SECOND YEAR SYLLABI 2023 SCHEME

B.Tech
Civil Engineering

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)
Mar Ivanios Vidyanagar, Nalanchira, Thiruvananthapuram – 695 015
March 2024

DETAILED SYLLABI OF SECOND YEAR

FOR

B. TECH. DEGREE PROGRAMME

IN

CIVIL ENGINEERING

SEMESTERS III & IV

2023 SCHEME

(AUTONOMOUS)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)
(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University)
MAR IVANIOS VIDYANAGAR, NALANCHIRA, THIRUVANANTHAPURAM – 695015, KERALA.
Phone: 0471 2545866
Fax: 0471 2545869
Web: www.mbcet.ac.in
email: hodce@mbcet.ac.in

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

DEPARTMENT OF CIVIL ENGINEERING

B. TECH DEGREE PROGRAMME
IN
CIVIL ENGINEERING

DETAILED SYLLABI OF SECOND YEAR

Items	Board of Studies (BoS)	Academic Council (AC)
Date of Approval	21-03-2024	09-03-2024

Head of Department
Chairman, Board of Studies

Principal
Chairman, Academic Council

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

Vision and Mission of the Institution

Vision:

To be an Institution moulding globally competent professionals as epitomes of Noble Values.

Mission:

To transform the Youth as technically competent, ethically sound and socially committed professionals, by providing a vibrant learning ambience for the welfare of humanity.

DEPARTMENT OF CIVIL ENGINEERING

Vision and Mission of the Department

Vision:

To be a Centre of Excellence in Civil Engineering education with a global perspective, creating ethically strong engineers for the service of society.

Mission:

To provide Engineering Education which can create exemplary professional Civil Engineers of high ethics with strong conceptual foundation coupled with practical insight, to serve the industry and community.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of the Programme will have a successful career as Civil Engineering practitioners, entrepreneurs or professionals, addressing the needs of the industry with a global perspective.

PEO2: They will contribute to society as ethical and responsible citizens with proven expertise

PEO3: They will engage in continuous professional development and advance to leadership roles in their chosen career.

PROGRAMME OUTCOMES (POs)

Engineering graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: 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.
4. **Conduct investigations of complex problems**: 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.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: 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.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: 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.
11. **Project management and finance**: 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.
12. **Life-long learning**: 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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Provide feasible and sustainable solutions to problems in various Civil Engineering disciplines such as Structural, Environmental, Geo technical, Transportation and Construction Engineering.

PSO2: Apply the principles, methods, software and codes of practices to design various Civil Engineering Systems.

CURRICULUM SECOND YEAR

SEMESTER III						
Slot	**Category**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL20A	Partial Differential Equations and Complex Analysis	3-1-0-0	4	4
B	PCC	23CEL20A	Mechanics of Structures	3-1-0-0	4	4
C	PCC	23CEL20B	Fluid Mechanics and Hydraulics	3-1-0-0	4	4
D	PCC	23CEL20C	Surveying and Geomatics	3-0-0-0	3	3
E	ESC	23ESL00A	Design Engineering	2-0-0-0	2	2
G	HSC	23HSL2NA	Professional Ethics	2-0-0-0	2	1*
S	PCC	23CEP20A	Fluid Mechanics Laboratory	0-0-3-0	3	2
T	PCC	23CEP20B	Surveying Laboratory	0-0-3-0	3	2
M	VAC		Minor Course	3-0-0-0	3	3
				TOTAL	**25/28**	**22/25**

***Not to be considered for Grade/GPA/CGPA. Pass or Fail only**

SEMESTER IV						
Slot	**Category**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL20C	Probability, Statistics and Numerical Methods	3-1-0-0	4	4
B	PCC	23CEL20D	Structural Analysis	3-1-0-0	4	4
C	PCC	23CEL20E	Hydrology and Water Resources Engineering	4-0-0-0	4	4
D	PCC	23CEB20F	Water and Wastewater Engineering	4-0-2-0	6	5
E	HSC	23HSL2NB	Universal Human Values -II	2-1-0-0	3	1*
G	ESC	23ESL2NC	Industrial Safety Engineering	2-1-0-0	3	1*
S	PCC	23CEP20C	Material Testing Lab I	0-0-2-0	2	1
M/H	VAC		Minor/Honors Course	3-0-0-0	3	3
				TOTAL	**26/29**	**20/23**

***Not to be considered for Grade/GPA/CGPA. Pass or Fail only**

MINOR BASKET

Semester	Basket I				Basket II				Basket III			
	Infrastructure Development and Management				Environmental and Water Resource Engineering				Transportation Engineering			
	Course Code	Course	L-T-P-J	Credits	Course Code	Course	L-T-P-J	Credits	Course Code	Course	L-T-P-J	Credits
S3	23CEL2MA	Building Information Modelling	3-0-0-0	3	23CEL2MC	Climate Change and Disaster Mitigation	3-0-0-0	3	23CEL2ME	Traffic Engineering	3-0-0-0	3
S4	23CEL2MB	Infrastructure Health Monitoring	3-0-0-0	3	23CEL2MD	Watershed Management	3-0-0-0	3	23CEL2MF	Urban Transportation Planning	3-0-0-0	3
S5	23CEL3MA	Infrastructure Project Management	3-0-0-0	3	23CEL3MC	Air Pollution and Control Techniques	3-0-0-0	3	23CEL3ME	Traffic Flow Theory and Modelling	3-0-0-0	3
S6	23CEL3MB	Performance and Risk Assessment of Infrastructure Systems	3-0-0-0	3	23CEL3MD	Integrated Waste Management for Smart Cities	3-0-0-0	3	23CEL3MF	Transportation and logistics management	3-0-0-0	3
S7/ S8	23CEl4MA	Mini Project	0-0-6–0	3	23CEL4MC	Mini Project	0-0-6–0	3	23CEL4ME	Mini Project	0-0-6–0	3

*Mini project can be done either in S7 or in S8

HONOUR BASKET

Semester	Basket I				Basket II				Basket III			
	Course Code	Course	L-T-P-J	Credits	Course Code	Course	L-T-P-J	Credits	Course Code	Course	L-T-P-J	Credits
S4	23CEL2HB	Advanced Mechanics of Solids	3-0-0-0	3	23CEL2HD	Environmental Pollution Control Techniques	3-0-0-0	3	23CEL2HF	Geographical Information System	2-0-2-0	3
S5	23CEL3HA	Modern Construction Materials	3-0-0-0	3	23CEL3HC	Ground Water Hydrology	3-0-0-0	3	23CEL3HE	Pavement Construction and Management	3-0-0-0	3
S6	23CEL3HB	Finite Element Method	3-0-0-0	3	23CEL3HD	Environmental Pollution Modelling	3-0-0-0	3	23CEL3HF	Transportation System Management	3-0-0-0	3
S7	23CEL4HA	Structural Dynamics	3-0-0-0	3	23CEL4HC	Earth Dams and Earth Retaining Structure	3-0-0-0	3	23CEL4HE	Soil Dynamics and Machine Foundation	3-0-0-0	3
S8	23CEL4HB	Mini Project	0-0-6–0	3	23CEL4HD	Mini Project	0-0-6–0	3	23CEL4HF	Mini Project	0-0-6–0	3

SEMESTER 3

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL20A	Partial Differential Equations and Complex Analysis	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW

This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. The basic theory of functions of a complex variable, residue integration and conformal transformation are discussed.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Solve partial differential equations.	Apply
CO2	Use appropriate methods to solve one dimensional wave equation and heat equation.	Apply
CO3	Solve problems using analyticity of complex functions	Apply
CO4	Find the image of regions under conformal mapping	Apply
CO5	Find complex integrals using Cauchy's formulas to compute several kinds	Apply

iii) SYLLABUS

Partial differential equations: Formation of partial differential equations, Solutions of a partial differential equations, Linear equations of the first order, Method of separation of variables.

One dimensional wave equation-derivation and solution -One dimensional heat equation, derivation and solution

Complex Differentiation: Analytic functions, Cauchy-Riemann equations, harmonic functions, Conformal mappings- standard mappings, Linear fractional transformation.

Complex integration: Line integrals in the complex plane, Contour integrals, Cauchy integral theorem, Cauchy Integral formula

Taylor's series and Laurent's series, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem, Evaluation of definite integral using residue theorem

iv) a) TEXTBOOKS

1.B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018
2.Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016

b) REFERENCES

1.J. Stewart, Essential Calculus, Cengage, 2nd Edition, 2017
2.G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3.Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition 2012

v) COURSE PLAN

Module	Contents	No. of hours
I	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order-Lagrange's linear equation, Non-linear equations of the first order - Charpit's method. Boundary value problems, Method of separation of variables.	12
II	One dimensional wave equation- vibrations of a stretched string, Derivation. Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation One dimensional heat equation, derivation. Solution of the heat equation using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation-Laplace's equations -Derivation and solution by method of separation of variables.	13
III	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations-harmonic functions, finding harmonic conjugate-Conformal mappings- mappings of w=z^2, w=e^z, w=1/z, $w=sinz$	12
IV	Complex integration, Line integrals in the complex plane, Basic properties, first evaluation method, second evaluation method, use of representation of a path-Contour integrals, Cauchy integral theorem (without proof) on simply connected domain, on multiply connected domain (without proof). Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function Taylor's series and Maclaurin series.	11
	Laurent's series (without proof)-zeros of analytic functions,	

V	singularities, poles, removable-singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem-Residue integration of real integrals –integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form ∫_(-∞)^∞f(x)dx with no poles on the real axis. (∫_A^Bf(x)dx whose integrand become infinite at a point in the interval of integration is excluded from the syllabus)	**12**
	Total	**60**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

Course Code	Course Name	Category	L	T	P	J	Credit
23CEL20A	Mechanics of Structures	PCC	3	1	0	0	4

PREREQUISITE: 23ESL10B APPLIED MECHANICS

i) COURSE OVERVIEW

Goal of this course is to expose the students to the fundamental concepts of stress, strain and material behaviour under different loading conditions and provide a firm base for the analysis of structural elements.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the behaviour of different structural elements under various loading conditions.	Understand
CO 2	Determine the response of beams under different loading conditions.	Apply
CO 3	Apply the principles of solid mechanics to calculate internal stresses/strains, stress resultants and strain energies in structural elements subjected to axial/transverse loads and bending/twisting moments.	Apply
CO 4	Determine principal stresses and maximum shear stress at a point performing stress transformation.	Apply
CO 5	Apply the theory of torsion to determine the stress in a circular shaft.	Apply
CO 6	Determine the load carrying capacity of axially and eccentrically loaded columns.	Apply

iii) SYLLABUS

Beams – Types of loading on beams. Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams subjected to different loading conditions.

