump trucks, dumpers, derrick cranes, mobile cranes, gantry cranes, belt conveyor, ready mix concrete unit, tunnelling and rock drilling equipment, Management of Construction Equipment: need for mechanization, financing aspects of construction plants and equipment, factors affecting selection of construction equipment, planning of construction equipment, factors affecting the cost of owning and operating the construction equipment.			
UNIT-IV			9 Hrs
Quality Control in Construction: importance and elements of quality, organization for quality control, quality assurance techniques, documentation, quality circles, six sigma concepts. Construction Safety Management: importance of safety, causes of accidents, classification of accidents, safety measures, safety benefits to stakeholders, fire safety in construction, personal			

protective equipment, mitigation methods and personnel training, measuring of safety.

<u>Text book(s):</u> 1. Subhajit Saraswati, Construction Technology, Oxford University Press, New Delhi 2008. 2. S. Seetharaman, Construction Engineering and Management, 5th ed., Umesh Publications, New Delhi, 2017.

- Reference Book(S):**
1. K.N. Jha, Construction Project Management: Theory and Practice, 2nd ed., Pearson Education India, New Delhi, 2018.
 2. B. L. Gupta, Construction Management, machinery and accounts, 4th ed., Standard Publishers, New Delhi, 2017.
 3. L. S. Srinath, PERT and CPM principles and applications, 3rd ed., East West Press, New Delhi, 2015.
 4. K. K. Chitkara, Construction Project Management: Planning, scheduling and controlling, 3rd ed., McGraw Hill Education, New Delhi, 2014.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105103206> NPTEL Course module on Construction Methods and Equipment Management, by Prof. Indu Siva Ranjani Gandhi, IIT Guwahati
2. <https://nptel.ac.in/courses/105104161> NPTEL Course module on Principles of Construction Management, Prof. Sudhir Misra, IIT Kanpur

Course Articulation Matrix (CAM):				U24CE705 : CONSTRUCTION MANAGEMENT AND EQUIPMENT										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE705.1	3	3	2	1	2	2	1	1	2	3	2	3	3
CO2	U24CE705.2	3	3	2	2	2	2	1	1	-	3	2	3	3
CO3	U24CE705.3	2	2	2	1	2	2	1	1	-	2	3	2	2
CO4	U24CE705.4	2	2	2	2	2	2	1	1	2	2	3	2	2
U24CE705		2.5	2.5	2	1.5	2	2	1	1	1	2.5	2.5	2.5	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	Synthesize process of construction management and planning	SDG 9	Industry Innovation and Infrastructure	Construction management and planning directly involve developing infrastructure projects such as roads, buildings, and water systems. Synthesizing these processes ensures efficient, resilient, and sustainable infrastructure development.
CO2	Optimize construction project duration and cost	SDG 8	Decent work and Economic growth	Optimizing project duration and cost improves the economic efficiency of construction projects, reduces resource wastage, enables timely completion, and supports productive employment in the construction sector.
CO3	Critique various construction equipment and their applicability	SDG 12	Responsible Consumption and Production	Critiquing construction equipment involves evaluating fuel efficiency, emission levels, resource consumption, and waste generation. Appropriate equipment selection reduces environmental impact, minimizes resource wastage, and promotes responsible production practices in construction.
CO4	Integrate norms for implementation of quality and safety aspects	SDG 3	Good Health and Wellbeing	Integrating quality and safety norms helps prevent accidents, injuries, and fatalities at construction sites. It ensures worker health, public safety around construction zones, and long-term structural safety for occupants.

CIVIL ENGINEERING SOFTWARE APPLICATIONS LABORATORY			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE706	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 : design structural elements using STAAD Pro CO2 : propose horizontal alignment, rail-tracking placing and flexible and rigid airfield pavements CO3 : demonstrate water hammer and water distribution system CO4 : calculate soil bearing capacity and load capacity of piles			
List of Experiments			
1. Analysis and design of RCC beams using STAAD.Pro and validate manually using IS Codal provisions. 2. Analysis and design of RCC columns using STAAD.Pro and validate manually using IS Codal provisions. 3. Analysis and design of RCC slabs using MS Excel / Mat Lab and validate manually using IS Codal provisions. 4. Analysis and design of Isolated RCC footings using STAAD Foundation Advanced and validate manually using IS Codal provisions. 5. Analysis and design of steel beams using STAAD.Pro and validate manually using IS Codal provisions. 6. Analysis and design of steel columns using STAAD.Pro and validate manually using IS Codal provisions. 7. Analysis of roof truss using STAAD.Pro and validate manually. 8. Determination of soil bearing capacity using MS Excel/MAT Lab. 9. Determination of pile load capacity using MS Excel/MAT Lab. 10. Horizontal alignment of a road using MX road. 11. Analysis of water hammer in a pipe using HAMMER. 12. Building a water distribution system using Water GEMS.			
<u>Textbook(s):</u> 1. S. Unnikrishna Pillai and Devdas Menon, <i>Reinforced Concrete Design</i>, 3rd ed., New Delhi: Tata McGraw-Hill Publishing Company Limited, 2011. 2. S. S. Bhavikatti, <i>Design of Steel Structures: By Limit State Method as Per IS: 800-2007</i>, 3rd ed., New Delhi: International Publishing House Pvt. Ltd, 2012.			
<u>Reference Book(S):</u> 1. <i>Manual of STAAD.Pro</i>, Bentley Software. 2. <i>Manual of MX Roads</i>, Bentley Software. 3. <i>Manual of In-Roads</i>, Bentley Software.			

Laboratory Manual:

1. *Civil Engineering Software Applications Laboratory Manual*, prepared by the faculty of Civil Engineering, KITSW.

- Web and Video link(s):**
1. <https://nptel.ac.in/courses/105105105> NPTEL Course on Design of Reinforced Concrete Structures (RCC Beams, Columns, Slabs & Footings – Limit State Method) by Prof. Nirjhar Dhang, IIT Kharagpur
 2. <https://nptel.ac.in/courses/105101087> NPTEL Course on Transportation Engineering I (Geometric Design of Highways, Railway Track, Pavement & Airport Design) by IIT Bombay
 3. https://onlinecourses.nptel.ac.in/noc22_ce07/preview NPTEL Course on Water Supply Engineering (Water Distribution Networks using WaterGEMS & EPANET, Water Hammer Analysis) by IIT
 4. <https://nptel.ac.in/courses/105105185> NPTEL Course on Geotechnical Engineering II – Foundation Engineering (Bearing Capacity, Pile Load Capacity, Settlement) by Prof. Dilip Kumar Baidya, IIT Kharagpur

1. <https://nptel.ac.in/courses/105105105> NPTEL Course on Design of Reinforced Concrete Structures (RCC Beams, Columns, Slabs & Footings – Limit State Method) by Prof. Nirjhar Dhang, IIT Kharagpur
2. <https://nptel.ac.in/courses/105101087> NPTEL Course on Transportation Engineering I (Geometric Design of Highways, Railway Track, Pavement & Airport Design) by IIT Bombay
3. https://onlinecourses.nptel.ac.in/noc22_ce07/preview NPTEL Course on Water Supply Engineering (Water Distribution Networks using WaterGEMS & EPANET, Water Hammer Analysis) by IIT
4. <https://nptel.ac.in/courses/105105185> NPTEL Course on Geotechnical Engineering II – Foundation Engineering (Bearing Capacity, Pile Load Capacity, Settlement) by Prof. Dilip Kumar Baidya, IIT Kharagpur

Course Articulation Matrix (CAM):				U24CE706: CIVILENGINEERINGSOFTWAREAPPLICATIONS LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE706.1	2	2	1	1	2	-	1	-	1	-	1	2	1
CO2	U24CE706.2	2	2	1	1	2	-	1	-	1	-	1	2	1
CO3	U24CE706.3	2	2	1	1	2	-	1	-	1	-	1	2	1
CO4	U24CE706.4	2	2	1	1	2	-	1	-	1	-	1	2	1
U24CE706		2	2	1	1	2	-	1	-	1	-	1	2	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

Course Articulation Matrix (CAM):				U24CE706: CIVILENGINEERINGSOFTWAREAPPLICATIONS LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE706.1	2	2	1	1	2	-	1	-	1	-	1	2	1
CO2	U24CE706.2	2	2	1	1	2	-	1	-	1	-	1	2	1
CO3	U24CE706.3	2	2	1	1	2	-	1	-	1	-	1	2	1
CO4	U24CE706.4	2	2	1	1	2	-	1	-	1	-	1	2	1
U24CE706		2	2	1	1	2	-	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	design structural elements using STAAD Pro	SDG 9	Industry, Innovation and Infrastructure	Using STAAD.Pro to design RCC and steel structural elements (beams, columns, slabs, footings, trusses) with software-based analysis and manual validation builds industry-relevant digital design skills, directly supporting the development of safe, efficient, and technology-driven building infrastructure.
CO2	propose horizontal alignment, rail-tracking placing and flexible and rigid airfield pavements	SDG 9	Industry, Innovation and Infrastructure	Proposing horizontal alignment using MX Road, rail-track turnouts using InRoads, and airfield pavement design using FAARFIELD develops software proficiency for planning resilient road, rail, and airport infrastructure, advancing sustainable and innovation-driven multimodal transport systems.
CO3	demonstrate water hammer and water distribution system	SDG 6	Clean Water and Sanitation	Demonstrating water hammer analysis using HAMMER and modelling distribution networks using WaterGEMS develops the digital skills needed to design safe, pressure-controlled, and equitable water supply systems – directly supporting universal access to clean water and sustainable management of water resources.
CO4	calculate soil bearing capacity and load capacity of piles	SDG 9	Industry, Innovation and Infrastructure	Calculating soil bearing capacity and pile load capacity using MS Excel / MATLAB equips engineers with computational tools for geotechnical assessment of foundations, underpinning the safe and cost-effective design of infrastructure on varied soil conditions for industrial and civil construction.

BUILDING INFORMATION MODELLING LABORATORY			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE707	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, (based on psychomotor skills acquired from laboratory component)</i> CO1 : Explain fundamental BIM concepts and create architectural BIM models using Autodesk Revit from 2D CAD drawings. CO2 : Develop structural BIM models and apply basic parametric modelling techniques for building components. CO3 : Generate schedules, quantity take-offs, bills of quantities (BOQ), and construction documentation directly from BIM models. CO4 : Apply BIM-based coordination techniques including interoperability with structural analysis software, clash detection, and construction sequencing for integrated project delivery.			
List of Experiments			
1. Introduction to BIM Concepts, BIM Dimensions (3D/4D/5D), and Revit Interface Navigation 2. Setting Up a BIM Project Using Levels, Grids, Views, and Project Templates 3. Developing an Architectural BIM Model from AutoCAD Floor Plans 4. Modeling Building Components: Floors, Roofs, Staircases, Ramps, and Railings 5. Editing Existing Families and Creating Simple Parametric Components in Revit 6. Creating a Structural BIM Model with Columns, Beams, Slabs, and Foundations 7. Developing Analytical Structural Models and Understanding BIM-Analysis Integration 8. Reinforcement Modeling for RCC Elements and Generation of Bar Bending Schedules 9. Creating Schedules for Doors, Windows, Concrete Volumes, and Building Components 10. Preparing Quantity Take-Offs and Bills of Quantities (BOQ) from BIM Models 11. Generating Construction Documentation: Plans, Elevations, Sections, and Sheet Layouts 12. Structural Model Exchange and Interoperability between Revit and STAAD Pro 13. Clash Detection, Model Coordination, and Resolution of Design Conflicts 14. 4D BIM Construction Planning and Simulation of Construction Sequencing			
<u>Textbook(s):</u>			
1. Eastman, C., Teicholz, P., Sacks, R., and Liston, K., <i>BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers</i>, Wiley, 3rd Edition, 2018. 2. Tickoo, S., <i>Autodesk Revit for Architecture and Structure</i>, CADCIM Technologies, 2023.			
<u>Reference Book(S):</u>			
1. Kim, M., <i>Mastering Autodesk Revit Architecture</i>, Wiley, Latest Edition. 2. Stine, D. J., <i>Residential Design Using Autodesk Revit</i>, SDC Publications, Latest			

Edition.
3. Stine, D. J., <i>Commercial Design Using Autodesk Revit</i> , SDC Publications, Latest Edition.
4. Hardin, B., <i>BIM and Construction Management: Proven Tools, Methods, and Workflows</i> , Wiley, 2nd Edition, 2015.
5. Kymmell, W., <i>Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations</i> , McGraw-Hill Education, 1st Edition, 2008.
Laboratory Manual (for laboratory component):
1. <i>Building Information Modelling Laboratory Manual</i> , Department of CE, KITSW

Course Articulation Matrix (CAM):				U24CE707:BUILDING INFORMATION MODELLING LABORATORY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE707.1	2	2	1	-	3	-	-	-	1	-	2	3	2
CO2	U24CE707.2	2	2	3	1	3	-	-	-	1	-	1	3	1
CO3	U24CE707.3	2	2	2	1	3	-	-	-	2	1	1	3	1
CO4	U24CE707.4	2	2	3	1	3	-	-	-	2	2	2	3	2
U24CE707		2	2	2	1	3	-	-	-	2	1	2	3	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 fundamental BIM concepts and create architectural BIM models using Autodesk Revit from 2D CAD drawings.	SDG 9	Industry, Innovation and Infrastructure	BIM introduces modern digital technologies and innovative workflows for planning, design, and development of infrastructure projects.
CO2	Develop structural BIM models and apply basic parametric modelling techniques for building components.	SDG 9	Industry, Innovation and Infrastructure	Structural BIM modelling promotes efficient infrastructure design, digital engineering practices, and technology-driven construction processes.
CO3	Generate schedules, quantity take-offs, bills of quantities (BOQ), and construction documentation directly from BIM models.	SDG 12	Responsible Consumption and Production	Automated quantity estimation and documentation help optimize material usage, reduce waste, minimize errors, and improve resource efficiency in construction projects.
CO4	Apply BIM-based coordination techniques including interoperability with structural analysis software, clash detection, and construction sequencing for integrated project delivery.	SDG 11, SDG 9	Sustainable Cities and Communities; Industry, Innovation and Infrastructure	BIM coordination, clash detection, and construction sequencing improve project efficiency, reduce construction conflicts and rework, and support sustainable and resilient built environments.

INTERNSHIP EVALUATION

Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE708	Credits:	1
Hours/Week (L-T-P- E):	0-0-2-2	CIE:	100%
Total Number of Teaching Hours:	-	ESE:	

Course Learning Outcomes (COs):

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

- CO1: Demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience
- CO2: Apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems
- CO3: Exhibit professional skills including communication, teamwork, leadership, and lifelong learning
- CO4: Prepare internship reports and effectively communicate internship outcomes through presentations and viva-voce

Mandatory Internships:

1. The internships provide exposure to the real-world, get a feel for the work environment and how a professional workplace operates.
2. During the internship, students will experience a real-life engineering workplace and understand how their engineering and professional knowledge, skills, and qualities (KSQs) can be utilized in industry.
3. Students can learn, more importantly, how to apply the KSQs they have acquired during an internship to their future workplaces.
4. Students will also be able to demonstrate functioning engineering knowledge, both new & existing, and identify areas of further development for their future careers.
5. Internships give the student an opportunity to bridge theory and practice
6. Internships also provide students with the soft skills needed at workplace and leadership positions.
7. The internship guidelines are governed by the rules stipulated in the Institute's Internship Policy-2020 document.
8. The students shall have to undergo 6-8 weeks of mandatory internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs, IIITs& NITs.
9. HoD, along with Prof i/c internships, shall address students (*of 2nd, 4th and 6th semesters*) during last week of even semester of every academic year on the following
 - a. creating awareness on mandatory 6-8 weeks internship by every student
 - b. creating awareness on COs of internships
 - c. KSQs the students would acquire doing internships
 - d. expected internship outcomes
 - e. available internship options, and organizations offering internships
 - f. progressively completing 6-8 weeks internship by the end of 6th semester summer, starting from 2nd semester summer break.
 - g. internship evaluation in 7th semester
 - h. internship report submission and oral presentation (through PPT) by student
10. Students undergoing the internship shall be required to submit their details to the department

internship coordinators of the respective branches. He will coordinate all the internship activities of the students of that department.

11. Students have to submit a signed undertaking to the department internship coordinator for demonstrating honesty, integrity, professionalism and regular attendance at work place to add value to the organization where the internship is allotted. Students also have to uphold the professional image of our institute.
12. In case, a student is found to violate the internship rules and regulations, the student will have to produce a valid reason for the violation of internship rules. Without a valid reason, the student will be debarred from taking part in subsequent placement activities of the institute.
13. The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of one week internship at every stage.
14. The internship evaluation shall be done in the VII semester of study and hence the students shall complete the prescribed period of internship before start of VII semester (from end of II semester to commencement of VII semester).
15. The student learning assessment process (SLAP): The SLAP in internships shall include feedback from internship supervisor, submission of internship report on the complete internship and PPT presentation.
16. Internship Log Book: The activity journaling in a log book is very important for a successful internship.
 - a. The internship supervisor identifies the work goals at the beginning of the internship
 - b. Student has to maintain internship log book, where in the activities undertaken during internship and timely submission at periodic intervals are to be documented.
 - c. At the conclusion of the internship, the supervisor shall specifically comment, in the internship log book, on whether the student met each of the work goals and to give evidence which describes the quality of work. For student, this also serves as a self- assessment.
 - d. Internship log book (*with due signatures of the internship supervisor*) shall 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):				U24CE708: INTERNSHIP EVALUATION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE708.1	1	-	-	-	-	-	1	3	-	-	-	-	-
CO2	U24CE708.2	3	2	1	1	3	-	1	-	-	-	-	2	2
CO3	U24CE708.3	-	-	-	-	-	-	1	1	3	3	2	-	-
CO4	U24CE708.4	-	-	-	-	-	-	1	-	1	3	-	-	-
U24CE708		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
CO 1	Demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience	SDG 9	Industry, Innovation and Infrastructure	Internship exposure helps students understand industrial practices, organizational systems, professional ethics and workplace functioning, thereby strengthening their readiness to contribute to engineering industries, innovation-driven work environments and infrastructure-related sectors.
CO 2	Apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems	SDG 9	Industry, Innovation and Infrastructure	Application of engineering knowledge and modern tools to practical tasks supports technological development, industrial problem solving and innovation-oriented engineering practice.
CO 3	Exhibit professional skills including communication, teamwork, leadership, and lifelong learning	SDG 11	Sustainable Cities and Communities	Communication, teamwork, leadership and professional responsibility are essential for working in multidisciplinary environments and contributing to engineering solutions that support safe, inclusive, resilient and sustainable communities.
CO 4	Prepare internship reports and effectively communicate internship outcomes through	SDG 9	Industry, Innovation and Infrastructure	Documentation, reporting and presentation of internship outcomes promote technical communication, dissemination of practical engineering knowledge and effective transfer of

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
	presentations and viva-voce			industry-oriented learning.