Theory of simple bending, Calculation of normal stress and shear stress in beams. Variation of shear stress across the cross section. Beams of uniform strength. Strain energy due to bending. Review of elastic constants.

Principal stresses and principal planes in 2D problems. Torsion of circular and hollow circular shafts, power transmitted by circular shafts and hollow circular shafts. Strain energy due to torsion.

Slope and deflection- determination of slope and deflection using Moment area method, Macaulay's method and Conjugate beam method.

Short columns – direct and bending stress. Kern of a section. Slender columns – Euler's buckling load, slenderness ratio, limitation of Euler's formula. Rankine's formula. Stresses in thin cylinders and spheres due to internal pressure.

iv) a) TEXTBOOKS

1) Leet K. Uang C M. & Gilbert A M., Fundamentals of Structural Analysis, McGraw Hill 6th edition, 2021.
2) Rajasekharan S. and Sankarasubramanian G., Computational Structural Mechanics, Prentice Hall of India, New Delhi, 3rd edition, July 2021.
3) Shah, H.J., Junnarkar, J. B. Mechanics of solids, Charotar Publishing House Pvt. Ltd., 32nd edition, 2016.
4) Bansal, R. K., Strength of Materials, Laxmi Publications (P) Ltd., 6th edition, 2018.

b) REFERENCES

1) Gere, J.M., Goodno, B. J., Mechanics of Materials, Cengage Learning, 9th edition, 2017.
2) Popov, E.P., Mechanics of Materials, Prentice Hall India, New Delhi, 2nd edition 2015.
3) Beer, F. P. and Johnston, E. R., Mechanics of Materials, Tata McGraw Hill, New Delhi, 7th edition, 2017.
4) Wang C.K., Intermediate Structural Analysis, McGraw Hill, 2017.

V) COURSE PLAN

Module	Contents	No. of hours
I	Beams – different types. Types of loading on beams. Concept of bending moment and shear force. Relationship between intensity of loading, shear force and bending moment. Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams subjected to point load, concentrated moments, uniformly distributed and uniformly varying loads. Point of contra flexure.	14

II	Theory of simple bending, assumptions and limitations. Calculation of normal stress and shear stress in beams. Variation of shear stress across the cross section. (Rectangular, circular and triangular sections only). Beams of uniform strength. Strain energy due to bending – calculation of strain energy in beams- Cantilever and simply supported beams subjected to point load and UDL. Review of elastic constants.	14
III	Principal stresses and principal planes in 2D problems, maximum shear stress. Strains along principal directions. Mohr's circle of stress for 2D problems. Torsion- Derivation of torsion equation and its assumptions. Applications of the equation on the hollow and solid circular shafts, torsional rigidity, combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Power transmitted by circular shafts and hollow circular shafts. Strain energy due to torsion.	14
IV	Slope and deflection- Relationship between moment, slope and deflection, determination of slope and deflection using Moment area method, Macaulay's method and conjugate beam method. Use of these methods to calculate slope and deflection for determinate beams.	10
V	Short columns – direct and bending stress. Kern of a section. Slender columns – Euler's buckling load, slenderness ratio, limitation of Euler's formula. Rankine's formula. Stresses in thin cylinders and spheres due to internal pressure.	8
	Total hours	60

VI) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
100	40	60	3 hours

VII) CONTINUOUS INTERNAL EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 numbers)	:	10 marks
Assignment/Quiz/Course Project	:	25 marks

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL20B	Fluid Mechanics and Hydraulics	PCC	3	1	0	0	4	2023

PREREQUISITE: 23ESL10B Applied Mechanics

i) COURSE OVERVIEW

Goal of this course is to expose the students to the fundamentals of fluid flow and to develop the skill for applying the fluid flow concepts in pipe flow and open channel flow for solving civil engineering problems.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the relevant concepts of hydrostatics and hydrodynamics.	Understand
CO 2	Identify the pressure distribution in fluids by applying the principles of fluid statics	Apply
CO 3	Solve for stability of bodies under hydrostatic condition by applying the concept of buoyancy and floatation	Apply
CO 4	Make use of the concepts of Bernoulli's equation in the determination of Flow Velocity and Discharge	Apply
CO 5	Calculate the major and minor losses in pipe flow	Apply
CO6	Apply the basic principles and laws governing fluid flow in solving open channel flow measurement and management.	Apply

iii) SYLLABUS

Fluid properties, variation of pressure in a fluid, measurement of fluid pressure using piezometers and manometers, U-tube manometers, Forces on immersed planes, Hydrostatic force on curved surfaces, Application of fluid pressure analysis in engineering problems.
Dimensional analysis and similitude: Methods of dimensional analysis, Dimensionless numbers. Principles of similarity

Buoyant force, Principle of floatation, stability of floating and submerged bodies, metacentre and metacentric height, Methods of describing fluid motion, types of fluid flow, continuity equation.

Bernoulli's equation, Euler's equation along a streamline, Venturimeter, Pitot tube and Orificemeter, Hydraulic coefficients of orifices, Computation of major and minor losses in pipes, hydraulic gradient line and total energy line, pipes in series and parallel.

Open channel flow, geometric elements of channel section, uniform flow computations, most economical sections, condition for maximum discharge and maximum velocity through circular channels, Discharge computations using weirs, velocity of approach and end contraction.

Streamflow measurement-Area velocity approach-Gauging station, Stage-Discharge Cure.

Specific energy diagram and discharge diagram, Critical flow and its computation, Dynamic equation of gradually varied flow, Computation of length of water surface profiles by direct step method, Specific force, Rapidly varied flow, Hydraulic jump-conjugate or sequent depths.

iii) a) TEXT BOOKS

1. Frank M White, Henry Xue, Fluid Mechanics,McGraw-Hill, 9th Edition, 2022
2. P.N. Modi and S. M. Seth,Hydraulics and Fluid Mechanics, S. B. H. Publishers, 22nd edition, New Delhi, 2019.
3. Victor L Streeter and E.B. Wylie, Fluid Mechanics, McGraw Hill, 7th edition, 2010.

b) REFERENCES

1. K.R.Arora, Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 9thedition,2017.
2. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S. K. Kataria & Sons, 9th edition, New Delhi, 2015.

iv) COURSE PLAN

Module	Content	Hours
I	Introduction: Fluid properties, Classification of Fluids.Fluid statics-variation of pressure in a fluid, measurement of fluid pressure using piezometers and manometers, U-tube manometers, Forces on immersed planes placed in vertical and inclined positions. Hydrostatic force on curved surfaces – Practical application of total pressure on spillway gates.Dimensional analysis and similitude: Methods of dimensional analysis, Dimensionless numbers. Principles of similarity.	**12**
II	Buoyancy and Floatation: Buoyant force, Principle of floatation, stability of floating and submerged bodies, metacentre and metacentric height, analytical and experimental determination of metacentric height.Hydrodynamics: Methods of describing fluid motion, Lagrangian and Eulerian methods, velocity and acceleration, types of fluid flow, description of fluid flow- streamline, pathline and streakline; continuity equation in one, two and three dimensions.	**8**

III	Fluid kinetics: Forces considered in describing fluid motion, Derivation of Bernoulli's equation by integration of Euler's equation along a streamline, kinetic energy correction factor, Applications of Bernoulli's equation- Venturimeter, Pitot tube and Orificemeter; Hydraulic coefficients of orifices and their experimental determination, Discharge through small orifice and large rectangular orifices Pipe flow: Computation of major and minor losses in pipes, hydraulic gradient line and total energy line, pipes in series- equivalent pipe, flow through parallel pipes.	**14**
IV	Open channel flow: Comparison between pipe flow and open channel flow, velocity distribution in open channels, types of channels, type of flow, geometric elements of channel section, uniform flow computations (Chezy's equation, Kutter's and Manning's formula); Most economical sections –condition for maximum discharge and maximum velocity (General Principle) Flow measurement in channels: Notches and weirs – Principle of Discharge computations-V notch,Rectangular Weir,Cippoletti Weir, trapezoidal weir, submerged weir and broad crested weir,velocity of approach and end contraction. Streamflow measurement-area velocity method- stream gauging, selection of site for stream gauging station, Stage-Discharge Curve.	**13**
V	Specific energy: specific energy diagram and discharge diagram, Critical flow and its computation. Gradually varied flow: Dynamic equation of gradually varied flow-different forms, types and characteristics of water surface profiles in rectangular prismatic channels. Computation of length of water surface profiles by direct step method Specific force, Rapidly varied flow-Hydraulic jump-conjugate or sequent depths, expression for sequent depths and energy loss for a hydraulic jump in horizontal rectangular channels, types, uses and characteristics of hydraulic jump.	**13**
	Total	**60**

v) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vi) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL20C	Surveying and Geomatics	PCC	3	0	0	0	3	2023

PREREQUISITE: 23ESL10N Basics of Civil Engineering

i) COURSE OVERVIEW

Goal of this course is to impart awareness on the various methods of surveying and its computations. In addition, it also provides a basic knowledge on geospatial data acquisition and its processes

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Discuss the fundamental aspects of various conventional and advanced surveying techniques.	Understand
CO2	Apply the concept of theory of errors in surveying techniques.	Apply
CO3	Apply the knowledge in setting out curves.	Apply
CO4	Apply surveying principles and concepts in practical surveying scenarios.	Apply

iii) SYLLABUS

Introduction to Surveying, Levelling- Principles and methods, Contouring, Theodolite survey, Principles of stadia and tangential tacheometry (concepts only), Total Station

Area and Volume- Computation of area, Computation of volume, Mass diagram, Traverse Surveying- Methods of traversing- Checks in closed traverse- Balancing the traverse- Omitted measurements.