MAJOR PROJECT PHASE 1

Class: B. Tech. VII – Semester			Branch: CE	
Course Code:		U24CE709	Credits:	4
Hours/Week (L-T-P- E):		0-0-8-8	CIE:	100%
Total Number of Teaching Hours:		-	ESE:	

Course Learning Outcomes (COs):

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

- 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. (Five specializations will be covered including the coordinator's and Convener's)</i>

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

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

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

- (a) Project titles shall come with the following details to be made available to students on dept webpage and notice boards, facilitating students to select problems that interest them.
 - i. abstract
 - ii. deliverables / outcomes
 - iii. knowledge and skills required to complete the project
 - iv. resources required
 - v. one of the deliverables shall be writing a technical paper out of the major project work done for submission to a reputed non-predatory conference/non-paid peer reviewed journal

- (iv) The major project teams, finalized by the convener DPEC, shall be allowed to exercise their

options on the titles that interest them from the notified list

- (v) **Project supervisor allotment:** The convener DPEC shall allot, during the last week of 6th semester, the faculty supervisors to all project teams

- (a) The project supervisors shall
- i. **define project objectives and expected deliverables**
 - ii. **help the students plan their project work and timeline**
 - iii. **provide enough resources for successful project completion**

- (vi) The faculty supervisors are expected to provide guidance to project teams on

- (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

i. **Following project timeline:** The project timeline shall be meticulously followed and the tasks shall be completed as planned in the project timeline.

ii. Project teams shall compulsorily show the following as part of their progress presentation-I

1. *The slides on project timeline and*

2. *A table showing targeted tasks as per timeline and whether tasks are accomplished?*

iii. **Project log book:** Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*)

(c) **CIE schedule:** The convener DPEC shall release the complete schedule of CIE before

start of 7th semester well in advance, so that student teams will complete the scheduled works and get ready with an informative, confident, and comfortable presentation for registration and progress presentations.

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

Major project work Phase-I Assessment (7th semester)	Weightage
A. Supervisor Assessment	20%
B. DPEC Assessment (i) Registration Presentation (10%) (ii) Progress Presentation-I (20%) (iii) Project progress*: Part of working model/ process/software package/system developed (30%) (iii) Well-documented Progress Report on Phase-I work (10%) (iv) Video pitch on Phase-I (10%)	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.
 - a. **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):				U24CE709: MAJOR PROJECT PHASE I										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE709.1	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	U24CE709.2	3	3	3	2	3	3	2	1	1	2	2	2	1
CO3	U24CE709.3	1	1	1	1	1	2	3	3	2	3	1	2	1
CO4	U24CE709.4	1	1	1	2	2	1	2	1	3	1	3	2	2
U24CE709		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
CO 1	review research literature, identify gaps in the literature, formulate problems, 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	This CO focuses on research, problem formulation, technical analysis, experimentation, data interpretation and innovation. These abilities directly support engineering innovation, technology development and infrastructure-related problem solving.
CO 2	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	This CO emphasizes sustainable design, efficient use of resources, ethical and environmental considerations, prototype development within constraints and responsible engineering decision-making, which align with responsible consumption and production.
CO 3	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	This CO develops teamwork, leadership, ethical responsibility and project management skills required for implementing engineering solutions that address societal needs and contribute to safe, resilient and sustainable communities.
CO 4	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	Industry, Innovation and Infrastructure	This CO deals with evaluation of prototype performance, technical communication and dissemination of engineering outcomes. These activities support innovation, technology development and effective presentation of infrastructure-oriented engineering solutions.

VIII SEMESTER(Stream - II)(URR24)

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	
1	PEC	U24CE801	Program Elective - III / MOOCs-III	2	1	-	3	3
2	PEC	U24CE802	Program Elective - IV / MOOCs-IV	2	1	-	3	3
3	PCC	U24CE803	Structural Health Monitoring	2	1	-	3	3
4	ELC	U24CE804	Major Project, Phase - 2 / Industrial Internship - 2	-	-	12	12	6
Total:				6	3	12	21	15
Additional Learning®:Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	19

REPAIR & REHABILITATION OF STRUCTURES			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE 801A	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: assess deterioration and maintenance requirements of RCC structures. CO2: evaluate concrete structures using destructive and non-destructive testing methods. CO3: select suitable repair materials and repair techniques for structural rehabilitation. CO4: propose retrofitting and rehabilitation strategies for structural health monitoring			
UNIT-I			9 Hrs
Maintenance and Inspection: Importance and requirement of maintenance, category of inspection and maintenance, aspects and periods of inspection, preliminary, detailed and rapid visual inspection, over view of maintenance buildings. Deterioration of concrete structures: Site survey, need for repair and rehabilitation, disintegration of RCC Structures, major causes and signs of deterioration. Accidental loading, chemical reactions, corrosion, freezing and thawing, settlement, movement, shrinkage, temperature changes, durability and permeability aspects, cracks, types, causes and characteristics.			
UNIT-II			9 Hrs
Evaluation of concrete structures: Condition evaluation of RCC Structures, objective and stages of condition assessment. In-situ laboratory testing of concrete: Non-destructive and semi destructive tests for strength assessment. Rebound hammer test, Ultrasonic Pulse Velocity (UPV), cores sampling and testing, chemical tests carbonation test, chloride content, corrosion potential assessment, cover meter survey, half-cell potential test, break off test and penetration test.			
UNIT-III			9 Hrs
Essential Parameters for Repair Materials: Low Shrinkage, requisite setting/hardening properties, workability, bond with the substrate, compatible coefficient of thermal expansion, compatible mechanical properties & strength, minimal or no curing requirement, alkalinity, low air & water permeability, aesthetics, cost, durability, non-hazardous/non-polluting. Materials for Repair: Premixed cement concrete / mortars, Polymer modified mortars and concrete (PMM/PMC), Epoxies and Epoxy systems including Epoxy mortars/concretes, polyester resins, surface coatings, micro concrete.			
UNIT-IV			9 Hrs

Repair Techniques: Repairs using mortars, shotcrete, concrete replacement, epoxybonded concrete, silica fume concrete, polymer concrete system, resin modified cement slurry injection, Ferro-cement, plate bonding, fiber wrap technique, RCC Jacketing, repair/strengthening columns, beams and slabs, seismic retrofitting, crack stitching and gravity filling.

Retrofitting and Rehabilitation Strategies: structural health monitoring, dilapidated structures, Resin/polymer modified slurry injection, ferro cement jacketing, plate bonding technique, propping and supporting, repair methods, foundation rehabilitation methods and strategies, stress reduction technique, cracks/joints, masonry, foundation base isolation.

Textbook(s):

1. P. Modi, C. Patel, Repair and Rehabilitation of Concrete Structures, 1st ed., PHI Learning Pvt Ltd., New Delhi, 2019.
2. Central Public Works Department (CPWD), Handbook on Repair and Rehabilitation of R.C.C. Buildings, Govt. of India, 2002.

Reference Book(S):

1. J. Bhattacharjee, *Concrete Structures - Repair, Rehabilitation and Retrofitting*, 1st ed., CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2017.
2. Santha Kumar A.R, *Concrete Technology*, 2nd ed., Oxford University Press, New Delhi, 2018.
3. ACI 562-16, *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary*, US: ACI Committee, 2019.
4. Dov Kaminetzky, *Design and Construction Failures*, 1st ed., Galgotia Publications Pvt. Ltd., New Delhi, 2001.
5. S. M. Johnson, *Deterioration, Maintenance and repair of structures*, 1st ed., Krieger Publishing Company, New Delhi, 1980.
6. R. T. Allen and S. C. Edwards, *Repair of Concrete Structures*, 1st ed., CRC Press, UK, 1992.
7. R.N. Raikar, *Learning from failures - Deficiencies in Design, Construction and Service*, 1st ed., R and D Centre (SDCPL), New Bombay, 1987.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105106202> NPTEL Course module on Maintenance and Repair of concrete structures, IIT Madras by Prof. Radhakrishna G. Pillai.
2. <https://nptel.ac.in/courses/105105213> NPTEL Course module on Retrofitting and Rehabilitation of Civil Infrastructure, IIT Kharagpur by Prof. Swati Maitra, Prof. Sriman Bhattacharya.

Course Articulation Matrix (CAM):			U24CE 801A: REPAIR & REHABILITATION OF STRUCTURES											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	

CO1	U24CE 801A.1	1	2	2	1	2	1	1	-	-	-	2	2	2
CO2	U24CE 801A.2	1	2	2	1	2	1	1	-	-	-	2	2	2
CO3	U24CE 801A.3	1	2	2	1	2	1	1	-	-	-	2	2	2
CO4	U24CE 801A.4	1	2	2	1	2	1	1	-	-	-	2	2	2
U24CE 801A		1	2	2	1	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	assess deterioration and maintenance requirements of RCC structures.	SDG 11	Make cities and human settlements inclusive, safe, resilient and sustainable	Assessing deterioration and maintenance needs of RCC structures supports safe, durable, and sustainable infrastructure development in urban environments.
CO2	evaluate concrete structures using destructive and non-destructive testing methods.	SDG 9	Build resilient infrastructure, promote inclusive and sustainable industrialization , and foster innovation	Structural evaluation techniques help ensure the reliability, safety, and resilience of infrastructure through advanced testing and assessment methods.
CO3	select suitable repair materials and repair techniques for structural rehabilitation.	SDG 12	Ensure sustainable consumption and production patterns	Appropriate selection of repair materials and rehabilitation methods minimizes material wastage, improves durability, and promotes sustainable construction practices.
CO4	propose retrofitting and rehabilitation strategies for structural health monitoring	SDG 9	Build resilient infrastructure, promote inclusive and sustainable industrialization , and foster innovation	Retrofitting and structural health monitoring enhance the service life, safety, and resilience of structures through innovative rehabilitation strategies.