Curve Surveying- Elements of simple and compound curves- Methods of setting out- Elements of Reverse curve- Transition curve- Vertical curve, Triangulation- Satellite Stations and reduction to centre.

Theory of Errors, Global Positioning Systems- GPS Surveying methods- GPS Errors and Accuracy – Error sources in GPS observations – Satellite geometry and Accuracy measures

Aerial Photogrammetry- Scale and Flying height, Remote Sensing- Raster and vector data representation.

iv) a) TEXT BOOKS

1. C. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited, 2nd Edition, 2011.
2. S.K. Duggal, Surveying (Vol. I and II), Tata Mc Graw Hill, 7th Edition, 2019.
3. Jonathan Iliffe, Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, 2nd Edition, 2008.

4. Kang Tsung Chang, Introduction to Geographic Information System, Tata McGraw-Hill Publishing Co. Ltd, 8th Edition, 2016.
5. Ian Heywood,Sarah Cornelius and Steve Carver, An Introduction to Geographical Information Systems, Pearson Education Ltd., 3rd Edition, 2010.

b) REFERENCES

1. B.C. Punmia, Ashok K Jain and Arun K Jain, Surveying (Vol. I and II), Laxmi Publications (P) Ltd., New Delhi, 17th Edition, 2016.
2. T.P. Kanetkar and S.V. Kulkarni, Surveying and Levelling (Vol. I), Pune Vidyarthi Griha Prakashan, 2004.
3. W. Schofield and M. Breach, Engineering Surveying, Butterworth-Heinemann, 6th Edition, 2007.
4. Peter A Burrough, Rachael A MCDonnell, Christopher D. LLoyd, Principles of Geographical Information systems, Oxford University Press, 3rd Edition, 2015.
5. Satheesh Gopi, R. Sathikumar and N. Madhu, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education Ltd., 2nd Edition, 2017.
6. James M Andersen and Edward M Mikhail, Surveying Theory and Practice, McGraw Hill Education, 7th Edition, 2017.

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Surveying- Principles, Ranging, Bearing of survey lines, Local attraction, Declination Levelling- Principles and methods- Reciprocal levelling, Profile levelling and cross sectioning (concepts only). Digital and Auto Level, Errors in levelling, Contouring. Theodolite survey- Measurement of horizontal and vertical angle, Principles of stadia and tangential tacheometry (concepts only) Total Station- Concept of EDM, Principles and working.	9
II	Area and Volume- Computation of area, Computation of volume- prismoidal and trapezoidal formula. Mass diagram. Traverse Surveying- Methods of traversing, Checks in closed traverse, Balancing the traverse, Omitted measurements.	10
III	Curve Surveying- Elements of simple and compound curves- Methods of setting out, Elements of Reverse curve, Transition curve, Vertical curve.	10

	Triangulation- Triangulation figures, Triangulation stations, Inter visibility and height of stations, Satellite Stations and reduction to centre.	
IV	Theory of Errors- Types, Theory of least squares, Weighting of observations, Most probable value, Computation of indirectly observed quantities- Method of normal equations. Global Positioning Systems- Components and principles, Satellite ranging, calculating position, signal structure, Application of GPS, GPS Surveying methods, static, rapid static, kinematic methods, GPS Errors and Accuracy – Error sources in GPS observations – Satellite geometry and Accuracy measures	**8**
V	Aerial Photogrammetry – Basic concepts – Vertical photographs – Scale and Flying height Remote Sensing – Electromagnetic spectrum, Energy interactions with atmosphere and earth surface features – Spectral reflectance, Resolution, Multi spectral scanning. Remote sensing: Interpretation – Introduction to image processing techniques Geographical Information System- Components of GIS, GIS operations, Data Types, Raster and vector data representation.	**8**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL00A	Design Engineering	ESC	2	0	0	0	2	2023

i) COURSE OVERVIEW:

Goal of this course is to expose the students to the fundamental principles of design engineering. Students are required to utilize design thinking as a crucial and pertinent approach to learning, reflecting its significance and relevance in contemporary contexts. The course also focuses on familiarizing the students with the concepts of innovative idea generation and presentation along with its market viability and business model.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Demonstrate the ability to effectively apply the principles of the design process in solving real-world engineering challenges	Apply
CO 2	Analyse user needs and frame well-defined problem statements	Analyse
CO 3	Create innovative ideas to solve real-world problems by applying the principles of Design Thinking	Create
CO4	Explain the concepts of Modular design, Ergonomics and Aesthetics to address design challenges	Understand
CO5	Create a pitch deck and deliver a presentation that effectively communicates an innovative idea	Create

iii) SYLLABUS

Defining a Design Process-: Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Empathize: Understanding User Needs, Define- Framing the Problem. Translating empathy findings into actionable problem statements.

Ideate: Brainstorming, Steps in Brainstorming: Divergent-Convergent Thinking and Questioning. Prototype: Inexpensive prototypes to quickly explore and iterate on ideas. Test: Gathering feedback from real users through interactions

Design Engineering Concepts: Modular Design and Life Cycle Design Approaches. Biomimicry, Aesthetics and Ergonomics in Design. Design for Production, Use, and Sustainability.

Product Viability and Business Model- Value Proposition, Market Opportunity, Cost Revenue Relationship, Technology and Implementation, Competitive Analysis, Traction and Milestones.

iv) a) TEXT BOOKS

1. Yousef Haik, Sangarappillai Sivaloganathan, Tamer M. Shahin, Engineering Design Process, 3rd Edition, Cengage Learning, January 2017
2. Michael Lewrick, Patrick Link, Larry Leifer, Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, Wiley Publications, June 2018
3. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods, Wiley Publications, April 2020
4. A Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want, Wiley Publications, October 2014

b) REFERENCES

1. Dr. Amitkumar Goudar, The Secrets of Design Thinking Mindset: More Tools And Techniques To Enhance Your Design Thinking Skill, Clever Fox Publishing, October 2023
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, Penguin Random House India Private Limited, 2020
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business; Revised, Updated edition, March 2019
4. Don Norman, The Design of Everyday Things, Basic Books; 2nd edition November 2013
5. Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

v) COURSE PLAN

Module	Content	No of Hours
I	Design Process: - Defining a Design Process-: Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.	3
	Practical Exercise: Need Identification Case studies. How to define a Problem Statement. Present an idea using the stages of the Design Process.	3
II	Design Thinking Approach: -Introduction to Design Thinking. Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Empathize: Understanding User Needs, Gathering meaningful insights from users. Define: Framing the Problem. Translating empathy findings into actionable problem statements. Utilizing tools such as problem statements, point-of-view statements, and user personas.	3
	Practical Exercise: Analyse user needs and frame well-defined problem statements	3
III	Ideate: Brainstorming, Steps in Brainstorming: Divergent-Convergent Thinking and Questioning,Prototype: Low-Fidelity	3

	Prototyping: Building rough, inexpensive prototypes using materials like paper, cardboard, or digital wireframes to quickly explore and iterate on ideas.Test: Gathering feedback from real users through interviews, surveys, or usability tests to evaluate prototypes and refine designs.	
	Practical Exercise: Design Thinking in a Team Environment. Create innovative ideas to solve real-world problems by applying the principles of Design Thinking	**3**
IV	Design Engineering Concepts: Modular Design and Life Cycle Design Approaches. Application of Biomimicry, Aesthetics and Ergonomics in Design. Design for Production, Use, and Sustainability. Design Communication: Communicating Designs Graphically, Communicating Designs Orally and in Writing.	**3**
	Practical Exercise: Apply the concepts of Modular design, Ergonomics and Aesthetics to address design challenges	**3**
V	Product Viability and Business Model: Customer Segments, Value Proposition, Market Opportunity, Cost- Revenue Relationship, Technology and Implementation, Competitive Analysis, Traction and Milestones.	**3**
	Practical Exercise: Create a Pitch deck and make a presentation of the idea generated along with its business model.	**3**
	Total	**30**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test	:	20 marks
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Understanding of User Needs and Problem Statement	:	10 marks
Creativity and Innovation in Solution Design	:	10 marks
Product Market Fit	:	10 Marks
Clarity and Effectiveness of Presentation	:	10 marks
Competitive Analysis	:	10 Marks
Individual and Teamwork	:	10 Marks
Maximum marks (Design Presentations)	:	**60 Marks**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23HSL2NA	Professional Ethics	HSC	2	0	0	0	1	2023

i) COURSE OVERVIEW

The objective of this course is to create an awareness on engineering ethics and human values. The course also aims to instill moral and social values, loyalty and also to learn to appreciate the rights of others

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Identify different skills required in personal life	Understand
CO2	Apply well-defined techniques to cope with emotion and stress	Apply
CO3	Solve moral and ethical problems in professional life	Apply
CO4	Explain the core values that shape the ethical behaviour of a professional	Understand
CO5	Solve moral and ethical problems through explorations and assessment by established experiments	Apply
CO6	Apply the knowledge of human values and social values to contemporary ethical values and global issues	Apply

iii) SYLLABUS

Meaning and significance of life skills. Life skills identified by WHO: Self- awareness, Empathy, Decision making, problem solving, interpersonal relationship, coping with stress, coping with emotion. Self-awareness: Definition, need for self-awareness; Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback Stress Management: Stress, reasons and effects, stress diaries, the four A's of stress management, techniques, approaches: action- oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude training

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques

Life skills for Professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, motivation, personality development, IQ, EQ and SQ Responsibilities and Rights.– Collegiality and loyalty- Managing conflict-Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity- conflicts of interest-occupational crime-professional rights-employee right-IPR discrimination

Engineering Ethics & Professionalism- Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles- Theories about right action- Self-Interest-Customs and Religion-uses of ethical theories

Engineering as social Experimentation- Engineering as Experimentation-Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law- Challenger case study- Bhopal gas tragedy