RAILWAY ENGINEERING			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE801B	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 factors governing the design of railway track CO2 : design railway track geometric parameters CO3 : synthesize railway track mechanics with rolling stock resistance parameters. CO4 : develop strategic plans for track rehabilitation and network expansion			
UNIT-I			9 Hrs
Railway Track gauge: Different Gauges on Indian Railways, Choice of Gauge, Problems Caused by Change of Gauge, Uni-gauge Policy of Indian Railways, Loading Gauge, Construction Gauge. Components of Railway Track: permanent way; forces acting on the track; coning of wheels; tilting of rails; rails: functions, types, requirements for an ideal rail sections; sleepers: functions and requirements of sleepers, sleeper density, types; ballast: functions, types, sizes, requirements, specifications; subgrade and formation; blanket layer; track fittings and fastenings.			
UNIT-II			9 Hrs
Geometric Design: Gradients, grade compensation, circular curves, super elevation, safe speed on curves, transition curves, widening of gauge on curves, vertical curves, checkrails. Points and Crossing: Switches: terms, types; tongue rails; crossing: number and angle of crossing, movable crossing, number and angle; design of turnouts: Coles method, IRS method, with curved switches.			
UNIT-III			9 Hrs
Locomotives and Other Rolling Stock: Types of traction, Locomotives-classification preventive maintenance; Rolling stock, brake systems, maintenance of coaches and wagons. Train Resistance due to friction, wave action, wind, gradient, curvature, starting accelerating; Tractive effort of a locomotive, hauling power of a locomotive. Railway Stations and Yards: Purpose of a railway station, selection of site for a railway station, facilities required at railway Stations, requirements of a passenger station yard, classification of railway Stations, main building areas for different types of stations, Types of yards.			
UNIT-IV			9 Hrs
Rehabilitation and Renewal of Track: classification of track renewal works , criteria for rail renewals, through sleeper renewals, execution of track renewal or track re-laying work, mechanized re-laying, track renewal trains, requirement of track material. Construction of New Railway Lines and Track Linking: Construction of new lines, requirement of Track Material for BG Track, Doubling of railway lines, Gauge conversion.			
Textbook(s):			

1. Satish Chandra, M.M. Agarwal; Railway Engineering, Oxford University Press, New Delhi, India, 2022, Second Edition (Tenth Reprint).

Reference Book(S):

1. JS Mundrey, Railway Track Engineering, McGraw-Hill Education, New Delhi, India, 2017, Fifth Edition.
2. M.M. Agarwal, Indian Railway Track, Prabha & Co., New Delhi, India, 2023, Twentieth Edition (Golden Jubilee Reprint Edition).
3. S.C. Saxena, S.P. Arora; A Textbook of Railway Engineering, Dhanpat Rai Publications, New Delhi, India, 2017, Eighth Edition.

Web and Video link(s):

<https://rdso.indianrailways.gov.in/>

<https://nptel.ac.in/courses/105107463> NPTEL video lecture on Railway Engineering by prof. Rajat Rastogi, IIT Roorkee.

Course Articulation Matrix (CAM):				U24CE801B: RAILWAY ENGINEERING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE801B.1	2	1	1	1	-	1	-	-	-	-	-	2	-
CO2	U24CE801B.2	2	2	2	2	-	1	-	-	-	-	-	2	2
CO3	U24CE801B.3	2	2	2	2	-	1	-	-	-	-	-	2	2
CO4	U24CE801B.4	2	2	2	2	-	1	-	-	-	-	-	2	2
U24CE801B		2.	1.25	1.25	1.25	0	1	0	0	0	0	0	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 the factors governing the design of railway track	SDG9	Industry, Innovation and Infrastructure	Analyzing track design factors (such as choice of gauge, loading gauge, and structural components like sleepers and ballast) is fundamental to building resilient, safe, and efficient national infrastructure
CO2	design railway track geometric parameters	SDG9 SDG3	Industry, Innovation and Infrastructure Good health and well being.	Designing precise geometric parameters—such as safe speeds on curves, transition curves, super-elevation, and checkrails—is critical to preventing derailments and ensuring passenger safety. Additionally, geometric optimization upgrades infrastructure by allowing trains to run efficiently without excessive wear and tear on the rails
CO3	synthesize railway track mechanics with rolling stock resistance parameters.	SDG 7	Affordable & Clean Energy	Synthesizing track mechanics with rolling stock resistance (such as friction, wind, and gradient forces) allows engineers to calculate exact locomotive tractive effort. Minimizing these resistances directly optimizes energy efficiency
CO4	develop strategic plans for track rehabilitation and network expansion	SDG9	Industry, Innovation and Infrastructure	using mechanized re-laying trains and modern track renewal planning fosters industrial innovation and sustainable infrastructure life-cycle management

SOIL – STRUCTURE INTERACTION			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE801C	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 the basic meaning and importance of soil–structure interaction CO2: understand simple methods of representing soil support in foundation analysis CO3: describe the basic interaction behaviour of shallow foundations and pile foundations CO4: explain the practical importance of soil–structure interaction in retaining structures and earthquake loading			
UNIT-I			9 Hrs
Introduction to soil–structure interaction: Meaning, soil as a flexible support, fixed-base and flexible-base structures, importance of SSI in civil engineering, simple examples from buildings, bridges, retaining walls, pavements and machine foundations. Basic soil and foundation behaviour: Soil stiffness, settlement of foundations, contact pressure below footings, rigid and flexible foundations, effect of soil type on foundation behaviour.			
UNIT-II			9 Hrs
Simple modelling of soil support: Concept of modulus of subgrade reaction, soil represented as springs, vertical and horizontal springs, practical meaning of spring stiffness, advantages and limitations of spring model. Beams and footings on soil: Basic idea of beam on elastic foundation, strip footing, isolated footing and grade beam resting on soil, effect of soil flexibility on deflection and bending moment.			
UNIT-III			9 Hrs
Raft foundation interaction: Basic behaviour of raft foundations, contact pressure below rafts, total settlement and differential settlement, importance of raft flexibility in foundation design. Pile–soil interaction: Basic load transfer in piles, skin friction and end bearing, pile under vertical load, pile under lateral load, pile group action and settlement of pile groups.			
UNIT-IV			9 Hrs
Retaining and buried structures: Soil pressure on retaining walls, active and passive earth pressure, effect of wall movement, basic behaviour of buried pipes and culverts. Introduction to dynamic and seismic SSI: Meaning of dynamic loading, examples of earthquake, traffic and machine vibration, effect of soil flexibility on vibration of structures, basic importance of SSI in earthquake-resistant design.			
Textbook(s):			

1. Das, B. M., *Principles of Foundation Engineering with MindTap*, Cengage Learning, 9th Edition, 2023.
2. Bowles, J. E., *Foundation Analysis and Design*, McGraw Hill Education, 5th Edition.

Reference Book(S):

1. Murthy, V. N. S., *Soil Mechanics and Foundation Engineering*, CBS Publishers.
2. Punmia, B. C., *Soil Mechanics and Foundations*, Laxmi Publications.
3. Kramer, S. L., *Geotechnical Earthquake Engineering*, Pearson Education.
4. Poulos, H. G. and Davis, E. H., *Pile Foundation Analysis and Design*, John Wiley & Sons.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105105176> NPTEL Video Lecture on Foundation Engineering by Prof. Koushik Deb, Department of Civil Engineering, I.I.T. Kharagpur
2. <https://nptel.ac.in/courses/105105168> NPTEL Video Lecture on Soil Mechanics by Prof. D. K. Baidya, Department of Civil Engineering, I.I.T. Kharagpur
3. <https://nptel.ac.in/courses/105105200> NPTEL Video Lecture on Soil Structure Interaction by Prof. Koushik Deb, Department of Civil Engineering, I.I.T. Kharagpur

Course Articulation Matrix (CAM):				U24CE801C: SOIL STRUCTURE INTERACTION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE801C.1	2	2	-	1	1	1	1	1	1	-	1	1	1
CO2	U24CE801C.2	2	2	-	1	1	1	1	1	1	-	1	1	1
CO3	U24CE801C.3	2	2	-	1	1	1	1	1	1	-	1	1	1
CO4	U24CE801C.4	2	2	-	1	1	1	1	1	1	-	1	1	1
U24CE801C		2	2	-	1	1	1	1	1	1	-	1	1	1
3 - HIGH, 2 - MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO1	<i>The student should be able to...</i> explain the basic meaning and importance of soil-structure interaction	SDG9	Industry, Innovation and Infrastructure	Basic understanding of SSI helps students appreciate the role of soil behaviour in safe infrastructure.
CO2	understand simple methods of representing soil support in foundation analysis	SDG9	Industry, Innovation and Infrastructure	Simple soil-support models introduce practical approaches used in foundation design.
CO3	describe the basic interaction behaviour of shallow foundations and pile foundations	SDG11	Sustainable Cities and Communities	Understanding foundation behaviour supports the design of safe and serviceable structures.
CO4	explain the practical importance of soil-structure interaction in retaining structures and earthquake loading	SDG11	Sustainable Cities and Communities	Awareness of SSI under earth pressure and earthquake loading contributes to safer built environments.

LIFE CYCLE ASSESSMENT

Class: B.Tech.VIII -Semester		Branch: CivilEngineering	
Course Code: U24CE801D	U24CE801D	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: Appraise the principles, framework, types, and standards of Life Cycle Assessment (LCA) for the built environment.			
CO2: Apply the phases of LCA including goal and scope definition, inventory analysis, impact assessment, and interpretation.			
CO3: Analyze environmental impacts of the built environment using life cycle inventory methodologies and data processing techniques.			
CO4: Evaluate life cycle impact assessment results and utilize LCA tools for sustainable decision-making in the built environment.			
UNIT-I			9Hrs
Introduction to Build Environment: Global warming issues, Strategies for improving the environmental performance of the built environment life cycle assessment, Life cycle assessment framework, an iterative approach.			
Types and Standards: Types of life cycle assessment, Baseline life cycle assessment, Comparative life cycle assessment, Streamlined life cycle assessment, International LCA standard – ISO 14040 series.			
UNIT-II			9Hrs
Phases of Life Cycle: Goal, Scope, Functional unit system boundaries and Data quality and scope. Life cycle inventory analysis: Data types, Quantifying inputs and outputs, Life cycle impact assessment: Selection and definition of impact categories, Classification, Characterization, Normalization, grouping and weighting and Data quality analysis, Interpretation: Identification of significant issues, Evaluation of results – completeness, consistency and sensitivity, Conclusions.			
Planning and limitations: limitations and recommendations. Uses of life cycle assessment, Environmental improvement, Strategic planning, Public policy making, Limitations of life cycle assessment, Availability and quality of life cycle inventory data.			
UNIT-III			9 Hrs
Quantifying environmental impacts of the built environment: Life cycle thinking in the built environment, Use of LCA in Built environment, Case study on Streamlined LCA - goal and scope definition, inventory analysis,			
Data Processing and compiling: Compiling a life cycle inventory using input-output-based hybrid analysis: Input-output analysis, Process data collection, Integrating process and input-output data, Using material coefficients, Avoiding sideways truncation of the system boundary, Comparison of life cycle inventory approaches.			
UNIT-IV			9Hrs
Life cycle impact assessment and interpretation: Selection of impact categories, Classification, Characterization, Normalization, grouping and weighting, Study limitations, Interpretation - Evaluation of results, Conclusions, limitations and recommendations.			
Built-environment-specific life cycle assessment tools: ATHENA Impact, Building for Environmental and Economic, Sustainability (BEES) tool by NIST and Integrated design tools, General life cycle assessment tools, Limitations of existing life cycle assessment tools.			

Textbook(s):

1. Klöpffer, Walter, *"Background and future prospects in life cycle assessment"*, Springer Science & Business Media, 2014.
2. Crawford, Robert *"Life cycle assessment in the built environment"*, Routledge, Spon Press, New York, 2011.

ReferenceBook(s):

1. Powell, Jane, Jennifer Monahan, and Chris Foulds. *"Building Futures: Managing energy in the built environment"*, Routledge, 2015.
2. GRIHA Manual, Ministry of New and Renewable Energy, Government of India, and The Energy and Resources Institute, TERI Press, 2010.
3. Finkbeiner, Matthias, Atsushi Inaba, Reginald Tan, Kim Christiansen, and Hans-Jürgen Klüppel. "The new international standards for life cycle assessment: ISO 14040 and ISO 14044." *The international journal of life cycle assessment* 11, no. 2 (2006): 80-85.

WebandVideolink(s):

1. <http://www.digimat.in/nptel/courses/video/105105157/L01.html> VideoLectureLife Cycle Assessment by Prof. Brijesh Kumar Dubdey, IIT Kharagpur

Course Articulation Matrix (CAM):			U24CE801D LIFE CYCLE ASSESSMENT											
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	U24CE801D.1	3	2	-	1	1	1	3	-	-	-	-	2	1
CO2	U24CE801D.2	3	3	2	2	2	1	3	-	-	1	1	2	2
CO3	U24CE801D.3	2	3	2	3	2	2	3	-	-	1	1	3	2
CO4	U24CE801D.4	2	3	3	2	3	2	3	1	-	1	2	3	2
U24CE801D		2.5	5.5	2.33	2.5	2	1.5	3	1	-	1	1.33	2.5	1.75
3-HIGH,2-MEDIUM,1-LOW														

CO	CO Statement - The student should be able to...	Relevant SDG	SDG Description	Mapping Justification
CO1	Explain the principles, framework, types, and standards of Life Cycle Assessment (LCA) for the built environment.	SDG 9	Industry, Innovation and Infrastructure	Understanding LCA principles and international standards promotes sustainable infrastructure development, innovation in construction practices, and environmentally responsible engineering solutions.
CO2	Apply the phases of Life Cycle Assessment including goal and scope definition, inventory analysis, impact assessment, and interpretation.	SDG 11	Sustainable Cities and Communities	Application of LCA methodologies helps evaluate and improve the environmental performance of buildings and urban infrastructure, supporting sustainable and resilient communities.
CO3	Analyze environmental impacts of the built environment using life cycle inventory methodologies and data processing techniques.	SDG 12	Responsible Consumption and Production	Life cycle inventory and impact analysis promote efficient resource utilization, waste minimization, and environmentally responsible production and construction practices.
CO4	Evaluate life cycle impact assessment results and utilize LCA tools for sustainable decision-making in the built environment.	SDG 13	Climate Action	LCA tools assist in identifying strategies to reduce greenhouse gas emissions, minimize environmental impacts, and support climate-resilient infrastructure development.

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE801E	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 concepts of AI CO2 : evaluate machine learning algorithms to determine their suitability for civil engineering Problems. CO3 : analyse AI based solutions used in construction and smart infrastructure projects. CO4 : design ML models to address real time problems in various fields of Civil engineering.			
UNIT-I			9 Hrs
Introduction to AI: Definition, History, Types of AI (narrow, general, superintelligent), Role of AI in daily life, Applications in civil engineering, Fundamental concepts, Intelligent agents, Learning, Reasoning, and Perception. AI Techniques: Rule-based systems (if-then logic) for decision-making, Expert systems, Basic concepts and applications, Introduction to fuzzy logic for handling uncertainty, Applications in construction safety, material selection, project planning.			
UNIT-II			9 Hrs
Introduction to ML: Definition, difference between AI and ML, Types of ML, supervised learning, unsupervised learning, ML applications in civil engineering. ML Models and Tools: Linear regression, decision trees, k-NN, Python programming and libraries like Scikit-learn, Model training and evaluation using real-world data.			
UNIT-III			9 Hrs
AI in Construction and Smart Infrastructure: AI for scheduling optimization and resource allocation in construction, AI in safety monitoring systems. AI for Environmental and Structural Monitoring: Using AI to monitor air/water quality with sensor data, Structural health monitoring: detecting cracks and damages with AI, predicting lifespan and repair needs of infrastructure using AI.			
UNIT-IV			9 Hrs
ML in Structural and Geotechnical Engineering: Predicting concrete strength using regression models, Soil classification with decision trees or clustering, Slope stability analysis using machine learning algorithms. ML in Transportation and Water Engineering: Traffic forecasting using time-series models, Pavement condition classification and assessment using image-based machine learning models, Flood prediction and water demand forecasting using ML.			

Textbook(s):

1. Stuart Russell & Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th edition, Pearson, 2020.
2. Aurelien Geron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd edition, O'Reilly Media, 2019.

Reference Book(S):

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, 1st edition, MIT Press, 2016.
2. Richard S. Sutton & Andrew G. Barto, *Reinforcement Learning: An Introduction*, 2nd edition, MIT Press, 2018.

Web and Video link(s):

1. <https://www.udemy.com/course/artificial-intelligence-ai-applications-for-civil-engineer/?couponCode=LEARNNOWPLANS> Udemy Lectures on Artificial Intelligence applications for Civil Engineer.
2. https://mkrausai.github.io/lectures/2021_SciML/ Web material on Scientific Machine and Deep Learning for Design and Construction in Civil Engineering.

Course Articulation Matrix (CAM):				U24CE802E : ADVANCED DATA STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE801E.1	3	2	2	1	3	2	1	-	1	-	2	3	2
CO2	U24CE801E.2	3	3	2	2	3	1	1	-	-	-	2	3	2
CO3	U24CE801E.3	2	2	3	2	2	3	2	1	1	2	2	3	3
CO4	U24CE801E.4	3	3	3	3	3	2	1	1	1	2	3	3	3
U24CE801E		2.5	2.5	2.5	2	2.75	2	1.25	0.5	0.75	1	2.25	3	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 concepts of AI	SDG 4	Quality Education.	Equips civil engineers with AI knowledge, fostering innovation in infrastructure.
CO2	evaluate machine learning algorithms to determine their suitability for civil engineering Problems.	SDG 9	Industry, Innovation & Infrastructure	Ensures appropriate use of ML for safe, efficient, and sustainable urban development.
CO3	analyse AI based solutions used in construction and smart infrastructure projects.	SDG 8	Decent Work & Economic Growth	Promotes safer construction practices and smarter infrastructure for sustainable cities.
CO4	design ML models to address real time problems in various fields of Civil engineering.	SDG 6 -	Clean Water & Sanitation	Addresses water management, infrastructure resilience, and climate-related challenges.

BRIDGE ENGINEERING

Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE802A	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: Appraise bridge loads, IRC specifications, and hydraulic considerations for bridge planning and design. CO2: Design RCC deck slab and T-beam bridges using IRC loading provisions. CO3: Select and recommend suitable bridge bearings and appurtenances. CO4: Analyze the stability and behaviour of bridge substructure and foundations.			
UNIT-I			9 Hrs
Bridges and their loading: Introduction to bridges, functions and requirements of bridges, classification of bridges, components of a bridge, materials used in bridge construction, IRC specifications and design philosophy, design loads on bridges, IRC standard loading, impact factor and dynamic effects, load combinations. Hydraulic Design: Introduction to hydraulic design, bridge site selection and planning, bridge layout and alignment, river behaviour and hydraulic geometry, linear waterway, economic span, afflux, scour around bridge foundations, geological considerations, geotechnical investigations, freeboard considerations.			
UNIT-II			9 Hrs
Deck Slab Bridge: Introduction to deck slab bridges, classification of deck slab bridges, components and functions, IRC loading standards, effective width concept, load transfer mechanism, analysis of deck slab bridge, design steps of RCC deck slab bridge, reinforcement detailing, advantages and limitations. T-Beam Bridge: Introduction to T-beam bridges, structural behaviour of T-beam bridge, components of T-beam bridge, load distribution in T-beam bridges, Courbon's method, analysis of longitudinal girder, design of deck slab in T-beam bridge, design of longitudinal girder, reinforcement detailing, advantages and limitations.			
UNIT-III			9 Hrs
Bearings: Introduction to bridge bearings, functions and requirements of bearings, types of bearings, forces acting on bearings, bearing materials, elastomeric bearings, design of unreinforced and reinforced elastomeric pad bearings, IRC code provisions for bearings. Bridge Appurtenances: Introduction to bridge appurtenances, expansion joints, bridge railings and crash barriers, drainage systems, bridge lighting, footpaths and utility ducts, inspection and maintenance of bridge appurtenances, IRC recommendations for appurtenances.			
UNIT-IV			9 Hrs
Stability analysis: Introduction to bridge substructures, functions of piers and abutments, types of piers, types of abutments, loads acting on piers and abutments, earth pressure			

theories, stability analysis of piers, stability analysis of abutments, IRC codal requirements.