Global Ethical Issues- Multinational Corporations- Environmental Ethics-Business Ethics- Computer Ethics- Role in Technological Development-Engineers as Managers-Consulting Engineers- Engineers as Expert witnesses and Advisors-Moral leadership

iv) a) TEXTBOOKS

1. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, 1st Edition, 2016.
2. Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016
3. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012
4. R S Naagarazan, A textbook on professional ethics and human values, New age international (P) limited, New Delhi,2006.

b) REFERENCES

1. Barun K.Mitra, Personality Development & Soft Skills, Oxford Publishers, 3rd impression, 2017.
2. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2014.
3. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
4. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.

v) COURSE PLAN

Module	Contents	No. of hours
I	Overview of Life Skills: Meaning and significance of life skills Life skills identified by WHO: Self- awareness, Empathy, Decision making, problem solving, interpersonal relationship, coping with stress, coping with emotion. Self-awareness: Definition, need for self-awareness; Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback. Stress Management: Stress, reasons and effects, stress	5

Module	Contents	No. of hours
	diaries, the four A's of stress management, techniques, Approaches: action- oriented, emotion- oriented, acceptance-oriented, resilience, Gratitude Training, Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques	
II	Life skills for Professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, motivation, personality development, IQ, EQ, and SQ Collegiality and loyalty, Managing conflict, Respect for authority Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest-Occupational crime, Professional rights, Employee right, IPR, Discrimination	**5**
III	Senses of Engineering Ethics, Variety of moral issues, Types of Inquiry- Professionalism, Models of professional roles, Theories about right action-Self-Interest-Customs and Religion, Uses of Ethical Theories	**6**
IV	Engineering as Experimentation, Engineers as responsible Experimenters-Codes of Ethics, Plagiarism, A balanced outlook on law-Case study)	**8**
V	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics-Role in Technological Development, Moral leadership- Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	**6**
	Total	**30**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Continuous Assessment	: 15 marks
Case study	: 30 marks
Group project with presentation	: 50 marks
Total	**: 100 marks**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEP20A	Fluid Mechanics Laboratory	PCC	0	0	3	0	2	2023

PREREQUISITE: 23CEL20B Fluid Mechanics and Hydraulics

i) COURSE OVERVIEW

Objective of the course is to develop a platform where the students can enhance their engineering knowledge in the fluid mechanics domain by applying the theoretical knowledge acquired

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Apply the knowledge of fluid mechanics to calibrate the flow measuring devices by determining the hydraulic coefficients	Apply
CO 2	Apply the knowledge of fluid mechanics to determine the stability of floating bodies	Apply
CO 3	Apply the knowledge of fluid mechanics to verify the energy equation and to determine pipe friction coefficients	Apply
CO 4	Apply the knowledge of fluid mechanics to evaluate the performance of hydraulic machines	Apply

iii) SYLLABUS

Study of taps, valves, pipe fittings, gauges, pitot tube, water meter, current meter. Determination of hydraulic coefficients and calibration of flow measuring devices. Determination of stability of floating bodies. Energy equation and its applications. Performance tests on pumps and turbines.

iv) REFERENCES

1. Yunus A. Cenegel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications 4th edition, McGraw Hill, 2019
2. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell Fluid Mechanics, John Wiley and sons, 9th Edition,2016
3. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulic Machines, Standard Book House, New Delhi, 22nd Edition,2019

v) COURSE PLAN

Experiment No.	List of Exercises / Experiments	No. of hours
I	Study of taps, valves, pipe fittings, gauges, pitot tube, water meter, current meter	**3**
II	Determination of coefficient of discharge and calibration of notches	**3**
III	Determination of coefficient of discharge and calibration of orifice meter	**3**
IV	Determination of coefficient of discharge and calibration of venturimeter	**3**
V	Determination of hydraulic coefficients of orifice	**3**
VI	Determination of Chezy's Constant and Darcy's coefficient on pipe friction apparatus	**3**
VII	Verification of Bernoulli's theorem	**3**
VIII	Determination of metacentric height and radius of gyration of floating bodies	**3**
IX	Performance test on reciprocating pumps	**3**
X	Performance test on centrifugal pumps	**3**
XI	**Performance test on Pelton wheel**	**3**
XII	**Performance test on Francis turbine**	**3**
	Total hours	**36**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Classwork/Assessment/Viva- Voce	: 55 marks
Final Assessment	: 40 marks
Total	**: 100 marks**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEP20B	Surveying Laboratory	PCC	0	0	3	0	2	2023

i) COURSE OVERVIEW

Goal of this course is to impart practical experience to students by exposing them to various techniques in the field of surveying. The course is designed to make students familiar with conventional and advanced surveying instruments by conducting a field survey and to use modern plotting software to prepare the plan and contour maps.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the use of modern surveying equipment, along with other conventional ones	Understand
CO 2	Determine the various measurements of a given plot using Total Station	Apply
CO 3	Apply the principles of DGPS for traversing an area	Apply
CO 4	Apply the principles of surveying to prepare the plan and contour maps by conducting a field survey	Apply

iii) SYLLABUS

1. a) Introduction to modern surveying equipment, along with other conventional ones.

   b) Measurement of Distance and level difference between two accessible points using Theodolite

2. Computation of area enclosed between accessible points using Total Station

3. a) Measurement of distances, area and difference in elevation between inaccessible points using Total station

   b) Traversing using Total Station

4. a) Introduction to DGPS

   b) Traversing using DGPS

5. Survey Camp

iv) a) REFERENCES

1. James M Andersen and Edward M Mikhail, Surveying Theory and Practice, McGraw Hill Education, 7th Edition, 2017
2. B. C. Punmia, Ashok K Jain, Arun K Jain, Surveying (Vol. I and II), 16th Edition,Laxmi Publications (P) Ltd.,New Delhi, 2016
3. C. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited, 2nd Edition, 2011.

v) COURSE PLAN

Experiment No.	List of exercises/ experiments	No. of hours
I	a) Introduction to modern surveying equipments, along with other conventional ones	3
	b) Measurement of Distance and level difference between two accessible points using Theodolite	
II	Computation of area enclosed between accessible points using Total Station	3
III	a) Measurement of distances, area and difference in elevation between inaccessible points using Total station	3
	b) Traversing using Total Station	3
IV	a) Introduction to DGPS	3
	b) Traversing using DGPS	3
V	Survey Camp	*12
Survey camp duration is one week		
	Total hours	**30**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Survey Camp	: 25 marks
Classwork/Assessment/Viva- Voce	: 30 marks
Final Assessment	: 40 marks
Total	**: 100 marks**

MINOR COURSE

BASKET I

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2MA	Building Information Modelling	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the use of Building Information Modelling in building construction projects. Students will learn terminology associated with buildings, the theory and evolution of BIM and how to develop BIM models using softwares like Autodesk Revit.

ii) COURSE OUTCOMES

After the completion of the course the student will be able to:

CO 1	Explain the basic concepts of BIM	Understand
CO 2	Apply the concepts of BIM to create a model	Apply
CO 3	Apply the principles of integrated project delivery	Apply
CO 4	Apply 4D,5D BIM concepts in project scheduling	Apply

iii) SYLLABUS

Traditional AEC Business Model and its inefficiencies, Evolution of Engineering from 2D drawings to BIM Model, Isometric View, Limitation of Isometric views. Concept of 3D-Modeling, Building Information Modeling – Introduction & Process, Design Authoring– Concepts and workflow, Fundamentals of Discipline Based Modeling, Introduction to stages of BIM Modeling process as per ISO 19650

Creating Modeling Views- model layout-Architectural Modeling-Structural Modeling-MEP Modeling-Construction Modeling-Project Management-Revit Families-Tools and techniques-Project Phasing- Document and present the design-Analyze and design- Schedules-Rendering-walkthroughs. Clash Check – Types, Clash avoidance process, Clash Detection Process, Clash Detection Priority Matrix and Report generation, Clash Detection Rules, Report, Grouping, Clash Detection Process

Documentation and CDE (Common Data Environment) -2D drawings generated from BIM Model, Concept and Application of CDE: Traditional Information Sharing, Roles and Responsibilities. Concept of LOD (Level of Development), Definition of LOD, Level of Detail and Information, LOD- various elements of a structure, LOD- Chart, Matrix and Model Progression Matrix

Overview of BIM Execution Planning Procedure for BIM, Establishing Project Modeling Goals, Plan Infrastructure, Implementing BIM Project Execution Planning Procedure. Principles of Integrated Project Delivery- Collaborative Innovation and decision making, Setting-up of integrated project- Team Building, Functioning, defining roles, responsibilities. Delivering an integrated project- Building an Integrated team, Project execution, redefining Project Phases

Introduction to basic concept of 4D BIM, Concepts of 5D BIM, Concept and usages of BIM in field for safety, disaster and risk analysis, digital fabrication and scan to BIM. Emerging Trends- Concepts of Industrialization, IoT, Big Data, Data Analytics and their applications in BIM. Future scope of BIM Applications: Smart Infrastructure and the need for connected infrastructure, Digital twins- Concepts and benefits (Introduction only)

iv) a) TEXTBOOKS

1. Eastman. Chuck, Teicholz Paul, BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors, International 3rd edition, John Wiley & Sons Publications, 2018.
2. Martin Fisher, Howard W. Ashcraft,1st edition, Integrated Project Delivery, John Wiley & Sons Publications, 2017.

b) REFERENCES

1. Dominic Holzer, The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction,1st edition, John Wiley & Sons Publications, 2016.
2. Danelle Briscoe, Beyond BIM: Architecture Information Modeling, 1st edition, Routledge Publishers, 2016.
3. John Messner, Chinmay Anumba, Craig Dubler, BIM Project Execution Planning Guide, Version 3.0, Autodesk Revit User Guide, Autodesk.
4. ISO 19650-1, Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM), Information management using building information modelling, 1st edition, International Standard, 2018.