Bridge Foundations: Introduction to bridge foundations, types of foundations, shallow foundations, deep foundations, pile foundations, well foundations, scour depth and foundation depth considerations, design of shallow foundations, design of deep foundations, construction aspects of foundations and failure modes.

Textbook(s):

1. T.R. Jagdish and M.A. Jayaram, *Design of Bridge Structures*, 3 ed. New Delhi: PHI Learning Pvt. Ltd., 2020.
2. N. Krishna Raju, *Design of Bridges*, 5th ed., New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd., 2019.

Reference Book(S):

1. D. Johnson Victor, *Essentials of Bridge Engineering*, 6th ed. New Delhi: IBH Publishing Co. Ltd., 2019.
2. IRC5:2015 Standard Specifications and Code of Practice for Road Bridges, 8 revision, New Delhi: The Indian Road Congress, 2015.
3. IRC6:2017 Standard Specifications and Code of Practice for Road Bridges, 7th revision, New Delhi: The Indian Road Congress, 2014.
4. IRC21:2000 Standard Specifications and Code of Practice for Road Bridges, 3 revision, New Delhi: The Indian Road Congress, 2000.
5. IRC83:2018 Standard Specifications and Code of Practice for Road Bridges, Section IX-Bearings (Elastomeric Bearings), Part II, 2 revision, New Delhi: The Indian Road Congress, 2018.
6. IS456:2000, Code of practice for Plain and reinforced concrete, 5 revision, New Delhi: Bureau of Indian standards, 2000.

Web and Video link(s):

1. <https://nptel.ac.in/courses/105105216> NPTEL Video Lecture on NPTEL Course on Bridge Engineering (Types, Analysis, Design, Inspection, Repair & Retrofit) by Prof. Piyali Sengupta, IIT (ISM) Dhanbad
2. <https://nptel.ac.in/courses/105105165> NPTEL Course on Reinforced Concrete Road Bridges (Deck Slab & T-Beam Bridge Design, IRC Loading) by Prof. Nirjhar Dhang, IIT Kharagpur
3. <https://www.youtube.com/playlist?list=PLk7-CBCLERSZ7nSsxFIKEWNz4s9RA89t> NPTEL Bridge Engineering YouTube Playlist (Bearings, Substructure, Foundations, IRC Codes)
4. [https://eng.libretexts.org/Bookshelves/Civil_Engineering/Structural_Analysis_\(Udacity\)/01:_Chapters/1.06:_Arches_and_Cables_Engineering_Libre_Texts_-_Structural_Analysis:_Arches,_Cables_and_Bridge_Fundamentals](https://eng.libretexts.org/Bookshelves/Civil_Engineering/Structural_Analysis_(Udacity)/01:_Chapters/1.06:_Arches_and_Cables_Engineering_Libre_Texts_-_Structural_Analysis:_Arches,_Cables_and_Bridge_Fundamentals)

Course Articulation Matrix (CAM):			U24CE802A: Bridge Engineering											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	

Course Articulation Matrix (CAM):				U24CE802A: Bridge Engineering										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE802A.1	1	1	1	1	-	-	1	-	-	-	-	1	1
CO2	U24CE802A.2	1	2	2	1	-	-	1	-	-	-	-	1	1
CO3	U24CE802A.3	1	1	2	1	-	-	1	-	-	-	-	1	1
CO4	U24CE802A.4	1	2	2	1	-	-	1	-	-	-	-	1	1
U24CE802A		1	1.5	1.7 5	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	appraise loads and design specification for bridges	SDG 9	Industry, Innovation and Infrastructure	Appraising design loads and IRC specifications ensures that bridges are designed to carry prescribed traffic and environmental loads safely, forming the regulatory foundation for resilient, standards-based transport infrastructure that drives economic growth and industrial connectivity.
CO2	design deck slab and T-Beam bridge	SDG 9	Industry, Innovation and Infrastructure	Design of deck slab and T-Beam bridges using IRC loading equips engineers to produce structurally efficient and cost-effective road bridge superstructures, directly advancing the development of quality, reliable, and sustainable transport infrastructure for national and regional connectivity.
CO3	recommend types of bearing and appurtenances	SDG 11	Sustainable Cities and Communities	Recommending appropriate bearings, expansion joints, drainage systems, and lighting for bridges enhances the longevity, safety, and serviceability of urban and rural bridge infrastructure, contributing to well-maintained and inclusive transport systems in sustainable communities.
CO4	evaluate the behaviour of sub-structure elements	SDG 11	Sustainable Cities and Communities	Evaluating the behaviour of piers, abutments, retaining walls, and bridge foundations under various loads ensures the stability and safety of bridge substructures, supporting the creation of resilient and disaster-resistant urban infrastructure in growing and flood-prone communities.

HIGHWAY CONSTRUCTION			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE802B	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 : summarize elements of highway construction and subgrade preparation CO2 : propose construction methods for unbound bound pavements. CO3 : evaluate bituminous mixes based on functional pavement requirements. CO4 : suggest construction methodology for rigid pavements and assess quality.			
UNIT-I			9 Hrs
Fundamentals of Highway Construction: Phases of highway construction projects; Pre-construction activities. Types of highway construction, factors considering for selection of types of pavements. Earthwork and Subgrade Preparation: Earthwork-excavation and embankment, embankment construction, preparation of subgrade- evaluation of compaction parameters, construction of embankment and subgrade under special conditions; compaction equipment. Ground improvement for weak embankment foundation.			
UNIT-II			9 Hrs
Construction of Unbound Granular Layers: - Gradation and material quality requirement for granular subbase and base layers such as Water Bound Macadam subbase/ base, Crushed Cement Concrete subbase, Wet Mix Macadam subbase/base; blending and proportioning; compaction requirements; field quality control. Construction procedure. Construction of bound subbase and base layers: mix design, placing, laying, and compaction requirements; crack relief and Stress Absorbing Membrane Interlayer (SAMI layer); geosynthetic application reinforced granular layers; construction of subsurface drainage for highways.			
UNIT-III			9 Hrs
Construction of Bituminous Pavements: Fundamentals of mix selection based on their intended function, Types of bituminous mixes based on their gradation; Dense Graded Bituminous mixes; Semi Dense Bituminous Mixes; Open graded Bituminous mixes; Gap graded bituminous mixes. Construction procedure for dense graded bituminous mixes. Hot Mix Asphalt Production and Construction: Asphalt mix production, Asphalt mix transportation and laydown, Asphalt mix compaction, Quality control/Quality assurance of Hot Mix Asphalt Construction.			
UNIT-IV			9 Hrs
Construction of Cement Concrete Pavements: preparation of subgrade and base; Dry Lean Concrete (DLC)-execution, mix proportions and curing; Pavement Quality Concrete(PQC) slab constructions: slip form paving, fixed form paving. Joint construction, finishing and curing: Installation and alignment of dowel bars and tie bars; cutting of contraction joints, joint cleaning and installation of joint sealants, texturing for skid resistance and curing process; quantification of curing effectiveness; quality control			

tests.

Textbook(s):

1. S. K. Khanna, C. E. G. Justo, A. Veeraraghavan, *Highway Engineering*, 10th ed., Roorkee: Nem Chand & Bros, 2015.

Reference Book(S):

1. Prithvi Singh Kandhal, A. Veeraragavan and Rajan Choudhary, *Bituminous Road Construction in India*, Second Edition.
2. **Ministry of Road Transport and Highways (MoRTH code):** Fifth revision (2013).

Web and Video link(s):

<https://nptel.ac.in/courses/105103685> Pavement Construction Technology by Prof. Rajan Choudhary, IIT Guwahati.

Course Articulation Matrix (CAM):				U24CE802B: Highway Construction										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE802B.1	2	2	2	1	-	-	-	-	-	-	-	2	-
CO2	U24CE802B.2	2	2	2	2	-	2	-	-	-	-	-	2	2
CO3	U24CE802B.3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO4	U24CE802B.4	2	2	2	2	-	-	-	-	-	-	-	2	2
U24CE802B		2	2	2	1.75	0	2	0	0	0	0	0	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	summarize elements of highway construction and subgrade preparation	SDG 9	Industry, Innovation & Infrastructure	Optimizing earthwork compaction strategies and introducing ground improvement on weak subgrades builds long-lasting foundations for resilient regional connectivity.
CO2	propose construction methods for unbound bound pavements.	SDG 12	Responsible Consumption & Production	Designing aggregate blending options and using Crushed Cement Concrete sub-bases directly offsets the over-extraction of virgin river and hill quarry resources.
CO3	evaluate bituminous mixes based on functional pavement requirements.	SDG 11	Sustainable Cities & Communities	Selecting the correct functional bituminous mix (e.g., open-graded surface mixes) lowers urban hydroplaning risks, enhances tire friction, and cuts vehicular noise pollution.
CO4	suggest construction methodology for rigid pavements and assess quality.	SDG 9	Industry, Innovation & Infrastructure	Enforcing rigorous quality control on long-life concrete pavements (PQC) ensures a highly durable transport corridor that requires minimal maintenance cycles over its design life.

SOIL DYNAMICS& MACHINE FOUNDATIONS			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE802C	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 : outline concepts of soil dynamics, dynamic loading, and vibration of soil-foundation systems.			
CO2 : interpret dynamic soil properties and the laboratory and field methods used for their evaluation.			
CO3 : evaluate earthquake-induced soil response, wave propagation, and liquefaction of soils.			
CO4 : apply principles of machine foundation design, vibration isolation, and vibration control measures.			
UNIT-I			9 Hrs
Introduction to Soil Dynamics: Scope and importance of soil dynamics; static and dynamic loading; sources of dynamic loads such as earthquakes, machines, traffic and blasting; soil-foundation interaction under dynamic loading; civil engineering applications of soil dynamics.			
Basic Concepts of Vibrations: Free and forced vibrations; damped and undamped vibrations; natural frequency, resonance, damping, amplitude and transmissibility; basic modes of foundation vibration: vertical, horizontal, rocking and torsional.			
UNIT-II			9 Hrs
Dynamic Soil Properties: Shear modulus, Poisson's ratio, damping ratio, cyclic strength and pore pressure generation; small-strain and large-strain behaviour of soils; modulus reduction and damping curves.			
Evaluation of Dynamic Soil Properties: Introduction to laboratory tests: resonant column test, cyclic triaxial test, cyclic simple shear test and bender element test; introduction to field tests: cross-hole test, down-hole test and MASW; basic interpretation of dynamic soil test results.			
UNIT-III			9 Hrs
Wave Propagation and Site Response: Basic types of waves in soil; compression waves, shear waves and surface waves; shear wave velocity and its importance; local site effects, amplification and natural period of soil deposits.			
Liquefaction of Soils: Meaning and mechanism of liquefaction; cyclic mobility and flow liquefaction; factors affecting liquefaction; basic evaluation of liquefaction potential using SPT, CPT and shear wave velocity; introduction to liquefaction mitigation methods.			

UNIT-IV			9 Hrs

Basics of Machine Foundations: Types of machines and machine foundations; block, box, frame and pile-supported foundations; basic design requirements; permissible vibration limits; data required for machine foundation design; natural frequency and amplitude of vibration.

Vibration Isolation and Practical Applications: Active and passive vibration isolation; isolation efficiency; use of springs, dampers, rubber pads, trenches and barriers; vibration monitoring using accelerometers and geophones; practical vibration problems and remedial measures.

Textbook(s):

1. Swami Saran, *Dynamics of Soils and Their Engineering Applications*, CRC Press, 1st edition, 2021.
2. Braja M. Das and Zhe Luo, *Principles of Soil Dynamics*, Cengage Learning, 3rd edition, 2017.
3. Shamsheer Prakash and Vijay K. Puri, *Foundations for Machines: Analysis and Design*, John Wiley & Sons, 1st edition, 1988.

Reference Book(S):

1. Steven L. Kramer, *Geotechnical Earthquake Engineering*, Pearson Education, Indian edition, 2015, New Delhi.
2. F. E. Richart Jr., J. R. Hall and R. D. Woods, *Vibrations of Soils and Foundations*, Prentice Hall, 1st edition, 1970, New Jersey.
3. S. C. Arya, Michael W. O'Neill and George Pincus, *Design of Structures and Foundations for Vibrating Machines*, Gulf Publishing Company, 1st edition, 1979, Houston.
4. Bureau of Indian Standards, IS 2974 (Part 1): 1982 – *Code of Practice for Design and Construction of Machine Foundations*, BIS, reaffirmed edition, 2011, New Delhi.

Web and Video link(s):

1. <https://archive.nptel.ac.in/courses/105/101/105101082/NPTELVideo> Lecture on Fluid Mechanics by Dr. T.I. Eldho, IIT Bombay.
2. <https://archive.nptel.ac.in/courses/105/103/105103095/NPTELVideo> Lecture on Fluid Mechanics by Dr. Subhashisa Dutta, IIT Guwahati.
3. <https://archive.nptel.ac.in/courses/105/103/105103095/NPTELVideo> Video Lecture on Fluid Mechanics by Dr. N. Sahoo, IIT Guwahati.

Course Articulation Matrix (CAM):				U24CE802C: SOL DYNAMICS & MACHINE FOUNDATIONS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE802C.1	3	2	–	–	–	1	–	–	–	–	2	2	1
CO2	U24CE802C.2	3	2	–	2	1	1	–	–	1	–	2	3	1
CO3	U24CE802C.3	3	3	1	1	1	2	–	–	1	–	2	3	2
CO4	U24CE802C.4	3	2	2	1	1	2	1	–	1	1	2	3	2
U24CE802C		3.00	2.25	0.75	1.00	0.75	1.50	0.25	–	1	0.25	2.00	2.75	1.50
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	outline concepts of soil dynamics, dynamic loading, and vibration of soil-foundation systems.	SDG9	Industry, Innovation and Infrastructure	Soil dynamics and vibration analysis are fundamental for designing safe, stable, and resilient civil engineering infrastructure and foundation systems.
CO2	interpret dynamic soil properties and the laboratory and field methods used for their evaluation.	SDG9	Industry, Innovation and Infrastructure	Evaluation of dynamic soil properties supports accurate geotechnical investigations necessary for sustainable and reliable infrastructure development.
CO3	evaluate earthquake-induced soil response, wave propagation, and liquefaction of soils.	SDG11	Sustainable Cities and Communities	Understanding seismic soil behavior and liquefaction helps in developing earthquake-resistant structures and disaster-resilient communities.
CO4	apply principles of machine foundation design, vibration isolation, and vibration control measures.	SDG9	Industry, Innovation and Infrastructure	Machine foundation design and vibration control ensure structural safety, durability, and efficient performance of industrial infrastructure.

SUSTAINABLE MATERIALS AND GREEN BUILDINGS			
Class: B. Tech. VII – Semester		Branch: CE	
Course Code:	U24CE802D	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 : infer the significance of sustainability in construction engineering CO2 : appraise and select sustainable building materials CO3 : interpret the energy and carbon reduction strategies CO4 : rate and propose sustainable building			
UNIT-I			9 Hrs
Sustainability concepts: Pillars, circle, need, Engineering principles and systems approach to sustainability. Environmental concerns: Consumption and depletion of natural resources, Land use patterns, Climate change, Global warming, National and International policies, and regulations of sustainability.			
UNIT-II			9 Hrs
Sustainable building materials: Materials, qualities, uses, natural building materials, locally available and manufactured materials, biomaterials, salvaged and recycled materials, nontoxic materials: low volatile organic compound (VOC) paints, coating and adhesives. Selection of sustainable materials: Challenges in selecting green materials, pragmatic view of green materials, priorities in selection process, Life cycle assessment of building materials, Sustainable concrete production.			
UNIT-III			9 Hrs
Energy and carbon reduction: Building energy issues, High performance building design strategy, goal setting for high performance, Passive design strategy - shape, orientation, and massing, lighting, ventilation, passive cooling, composite beam and panel, funicular shells, filler slabs, reinforced concrete masonry, vaulted roofs, Ferro-cement walls. Applications in the built environment: Concepts of green buildings, climate responsive building, Indoor Environmental Quality (IEQ), issues, factors, Acoustics transmission, Lighting quality, Thermal comfort conditions, Odours, Volatile Organic compounds, Humidity, Integrated IEQ.			
UNIT-IV			9 Hrs
Indian green building rating systems: Sustainable Buildings, Green building rating systems: IGBC and GRIHA tools for building assessment, Codes and regulations for green building. Future of sustainable buildings: Business case of high performance green buildings, Design and construction strategies, Reinventing the construction industry, challenges and opportunities.			

Textbook(s):

1. C. J.Kibert, *Sustainable Construction Green Building Design and Delivery*, John Wiley & sons, 3rd edition, 2014, Canada. (Chapters 4,6,7,8,9, 11, 12, 13&15)
2. S. Goodhew, *Sustainable Construction Processes*, John Wiley & sons, 1st edition, 2016, London. (Chapters 1-9)

Reference Book(S):

1. ISO 15392 Sustainability in Buildings and civil engineering works – General Principles, 2nd edition, 2019
2. G. M. Sabnis, *Green Building with concrete – sustainable design and construction*, CRC press, 1st edition, 2016, London.
3. G. S. Kainth, *Climate Change, Sustainable Development and India*, LAP Lambert Academic Publishing, 2011.
4. *Sustainable Building - Design Manual Part 1 & 2*, The Energy and Resources Institute, TERI, 2004.
5. L Reeder, *Guide to Green Building Rating Systems: Understanding LEED*, Green Globes, John Wiley & Sons publisher, 2010.
6. M. Robertson, *Sustainability Principles and Practice*, Routledge publisher, 2nd edition, 2014, London.
7. T. R. Rider, S. Glass, J. McNaughton, *Understanding Green Building Materials*, W.W.Norton and Company, 2011.
8. C. Cameselle, J. A. Adams, and K R. Reddy, *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley & Sons, 1st edition, 2019, U.S.

Web and Video link(s):

<https://nptel.ac.in/courses/105102195>; NPTEL Video Lecture on Sustainable Materials and Green Buildings, IIT Delhi, Prof. B Bhattacharjee.

Course Articulation Matrix (CAM):				U24CE802D : Sustainable Materials and Green Buildings										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE802D.1	1	-	1	-	-	1	1	1	1	1	1	-	2
CO2	U24CE802D.2	1	-	1	-	-	1	1	1	1	1	1	-	2
CO3	U24CE802D.3	1	-	2	-	-	1	1	1	1	1	1	-	2
CO4	U24CE802D.4	1	-	2	-	2	1	1	1	1	1	1	-	2
U24CE802D		1	-	1.5 0	-	2	1	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	infer the significance of sustainability in construction engineering	SDG11 SDG12	Sustainable Cities and Communities Responsible Consumption and Production	Emphasizes sustainable construction practices, environmental protection, and climate-responsive development.
CO2	appraise and select sustainable building materials	SDG11 SDG12	Sustainable Cities and Communities Responsible Consumption and Production	Encourages the use of eco-friendly, recycled, and resource-efficient construction materials.
CO3	interpret the energy and carbon reduction strategies	SDG11	Sustainable Cities and Communities	Focuses on energy-efficient buildings and reduction of greenhouse gas emissions in the construction sector.
CO4	rate and propose sustainable building	SDG9 SDG 11	Industry, Innovation and Infrastructure Sustainable Cities and Communities	Promotes healthy indoor environments and sustainable building assessment through green building concepts and rating systems.