v) COURSE PLAN

Module	Contents	No. of hours
I	Traditional AEC Business Model and its inefficiencies, Evolution of Engineering from 2D drawings to BIM Model, Isometric View, Limitation of Isometric views. Concept of 3D-Modeling, Building Information Modeling – Introduction & Process, Design Authoring– Concepts and workflow, Fundamentals of Discipline Based Modeling, Introduction to stages of BIM Modeling process as per ISO 19650	9
	Creating Modeling Views- model layout-Architectural Modeling-Structural Modeling-MEP Modeling-Construction Modeling-Project Management-Revit Families-Tools and techniques-Project Phasing-	

II	Document and present the design-Analyze and design- Schedules-Rendering-walkthroughs. Clash Check – Types, Clash avoidance process, Clash Detection Process, Clash Detection Priority Matrix and Report generation, Clash Detection Rules, Report, Grouping, Clash Detection Process. (Topic to be demonstrated using software)	**10**
III	Documentation and CDE (Common Data Environment) -2D drawings generation from BIM Model, Concept and Application of CDE: Traditional Information Sharing, Roles and Responsibilities. Concept of LOD (Level of Development), Definition of LOD, Level of Detail and Information, LOD- various elements of a structure, LOD- Chart, Matrix and Model Progression Matrix	**8**
IV	Overview of BIM Execution Planning Procedure for BIM, Establishing Project Modeling Goals, Plan Infrastructure, Implementing BIM Project Execution Planning Procedure. Principles of Integrated Project Delivery- Collaborative Innovation and decision making, Setting-up of integrated project- Team Building, Functioning, defining roles, responsibilities. Delivering an integrated project- Building an Integrated team, Project execution, redefining Project Phases	**9**
V	Introduction to basic concept of 4D BIM, Concepts of 5D BIM, Concept and usages of BIM in field for safety, disaster and risk analysis, digital fabrication and scan to BIM. Emerging Trends- Concepts of Industrialization, IoT, Big Data, Data Analytics and their applications in BIM. Future scope of BIM Applications: Smart Infrastructure and the need for connected infrastructure, Digital twins- Concepts and benefits (Introduction only)	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

BASKET II

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2MC	Climate Change and Disaster Mitigation	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the fundamental concepts of Climate change and also introduces the concepts, tools, methods for disaster risk management, specifically for climate and weather-related disasters; role of policies and frameworks at international, national and sub-national contexts, with focus on emerging issues and recent developments.

ii) COURSE OUTCOMES

After the completion of the course the student will be able to:

CO 1	Utilize the fundamental concepts and terminology related to disaster management cycle to identify the vulnerability of the country	Apply
CO 2	Explain the factors affecting climate change and the harmful impacts due to climate change	Understand
CO 3	Make use of the core elements and phases of disaster risk management and measures to reduce disaster risks across sector and community	Apply
CO 4	Explain the legislation's and best practices for disaster management and risk reduction at national and international level	Understand

iii) SYLLABUS

Environment-development and disasters; Disaster typology and classification; Basic concepts and Terminologies DRR and its evolution, DRM, Emergency, Response, Relief; Resilience, Reconstruction, Recovery; Hydro meteorological and related disasters; Disaster vulnerability of the region/country.

Meteorology and climatology, Composition and structure of atmosphere. Factors influencing Climate; Atmospheric stability, Lapse rate, Inversions, Types of inversions; Cyclones and Anticyclones.

Climate change, climate variability and implications on disaster risk; Climatic extreme events and disasters–global, regional and national scenario, predictions and projections. Climate change effects on disaster vulnerabilities; Recent hydro-met disasters.

Risk Assessments, Risk Mapping, Preparedness theories, Community resilience; Approaches in disaster management; Structural and non-structural measures of mitigation for hydro-met disasters, extremes and health risks.

Crisis management, Early warning and communication, Emergency response, Local preparedness, Relief management-Shelter Common disaster legislations in India on disaster management, Institutional arrangements for disaster management in India, The Sendai Framework for Disaster risk reduction and targets.

iv) a) TEXTBOOKS

1. D.P. Coppola, Introduction to International Disaster Management, Elsevier Science (B/H), London, 2020.
2. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
3. M.M. Sulphey, Disaster Management, PHI Learning, 2016
4. Rajib Shaw and R.R. Krishnamurthy). Disaster Management: Global Challenges and Local Solutions. Universities Press (India) Pvt. Ltd. 2009.
5. Ross Prizzia , Climate Change and Disaster Management. Sentia Publishing, USA, 2015
6. Anil K Gupta, S S Nair, S Chatterji and Florian B-Lux. Disaster Management and Risk Reduction, Narosa Publishing New Delhi,2015.

b) REFERENCES

1. NDMA, National Policy on Disaster Management, Ministry of Home Affairs, Government of India,2009
2. National Disaster Management Division, Disaster Management in India - A Status Report, Ministry of Home Affairs, Government of India, New Delhi,2004
3. National Disaster Management Plan, NDMA, Ministry of Home Affairs, Government of India,2019
4. Disaster Management Training Manual, UNDP, 2016
5. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 201.

v) COURSE PLAN

Module	Contents	No. of hours
I	Environment-development and disasters; Disaster typology and classification; Basic concepts and Terminologies-Hazard, Risk, Vulnerability, Disaster, Mitigation, DRR and its evolution, DRM, Emergency, Response, Relief; Resilience, Reconstruction, Recovery; Hydro meteorological and related disasters; Disaster vulnerability of the region/country, Case study using Earthquake hazard map App for India.	9

II	Meteorology and climatology, Composition and structure of atmosphere; Factors influencing Climate-Insolation, Temperature, Humidity, Pressure, Wind, Precipitation, Topography; Atmospheric stability, Lapse rate, Inversions, Types of inversions. Cyclones and Anticyclones.	**9**
III	Climate change, climate variability and implications on disaster risk; Climatic extreme events and disasters–global, regional and national scenario, predictions and projections; Climate change effects on disaster vulnerabilities environmental & land/geography, social-economic, health, infrastructure, systems, etc.; Recent hydro-met disasters. Climate change issues for human security, national security.	**9**
IV	Risk Assessments, Risk Mapping, Preparedness theories, Community resilience; Approaches in disaster management–Engineering centric, CBDP, Indent management, ecoDRR. Structural and non-structural measures of mitigation–for hydro-met disasters, extremes and health risks.	**9**
V	Crisis management, Early warning and communication, Emergency response, Local preparedness, Relief management-Shelter Common disaster legislations in India on disaster management National disaster management policy, Institutional arrangements for disaster management in India. The Sendai Framework for Disaster risk reduction and targets- priorities for action, guiding principles.	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

BASKET III

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2ME	Traffic Engineering	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

The objective of this course is to impart in-depth knowledge pertinent to traffic flow characteristics, traffic regulations, traffic management and control measures, traffic operations, design of road intersections and road safety.

ii) COURSE OUTCOMES

After the completion of the course the student will be able to:

CO 1	Explain the relationship among various traffic stream variables	Understand
CO 2	Apply traffic management measures, control measures and regulations to solve issues related to traffic flow in the road network	Apply
CO 3	Analyse accident data and suggest countermeasures	Apply
CO 4	Plan various traffic surveys and interpret the collected data	Apply

iii) SYLLABUS

Traffic Flow Characteristics- Fundamental Parameters- time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow

Traffic Surveys - Data collection and Analysis- sampling in traffic studies

Traffic stream models- Single Regime models - Multi-regime models- Two and three regime linear models, Capacity and Level of service (LOS)- Base capacity- adjusted capacity- Homogeneous and heterogeneous traffic conditions- Concept of PCU.

Regulation of Traffic- Motor Vehicle Act- Enforcement of regulations, Traffic Management measures

Traffic Control Measures - Traffic Signs- Road Markings and Traffic control aids, Intersections- At-grade intersections- basic forms- conflict points- visibility triangle- design principles- Channelization, Roundabouts - Geometric layout- design elements, Grade separated intersection without interchange and with interchange

Traffic Signals Warrants- pre-timed and traffic actuated, Design of signal timing at isolated intersections - Phase design - timing diagram

Traffic Safety- Road Safety Situation in India, Causes of road accidents, Pedestrian Safety, Collection and statistical analysis of accident data, Collision and condition diagram, Road safety audit

iv) a) TEXTBOOKS

1. Roger P. Roess, William R. Mc Shane and Elena S. Prassas, Traffic Engineering, 5th edition, Prentice-Hall, 2019
2. C.S. Papacostas, P. D. Prevedouros Transportation Engineering and Planning, Prentice-Hall India, 3rd Edition, 2015

b) REFERENCES

1. C. Jotin. Khisty and B. Kent. Lall, Transportation Engineering: An Introduction, Prentice- Hall India, 3rd Edition, 2002.
2. Fred L. Mannering and Scott S. Washburn, "Principles of Highway Engineering and Traffic Analysis", Wiley, 7th Edition 2020
3. Mike Slinn, Paul Matthews, Peter Guest, "Traffic Engineering Design – Principles and Practice", Butterworth-Heinemann, 2nd Edition 2005

v) COURSE PLAN

Module	Contents	No. of hours
I	Traffic Flow Characteristics: Fundamental Parameters- speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow. Traffic Surveys - Data collection and Analysis - Measurement oftraffic parameters, sampling in traffic studies	9
II	Traffic stream models: Single Regime models - Greenshields model, Greenberg logarithmic model, multi-regime models Two and three regime linear models. Capacity and Level of service (LOS): Concept- Base capacity, adjusted capacity, LOS definition, Factors affecting Capacity and LOS, Homogeneous and heterogeneous traffic conditions- vehicle types - Concept of PCU.	9
III	Regulation of Traffic Need and scope of traffic regulations- Motor Vehicle Act Regulation of speed- Regulation of vehicles Regulations concerning driver- General rules concerning traffic- parking regulations- Enforcement of regulations. Traffic Management - Scope of traffic management measures - Restrictions to turning movements – One-way streets - Tidal flow operations - Closing side streets - Exclusive bus lanes, Exclusive two wheeler lanes	9