Introduction to Data Bases			
Class: B. Tech. VIII – Semester		Branch: CE	
Course Code:	U24CE802E	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 : Build formal notation for languages, automata, and regular expressions CO2 : Simplify context-free grammar and prove non-regular languages CO3 : Convert CFG to CNF/GNF and design pushdown automata CO4 : Design Turing Machines and analyze Post's correspondence problem			
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 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 Data Modelling using the Entity-Relationship (ER) Model: 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			
UNIT-II			9 Hrs
The Relational Data Model, Relational Database Constraints: Relational model concepts, Relational constraints and the Relational database schemas, Update operations and dealing with constraint violations Basic Structured Query Language (SQL): SQL Data definition and data types, specifying constraints in SQL, Basic retrieval queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL Relational Database Design by ER-to Relational Mapping: Relational database design using ER-to-Relational mapping, EER to-Relational mapping			
UNIT-III			9 Hrs
The Relational Algebra and Relational Calculus: Basic relational algebra operations, Examples of queries in relational algebra, The tuple relational calculus 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			
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
Textbook(s): 1. RamezElmasriandShamkanthB.Navathe, Fundamentals of Database Systems, 6thed., Pearson Education2010
Reference Book(S): 1. Raghu Rama krishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill Education, 3 rd ed., 2002. 2.Abraham Silberschatz, Henry F.Korth and Sudarshan, Data base System Concepts, McGraw Hill Education, 3 rd ed.,1997 3.Thomas Connolly and Carolyn Begg, Database Systems, Pearson Education, 3 rd ed.,2003
Web and Video link(s): https://onlinecourses.nptel.ac.in/noc22_cs91/preview NPTEL Video Lecture: DataBase Management System by Prof. ParthaPratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur

Course Articulation Matrix (CAM):				U24CE802E : ADVANCED DATA STRUCTURES										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE802E.1	2	1	2	1	-	-	1	-	-	-	1	2	2
CO2	U24CE802E.2	2	1	2	1	-	-	1	-	-	-	1	2	2
CO3	U24CE802E 5.3	2	1	2	2	-	-	1	-	-	-	1	2	2
CO4	U24CE802E.4	2	1	1	1	-	-	1	-	-	-	1	2	2
U24CE802E		2	1	1.7 5	1.2 5	-	-	-	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	Build formal notation for languages, automata, and regular expressions	SDG 4	Quality Education.	Strengthens foundational knowledge in formal systems, enabling students to contribute to advanced computing and innovative infrastructure
CO2	Simplify context-free grammar and prove non-regular languages	SDG 4	Quality Education	Enhances analytical and problem-solving skills, directly supporting high-quality education and academic rigor.
CO3	Convert CFG to CNF/GNF and design pushdown automata	SDG 9	Industry, Innovation & Infrastructure,	Pushdown automata and grammar transformations underpin compiler design and efficient systems, which support sustainable digital infrastructure.
CO4	Design Turing Machines and analyze Post's correspondence problem	SDG 4 -	Quality Education,	Understanding undecidability and computational limits fosters ethical, transparent, and robust digital institutions.

STRUCTURAL HEALTH MONITORING			
Class: B. Tech.VIII – Semester		Branch: Civil Engineering	
Course Code:	U24CE803	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: Analyse the principles, framework, and significance of Structural Health Monitoring (SHM) for civil infrastructure systems. CO2: Identify deterioration mechanisms in civil structures and select appropriate sensing and measurement technologies for monitoring. CO3: Interpret vibration and monitoring data using basic signal analysis and damage-sensitive features for structural condition assessment. CO4: Evaluate damage detection approaches and SHM applications in bridges, buildings, dams, and other civil infrastructure systems.			
UNIT-I			9 Hrs
Fundamentals of Structural Health Monitoring: Basics of health monitoring, definition and objectives of SHM, engineering and commercial needs for SHM, damage and failure concepts, comparison of SHM with conventional inspection and Non-Destructive Testing (NDT), benefits and limitations of SHM. Structural Dynamics and SHM Framework: Review of single-degree-of-freedom (SDOF) and multi-degree-of-freedom (MDOF) systems, free and forced vibration, natural frequencies, mode shapes, damping, SHM workflow, statistical pattern recognition framework, structural modelling concepts, role of modelling in damage assessment.			
UNIT-II			9 Hrs
Damage Mechanisms in Civil Infrastructure: Deterioration mechanisms in reinforced concrete structures, corrosion of reinforcement, carbonation, chloride attack, shrinkage and fatigue cracking, alkali-silica reaction, corrosion and fatigue in steel structures, weld cracking, deterioration of bridge components, prestress loss in prestressed concrete structures, masonry deterioration, damage progression and failure mechanisms. Sensors and Data Acquisition Systems: Measurement principles and sensor systems, transducer attachment methods, resistance strain gauges, piezoelectric sensors, accelerometers, MEMS sensors, Fiber Bragg Grating (FBG) sensors, GPS/GNSS monitoring systems, vision-based monitoring, UAV/Drone-based inspection, sensor calibration and reliability, data acquisition systems, signal conditioning, sampling and digitization, aliasing and leakage, powering the sensing system.			
UNIT-III			9 Hrs
Vibration Data Analysis and Feature Extraction: Data preprocessing, filtering concepts, time-domain and frequency-domain analysis, Fast Fourier Transform (FFT), Power Spectral Density (PSD), introductory wavelet concepts, temporal and statistical data analysis, feature extraction techniques, common vibration signatures, modal properties. Damage Detection and Assessment: Fundamentals of damage detection, localization and quantification, damage-sensitive features, model-based and data-driven approaches, novelty detection concepts, basic classification concepts, autoregressive (AR) models for damage detection, condition assessment, decision making and hypothesis testing concepts.			
UNIT-IV			9 Hrs

CO-SDG Alignment Matrix				
CO	CO Statement	Relevant SDG	SDG Description	Mapping Justification
CO1	Analyse the principles, framework, and significance of Structural Health Monitoring (SHM) for civil infrastructure systems.	SDG 9	Industry, Innovation and Infrastructure	Understanding SHM principles and framework enables development of resilient, sustainable infrastructure systems. Analysing SHM significance contributes to building quality, reliable, and sustainable infrastructure that supports economic development and human well-being.
		SDG 11	Sustainable Cities and Communities	Analysis of SHM framework for civil infrastructure systems directly contributes to making cities inclusive, safe, resilient, and sustainable by enabling continuous monitoring and maintenance of critical urban infrastructure.
CO2	Identify deterioration mechanisms in civil structures and select appropriate sensing and measurement technologies for monitoring.	SDG 9	Industry, Innovation and Infrastructure	Identifying deterioration mechanisms and selecting appropriate monitoring technologies promotes innovation in infrastructure management. This supports building resilient infrastructure and fosters innovation in civil engineering practice.
		SDG 11	Sustainable Cities and Communities	Identifying deterioration mechanisms in critical infrastructure like bridges, buildings, and dams helps ensure safety and longevity of urban infrastructure, contributing to sustainable and resilient communities.
		SDG 12	Responsible Consumption and Production	Early identification of deterioration enables timely maintenance and repair, reducing material waste and promoting efficient use of resources. Selecting appropriate sensors optimizes monitoring efforts and minimizes unnecessary consumption of materials.
CO3	Interpret vibration and monitoring data using basic signal analysis and damage-sensitive features for structural condition assessment.	SDG 9	Industry, Innovation and Infrastructure	Interpreting monitoring data using signal analysis and damage-sensitive features represents technological innovation in infrastructure management. This enables evidence-based decision making for infrastructure maintenance and rehabilitation.
		SDG 11	Sustainable Cities and Communities	Accurate interpretation of vibration data enables early detection of structural damage, ensuring safety and reliability of buildings, bridges, and other critical urban infrastructure, thereby contributing to sustainable and safe communities.
CO4	Evaluate damage detection approaches and SHM applications in bridges, buildings, dams, and other civil infrastructure systems.	SDG 9	Industry, Innovation and Infrastructure	Evaluating damage detection approaches for diverse civil infrastructure systems drives innovation in infrastructure monitoring and management, promoting development of resilient and sustainable infrastructure.
		SDG 11	Sustainable Cities and Communities	Application of SHM to bridges, buildings, dams, and other critical infrastructure ensures their safety, reliability, and longevity, directly contributing to making cities and human settlements inclusive, safe, resilient, and sustainable.
		SDG 12	Responsible Consumption and Production	Effective SHM applications enable condition-based maintenance, extending service life of infrastructure, reducing premature replacement, and promoting responsible consumption of construction materials and resources.
		SDG 13	Climate Action	Evaluating SHM applications helps infrastructure adapt to climate change impacts. Monitoring of dams, coastal structures, and bridges helps assess climate-induced deterioration and plan adaptation strategies.

MAJOR PROJECT PHASE II

Class: B. Tech. VIII – Semester

Branch: CE

Course Code:	U24CE804	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,
(based on cognitive skills acquired from theory component)*

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**
 - 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.
 - 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.
 - The project supervisors shall ensure students focus on the project objectives and expected deliverables
 - 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>Projectpaper(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):				U24CE804: MAJOR PROJECT PHASE II										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24CE804.1	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	U24CE804.2	3	2	3	2	2	1	2	1	1	2	2	2	1
CO3	U24CE804.3	1	1	1	1	1	2	1	1	2	2	1	2	1
CO4	U24CE804.4	1	1	1	2	2	1	2	1	2	1	2	2	2
U24CE804		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
CO 1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering	SDG 13	Industry, Innovation and Infrastructure	Research-based problem identification, engineering analysis and technical solution development can support climate-responsive engineering practices by enabling solutions that improve resilience,

CO-SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
	fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)			reduce environmental impact and address sustainability-oriented real-world engineering problems.
CO 2	design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)	SDG 12	Responsible Consumption and Production	Sustainable design practices, efficient resource utilization, cost-effective prototyping, material optimization and environmentally responsible engineering decisions promote responsible consumption and production.
CO 3	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	Project management, teamwork, leadership and ethical responsibility help in developing engineering solutions that address societal needs and contribute to safe, inclusive, resilient and sustainable communities.
CO 4	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	Systematic performance evaluation, technical documentation, presentation of engineering solutions and continuous professional learning support innovation, technology development and effective communication of infrastructure-oriented engineering outcomes.