IV	Traffic Control Measures - Traffic Signs, Road Markings, and Traffic control aids. Intersections: At-grade intersections- basic forms- conflict points - visibility triangle - design principles - Channelization. Roundabouts - Geometric layout, types - design elements- Grade separated intersection: grade separated intersections without interchange and with interchange	**9**
V	Traffic Signals Warrants- pre-timed and traffic actuated. Design of signal timing at isolated intersections - Phase design - timing diagram Traffic Safety: Road Safety Situation in India, Causes of road accidents influence of road, vehicle, driver and environmental factors - Pedestrian Safety, Collection and statistical analysis of accident data, Collision and condition diagram, Road safety audit	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Continuous Assessment Test (2 Numbers)	: 10 marks each
Assignment/Project/Case study etc.	: 15 marks
Total	**: 40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	: 2
Maximum marks	: 30 Marks
Test Duration	: 1.5 hours
Topic	: 2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	: **60 Marks**
Exam Duration	: 3 Hours

SEMESTER 4

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL20D	Probability, Statistics and Numerical Methods	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW

This course introduces students to the modern theory of probability and statistics, covering important models of random variables and techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarizes students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations, and solving ordinary differential equations which are especially useful when analytical solutions are hard to find

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Identify the different discrete random experiments and find the probabilities of their occurrence	Apply
CO2	Identify the different continuous random experiments and find the probabilities of their occurrence	Apply
CO3	Use statistical inference to draw conclusions concerning characteristics of a population based on attributes of samples drawn from the population	Apply
CO4	Find roots of equations, definite integrals and interpolating polynomial on given numerical data using standard numerical techniques	Apply
CO5	Apply standard numerical techniques for solving systems of equations, ordinary differential equations and for fitting curves on given numerical data	Apply

iii) SYLLABUS

Discrete random variables and their probability distributions, Binomial distribution, Poisson distribution, Discrete bivariate distributions, Expectation -multiple random variables.

Continuous random variables and their probability distributions -Uniform, exponential and normal distributions, Continuous bivariate distributions, Expectation-multiple random variables, i.i.d random variables and Central limit theorem.

Population and samples, Sampling distribution of the mean and proportion. Test of hypotheses Concerning mean and proportion. Confidence interval.

Roots of equations- Newton-Raphson, regula falsi methods. Interpolation-finite differences, Newton's forward and backward formula, Newton's divided difference method, Lagrange's method. Numerical integration.

Solution of linear Systems-Gauss-Seidel and Jacobi iteration methods. Curve fitting- method of least squares, Solution of ordinary differential equations -Euler and Classical Runge-Kutta method of second and fourth order, Adams- Moulton predictor-corrector method

iv) a) TEXTBOOKS

1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th edition, Cengage, 2012
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016

b) REFERENCES

1. Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, Introduction to probability and statistics for engineers and scientists, 4th edition, Elsevier, 2009
3. T. Veera Rajan, Probability, Statistics and Random processes, Tata McGraw-Hill, 2008
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

v) COURSE PLAN

Module	Contents	No. of hours
I	Discrete random variables and probability distributions, expected value, mean and variance (discrete) Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial- Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	12
II	Continuous random variables and probability distributions, expected value, mean and variance (continuous)-Uniform, exponential and normal distributions, mean and variance of these distributions Continuousbivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	12
III	Population and samples, Sampling distribution of single mean and single proportion (large samples) Confidence interval for single mean and single proportions (large samples) Hypothesis testing basics, large sample test for single mean and single proportion Large sample test for equality of means and equality of proportions of two populations-t-distribution and small sample t-test for single mean and pooled t-test for equality of means	12

IV	Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula Falsi method. Interpolation-finite differences, Numerical integration- Trapezoidal rule and Simpson's 1/3rd rule (Proof or derivation of the formulae not required for any of the methods in this module)	**12**
V	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares -Solution of ODE-Euler and Classical Runge - Kutta methods of second and fourth order- Adams-Moulton predictor corrector methods	**12**
	Total hours	**60**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Continuous Assessment Test (2 Numbers)	: 10 marks each
Assignment/Project/Case study etc.	: 15 marks
Total	**: 40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL20D	Structural Analysis	PCC	3	1	0	0	4	2023

PREREQUISITE: 23CEL20A Mechanics of Structures

i) COURSE OVERVIEW

The course enables the students to analyse various types of simple structures using appropriate methods and tools. It introduces the applications of principles of mechanics of solids to determine stress resultants in statically determinate and indeterminate structures. Specific cases of cables, suspension bridges and arches are also discussed at length. The students will be able to analyse structures subjected to moving loads as well. The course utilizes the procedures of force methods and displacement methods for analysing framed structures. Principles of dynamics to analyse structures while undergoing dynamic deformations is made familiar with. The course trains the students to develop mathematical models and helps to sharpen their analytical skills.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the concept of statically determinate and indeterminate structures.	Understand
CO 2	Apply the concept of Influence Line Diagrams to interpret the effect of moving loads on beams, arches and cables.	Apply
CO 3	Apply energy methods to study the displacement response of statically determinate structural systems.	Apply
CO 4	Analyse indeterminate beams and portal frames.	Analyse
CO 5	Analyse trusses and frames using stiffness and flexibility methods.	Analyse

iii) SYLLABUS

Arches: Theory of arches – Eddy's theorem - analysis of three hinged arches- Support reactions- normal thrust and radial shear at any section of a parabolic arch and circular arch due to simple cases of loading. Moving loads and influence lines: Introduction to moving loads - concept of influence lines- influence lines for reaction, shear force and bending moment in simply supported beams and overhanging beams

Elastic theorems and energy principles, Principle of least work, Application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames, Introduction to force and displacement Methods- Method of Consistent deformations

Slope Deflection Method: Analysis of continuous beams and portal frames without sway. Moment Distribution Method: Analysis of beams and frames – non-sway analysis.

Approximate methods (continued): Wind load analysis of multi-storeyed frames – portal method and cantilever method for lateral load analysis.

Matrix analysis of structures: Definition of flexibility and stiffness influence coefficients - Concepts of physical approach Flexibility method: flexibility matrices for truss and frame elements- load transformation matrix-development of total flexibility matrix of the structure-analysis of simple structures-plane truss and plane frame-nodal loads and element loads.

Stiffness method: Development of stiffness matrices by physical approach-stiffness matrices for truss and frame elements- displacement transformation matrix-analysis of simple structures- plane truss and plane frame-nodal loads and element loads.

iv) a) TEXTBOOKS

1. Devdas Menon, Structural Analysis, Narosa Publications, 3rd Edition, 2023
2. S. S. Bhavikatti, Structural Analysis I & II, Vikas Publishing House Ltd., 5th Edition, 2021
3. R. C. Hibbeler, Structural Analysis, Pearson Education, New Delhi, 9th Edition, 2017
4. G. S. Pandit and S. P. Gupta, Structural analysis – A Matrix Approach, Tata McGraw Hill, New Delhi, 2nd Edition, 2008

b) REFERENCES

1. Dr. R. Vaidyanathan and Dr. P. Perumal, Comprehensive Structural Analysis Volume I & II, Laxmi Publications (P) Ltd, 4th Edition, 2019
2. William Weaver, Jr. and James M. Gere, Matrix analysis of framed structures, CBS Publishers, New Delhi, 2nd Edition, 2018
3. A. Ghali A., A. M. Neville and T. G. Brown, Structural Analysis – A unified classical and matrix approach, CRC Press, 7th Edition, 2017
4. C. K. Wang, Intermediate Structural Analysis, McGraw Hill, 1st Edition,2017
5. P. N. Chandramouli, Structural Analysis I – Analysis of Statically Determinate Structures, Yes Dee Publishing Pvt Ltd., Chennai, Tamil Nadu, 1st Edition,2015

v) COURSE PLAN

Module	Contents	No. of hours
I	Arches: Theory of arches – Eddy's theorem - analysis of three hinged arches- Support reactions-normal thrust and radial shear at any section of a parabolic arch due to simple cases of loading. Moving loads and influence lines: Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and overhanging beams - analysis single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span	12
II	Elastic theorems and energy principles: strain energy due to axial load, bending moment, shear and torsion - strain energy method, Castigliano's method for deflection Derivations only). Principle of least work; Application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames - pin jointed trusses (simple numerical problems). Introduction to force and displacement Methods. Method of Consistent deformations: Analysis of beams frames and trusses with internal and external redundancy (Simple problems with maximum one redundant – Illustration only for two redundant).	14
III	Slope Deflection Method: Analysis of continuous beams and portal frames without sway. Frames with sway (illustration only). Settlement effects (derivation only). Moment Distribution Method: Analysis of beams and frames – non-sway analysis. Sway analysis (illustration only). Introduction to structural analysis software (hands on exercises on two simple structural analysis problems). Approximate methods: Wind load analysis of multi storied frames – portal method and cantilever method for lateral load analysis.	15
IV	Matrix analysis of structures: Definition of flexibility and stiffness influence coefficients - Concepts of physical approach Flexibility method: flexibility matrices for truss and frame elements- load transformation matrix-development of total flexibility matrix of the structure-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effect	10

Module	Contents	No. of hours
V	Stiffness method: Development of stiffness matrices by physical approach-stiffness matrices for truss and frame elements-displacement transformation matrix-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects.	9
	Total hours	**60**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Continuous Assessment Test (2 Numbers)	: 10 marks each
Assignment/Project/Case study etc.	: 15 marks
Total	**: 40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	: 2
Maximum marks	: 30 Marks
Test Duration	: 1.5 hours
Topic	: 2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	: **60 Marks**
Exam Duration	: 3 Hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL20E	Hydrology and Water Resources Engineering	PCC	4	0	0	0	4	2023

i) COURSE OVERVIEW

The general objective of this course is to expose the students to the fundamental concepts of surface and groundwater components of hydrology and basics of water resources engineering. The course aims to impart the knowledge on the availability of water on hydrosphere, its storage, distribution and quantification, scientific methods for computing irrigation water requirements, reservoir engineering.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the surface and subsurface hydrology, principles of irrigation and irrigation structures.	Understand
CO 2	Identify the different components of the hydrologic cycle for analyzing hydro-meteorological data and to develop flood hydro graph.	Apply
CO 3	Make use of principles of irrigation engineering for effective irrigation management.	Apply
CO 4	Apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life.	Apply
CO 5	Make use of principles of groundwater engineering for computing the yield of aquifers and wells	Apply

iii) SYLLABUS

Hydrologic cycle, Precipitation- measurement using rain gauges, representation of rainfall data, computation of mean precipitation over a catchment; Infiltration, Evaporation.

Catchment Characteristics, Runoff, Hydrograph Analysis, Unit Hydrograph-Computation of storm/flood hydrograph of different duration by method of superposition and by development of S–Hydrograph; Floods-methods of design-flood estimation

Irrigation– Types; Soil-water –plant relationships. Irrigation efficiencies, Computation of crop water requirement, Duty and delta.

Types of Dam, Spillways, Stilling Basins- Reservoirs- types, Reservoir sedimentation, computation of life of reservoir;Diversion head works -Canal Falls-Cross drainage works-Canal type.

Vertical distribution of groundwater-Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers, Types of wells and tube well; Yield of open well.

iv) a) TEXTBOOKS

1. Sharad K Jain and Vijay P Singh, Engineering Hydrology, 1st edition, McGraw Hill, 2019
2. G.L.Asawa, Irrigation and Water Resources Engineering, 4th edition, New Age International New Delhi, 2008
3. K. Subramanya, Engineering Hydrology, 5th edition, Tata McGraw Hill, 2020
4. B.C. Punmia, Ashok K Jain, Arun K Jain, Pande B. B. L., Irrigation and Water Power Engineering, 17th Edition, Laxmi Publications (P) Ltd, 2021

b) REFERENCES

1. P. N. Modi, Irrigation, Water Resources and Water Power Engineering, 11thedition S.B.H Publishers and Distributors New Delhi , 2020
2. S.K.Garg, Irrigation Engineering and Hydraulic Structures, 38th edition, Khanna Publishers New Delhi, 2023
3. H.M.Raghunath, Hydrology: Principles, Analysis and Design, 3rdedition, New Age International New Delhi ,2015
4. Ven Te Chow, Handbook of Applied Hydrology,1st edition ,Tata McGraw Hill, 2017

v) COURSE PLAN

Module	Contents	No. of hours
I	Hydrologic cycle-precipitation-mechanism, types, forms and measurement using rain gauges, Optimum number of rain gauges, estimation of missing precipitation, representation of rainfall data-mass curve and hyetograph, computation of mean precipitation over a catchment, probable maximum precipitation; IDF curves. Infiltration-measurement by double ring infiltrometer, Horton's model, infiltration indices. Evaporation –measurement by IMD land pan, control of evaporation.	12
II	Catchment Characteristics –Classification of stream- Stream pattern and stream order. Runoff-factors affecting runoff-Hydrograph Analysis-Hydrograph from isolated storm-Base flow separation. Unit hydrograph – uses, assumptions and limitations of unit hydrograph theory. Computation of storm/flood hydrograph of different duration by method of superposition and by development of S– Hydrograph. Floods-methods of design-flood estimation –Empirical methods, SPF and PMF, Return period.	12

III	Irrigation– Necessity, Benefits and ill effects. Types: flow and lift irrigation -perennial and inundation irrigation. Soil-water –plant relationships. Irrigation efficiencies, Computation of crop water requirement- depth and frequency of Irrigation. Duty and delta, duty-factors affecting and method of improving duty, Computation of crop water requirement by using the concept of duty and delta.	**12**
IV	Types of Dam- Gravity and Arch dam- Spillways, Stilling Basins- Reservoirs- types, zones, yield of reservoir, determination of storage capacity and yield by mass curve method, Reservoir sedimentation and control- trap efficiency- computation of life of reservoir. Diversion head works -Canal Falls-Cross drainage works- Canal type-Lacey's and Kennedy's theory-Design of lined and unlined canal.	**12**
V	Vertical distribution of ground water- classification of saturated formation, Aquifer properties, Darcy's law, well hydraulics-Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers, Types of wells and tubewell; Yield of open wells-pumping test and recuperation test	**12**
	Total hours	**60**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CEB20F	Water and Wastewater Engineering	PCC	4	0	2	0	5	2023

i) COURSE OVERVIEW

This course aims to introduce students to quality analysis, quantity estimation and treatment technologies for water and wastewater. The course details the components of the water supply scheme, treatment processes and water distribution system. The course also introduces the components of sewerage systems, purification processes for wastewater and its safe disposal

ii COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the components of water supply and sewerage system and the treatment processes for water and wastewater	Understand
CO 2	Estimate water demand using population forecasting methods and the quantity of sewage generated for a given population	Apply
CO 3	Apply the standard procedure to design the units for the treatment of water and wastewater based on the given specifications	Apply
CO 4	Apply network analysis methods to determine the distribution of flow of water for a given pipe network	Apply
CO 5	Analyze the suitability of the given water and wastewater samples for its intended use	Analyse

iii SYLLABUS

Introduction to Water and Wastewater Engineering- Sources of water supply, Water Demand-Types-Quantification of water demand using population forecasting methods, Components of a water supply scheme, Water quality analysis- Drinking water standards.

Layout of a conventional water treatment plant, Unit operations and processes, Screening, Aeration, Sedimentation, Coagulation and Flocculation, Filtration.

Disinfection of water- Minor Methods of disinfection, Chlorination, Miscellaneous treatment methods, Layout of water distribution network, Methods of distribution, Pipe Network analysis.

Wastewater- Sources-Types, Sewerage systems, Quantitative estimation of wastewater, wastewater quality characterization - wastewater discharge standards, Layout of a conventional wastewater treatment plant, Wastewater treatment - preliminary- primary-

secondary - tertiary treatment, Advanced treatment technologies, Wastewater reuse & recycling, Standards for reuse, greywater reuse options.

Anaerobic treatment of high-strength wastewater- anaerobic degradation processes- applications- anaerobic reactor systems, Natural wastewater treatment systems, Low-cost sanitation systems, Sludge management.

iv a) TEXTBOOKS

1. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw Hill Education, 2017
2. Metcalf & Eddy, George Tchobanoglous, Franklin Burton and H. David Stensel, Wastewater Engineering; Treatment and Reuse, McGraw Hill Education, 4th edition, 2017
3. Mackenzie Davis, David Cornwell, Introduction to Environmental Engineering, McGraw Hill Education, 5th edition, 2017
4. G. S., Birdie and J.S. Birdie, Water Supply and Sanitary Engineering, DhanpatRai Publishing Company Ltd., 2010
5. Santosh Kumar Garg, Sewage Disposal and Air Pollution Engineering, Khanna Publishers, 41st edition, 2021
6. Arcadio P. Sincero and Gregoria A. Sincero, Environmental Engineering: A Design Approach, Pearson Education Services Pvt.Ltd., 2nd edition, 2016

b) CODES OF PRACTICE

1. Standard Methods for the Examination of Water and Wastewater, 23rd edition, American Public Health Association, American Water Works Association, Water Environment Federation, 2017.
2. IS: 10500:2012 Drinking Water- Specification, Second revision, Bureau of Indian Standards, 2012.
3. General Standards for Discharge of Environmental Pollutants under Environmental (Protection) Rules, 1986, Government of India.

c) REFERENCES

1. Soli J. Arceivala and Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGraw Hill Education, 3rd edition, 2007
2. Syed R. Qasim, Wastewater Treatment Plants- Planning, Design & Operation, Routledge, 2nd edition, 2017.

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Water and Wastewater Engineering- Role of Environmental Engineers- Public health perspective for treating water and wastewater Sources of water supply, Water Demand- Types- Per capita water demand- Factors affecting consumption- Fluctuations in demand Quantification of water demand through population forecasting methods Components of a Water Supply Scheme Quality of water - Drinking water standards - Physical, chemical and biological characteristics	10
	Laboratory experiments: Determination of pH, Electrical Conductivity, Turbidity, Acidity, Alkalinity	6
II	Layout of a conventional water treatment plant, Concept of unit operations and processes Screening-Purpose- Types, Aeration- Purpose- Types of aerators Sedimentation-Theory and principle of Sedimentation tanks- Stoke's law-Types of settling - Design of Plain Sedimentation tank Coagulation and Flocculation- Mechanism- Popular coagulants- Feeding devices, Clariflocculator, Lamella clarifiers, Sludge blanket clarifier, Pulsator clarifier, Use of coagulant aids Filtration-Theory- Types of filters, Working and design of Rapid sand filter- operational troubles and remedial measures, Pressure filters, Dual media filters, Mixed media filters, Microfiltration, Reverse Osmosis	12
	Laboratory experiments: Determination of DO, Optimum coagulant dosage, Iron	6
III	Disinfection of water- Minor Methods of disinfection, Chlorination- Types- Factors affecting chlorination- Chlorine demand Miscellaneous treatment methods- Removal of colour, odour, taste- Removal of salts and dissolved solids from water- Fluoridation and Defluoridation- Removal of iron and manganese Layout of water distribution network, Methods of distribution, Network analysis using Hardy Cross Method, Equivalent Pipe Method, EPANET	12
	Laboratory experiments: Determination of Solids, Residual chlorine, Break-point chlorination, Total Coliforms (MPN test)	6

IV	Wastewater- Sources, Types of sewage and sewerage systems, Components of sewerage system, Quantitative estimation of wastewater - Dry weather flow- Storm water flow- Peak flow and lean flow Wastewater quality characterisation -Physical-Chemical- Biological parameters, Wastewater discharge standards Layout plan of a conventional wastewater treatment plant, Wastewater treatment units and processes- preliminary, primary, secondary and tertiary treatment Secondary treatment - biological treatment processes- aerobic and anaerobic- attached and suspended growth processes, Activated sludge process- concepts- design of a conventional Activated Sludge Plant, Trickling filter- concepts- Design of Trickling filter Advanced treatment technologies- MBBR, SBR, Membrane Biofilm Reactor Wastewater reuse & recycling, Standards for reuse, greywater reuse options	**14**
	Laboratory experiments: Determination of BOD, COD, Nitrates	**6**
V	Anaerobic treatment of high-strength wastewater- anaerobic degradation processes- applications- anaerobic reactor systems- Up flow Anaerobic Sludge Blanket (UASB) reactor Natural wastewater treatment systems- Oxidation Ponds and Lagoons- Constructed Wetlands Low cost sanitation systems- Design of a septic tank and soak-pit Sludge management - thickening- digestion- dewatering- drying- incineration-composting- disposal, Sludge digestion and Biogas production	**12**
	Laboratory experiments: Determination of Sulphates, Phosphates	**6**
	Total	**90**

CYCLE OF EXPERIMENTS

Exp. No.	Experiment	No. of hours
1	Determination of pH , Electrical conductivity, Turbidity	2
2	Determination of Acidity	2
3	Determination of Alkalinity	2
4	Determination of Dissolved Oxygen	2
5	Determination of optimum coagulant dosage	2
6	Determination of Iron	2

7	Determination of Solids	2
8	Determination of Residual Chlorine, Breakpoint chlorination	2
9	Determination of Total Coliforms (MPN)	2
10	Determination of Biochemical Oxygen Demand (BOD)	2
11	Determination of Chemical Oxygen Demand (COD)	2
12	Determination of Nitrates	2
13	Determination of Sulphates	2
14	Determination of Phosphates	2
	Remedial class	2
	Total	**30**

vi) CONTINUOUS ASSESSMENT

Attendance	:	5 marks
Continuous Assessment Tests	:	20 marks
Assignment	:	15 marks
Assessment of Lab work	:	10 marks
Lab exam	:	10 marks
Total	:	**60 marks**

vii) END SEMESTER EXAMINATION

Maximum marks	:	**40 Marks**
Exam Duration	:	2 Hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23HSL2NB	Universal Human Values - II	HSC	2	1	0	0	1	2023

i) COURSE OVERVIEW

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS'
- To facilitate the development of a Holistic perspective among students towards life and profession leading towards a value-based living
- To help the students to have ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with nature.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Understand themselves and their surroundings (family, society, nature)	Understand
CO2	Show more Commitment towards what they have learnt about Human values, Human relationship and Human society	Understand
CO3	Apply Sustainable Solutions to Real Life problems based on the learning gained through Universal Human Values	Apply

iii) SYLLABUS

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I
Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
Continuous Happiness and Prosperity- A look at basic Human Aspirations
Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
(Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking)

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
Understanding the characteristics and activities of 'I' and harmony in 'I'

Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
Programs to ensure Sanyam and Health.

(Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease)

Understanding Harmony in the Family and Society- Harmony in Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
Understanding the meaning of Trust; Difference between intention and competence
Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

(Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives)

Understanding Harmony in the Nature and Existence - 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 Existence as Coexistence of mutually interacting units in all pervasive space
Holistic perception of harmony at all levels of existence.
Include practice sessions to discuss human beings as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values
Definitiveness of Ethical Human Conduct
Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order
b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems
Strategy for transition from the present state to Universal Human Order

a. At the level of individuals: as socially and ecologically responsible engineers, technologists and managers.
b. At the level of society: as mutually enriching institutions and organizations
Sum up.

(Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg.To discuss the conduct as an engineer or scientist etc.)

vi) a) TEXTBOOKS

1. Gaur P.R, Asthana R, Bagaria G.P, Human Values and Professional Ethics (2nd revised Edition) Excel Books, New Delhi, 2019
2. Tripathi A. N, Human Values, New Age Intl. Publishers, New Delhi, 2004

b) REFERENCES

1. Gaur R.R, Sangal R, Bagaria G P 'A Foundation Course in Human Values and Professional Ethics (Teacher Manual), Excel Books, 1stEdition 2013
2. Parichaya E K, Nagaraj A, JeevanVidya, Jeevan Vidya Prakashan, Amarkantak, 1999
3. Mohandas KGandhi, 'The story of my Experiments with Truth' Fingerprint,2009
4. Cecile Andrews 'Slow is Beautiful', New Society Publishers,2006
5. Kumarappa J C Economy of Permanence, Sarva Seva Sangh Prakashan, 2017

v) COURSE PLAN

Module	Contents	No. of hours
I	Understanding Value Education,Self Exploration as the process for Value Education, Sharing about oneself, Understanding Happiness and Prosperity-the Basic Human Aspirations, Right Understanding, Relationship, Physical Facility, Exploring Human Consciousness Happiness and Prosperity- Current Scenario, Method to Fulfil the Basic Human Aspirations, Exploring Natural Acceptance	9
II	Understanding Human Being as the Co-existence of the Self and Body, Distinguishing between the needs of the Self and the Body Exploring the difference of needs of the Self and the Body, The Body as an Instrument of the Self Understanding Harmony in the Self Exploring Sources of Imagination in the Self, Harmony of the Self with the Body Programme to ensure Self Regulation and Health, Exploring Harmony of Self with the Body	9

III	Harmony in the Family-the Basic unit of Human Interaction, Values in the Human-to-Human Relationship, 'Trust' –the foundation Value in Relationship, Exploring the feeling of Trust, 'Respect'- as the Right Evaluation, Exploring the feeling of Respect, Understanding Harmony in the Society, Vision for the Universal Human Order, Exploring Systems to fulfil Human Goal	**9**
IV	Understanding Harmony in the Nature, Interconnectedness, self regulation and Mutual Fulfilment among the four orders of Nature, Exploring the four orders of Nature, Realizing Existence as Coexistence at all Levels,The Holistic Perception of Harmony in Existence, Exploring Co-Existence in Existence	**9**
V	Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, Exploring Ethical Human Conduct, A Basis for Humanistic Education,Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Exploring Humanistic Models in Education, Holistic Technologies, Production Systems and Management-Models- Typical Case Studies,Strategies for Transition towards Value –based Life and Profession, Exploring Steps of Transition towards Universal Human Order	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Continuous Assessment Test (1 numbers)	: 10 marks
Assignment/Project/Case study etc.	: 20 marks
Self Assessment	: 5 marks
Peer Assessment	: 5 marks
Total	**: 40 marks**

vii) END SEMESTER EXAMINATION

The End semester examination will be conducted by the faculty. The examination will be for three hours and **60 marks**.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23ESL2NC	INDUSTRIAL SAFETY ENGINEERING	ESC	2	1	0	0	1*	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the concepts of safety engineering and identify possible safety requirements. It introduces students to the various safety equipment and precautions. After this course, students will be able to recognize similar safety problems in real-world situations and respond accordingly

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Explain the theories of accident causation and preventive measures of industrial accidents	Understand
CO2	Explain personal protective equipment, its selection, safety performance & indicators and importance of housekeeping.	Understand
CO3	Explain the various hazards and associated safety measures in construction industries.	Understand
CO4	Explain various hazards associated with different machines and mechanical systems	Understand
CO5	Explain different hazard identification tools in different industries with the knowledge of different types of chemical hazards	Understand

iii) SYLLABUS

Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management.

Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Typical industrial models and methodology.

Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space –

Temporary Structures. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding, Material Handling equipment-operation & maintenance. Hearing Conservation Program in Production industries.

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - Hazard and Operability study (HAZOP)) –Hazardous properties of chemicals, Material Safety Data Sheets

iv) a) TEXTBOOKS

1. **R.K Jain (2000)** Industrial Safety, Health and Environment management systems, Khanna Publications.
2. **Paul S V (2000),** Safety management System and Documentation training Programme handbook, CBS Publication.
3. **Krishnan, N.V. (1997).** Safety management in Industry. Jaico Publishing House, New Delhi.

b) REFERENCES

1. AIChE/CCPS. (1992). Guidelines for Hazard Evaluation Procedures. (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.
2. Alan Waring. (1996). Safety management system. Chapman & Hall, England

v) COURSE PLAN

Module	Contents	No. of hours
I	Need for safety- Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation - Safety, organization- objectives, types, functions, Role of management - supervisors, workers, unions, government and voluntary agencies in safety. Safety policy- Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.	9

II	Personal protection in the work environment -Types of PPEs, Personal protective equipment-respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance - Frequency rate, severity rate, incidence rate, activity rate. Housekeeping- Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits.	**9**
III	Introduction to construction - industry and safety issues in construction. Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds. Tunneling – Blasting , Demolition – Confined space –Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.	**9**
IV	Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements- wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.	**9**
V	Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis. Hazard and Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up. Control of Chemical Hazards- Hazardous properties of chemicals, Material Safety Data Sheets	**9**
	Total	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 100: 0

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
Final Assessment (Summative)	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1½ hours
- Topics: 2 ½ modules

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEP20C	Material Testing Lab I	PCC	0	0	2	0	1	2023

PREREQUISITE: 23CEL20A Mechanics of Structures

i) COURSE OVERVIEW

Goal of this course is to impart practical know how to students about the behavior of different materials when subjected to various types of loadings. The course details the different mechanical properties of engineering materials.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Identify the behaviour of engineering materials under various forms and stages of loading	Apply
CO 2	Examine the moment of inertia of rotating bodies	Apply
CO 3	Analyse the toughness, strength and stiffness properties of engineering materials under various loading conditions	Analyse
CO 4	Examine the displacement and strains of materials under various types of loading	Apply

iii) SYLLABUS

Study on stress-strain characteristics of mild steel rod and HYSD bars, Estimation of modulus of rigidity of Steel wire, Estimation of modulus of rigidity of mild steel circular bars and Tor steel, Study on flexural behaviour of wooden beam, Estimation of compressive strength of wooden specimen, Estimation of toughness of steel, Estimation of modulus of rigidity of open coiled and closed coiled springs, Estimation of hardness properties of engineering materials, Determination of shear capacity of mild steel specimen, Determination of moment of inertia of flywheel, Bend and rebend test on mild steel specimen, Verification of Clerk Maxwell's Reciprocal Theorem, Estimation of modulus of elasticity of Tor steel using strain gauge.

iv) a) REFERENCES

1. Davis, Troxell and Hawk, Testing of Engineering Materials", International Student Edition, McGraw Hill Book Co. New Delhi, 4th Edition, 2005
2. M.L. Gambhir and Neha Jamwal, Building and construction materials Testing and quality control, McGraw Hill education(India)Pvt. Ltd., 2014
3. K.A. Holes , Experimental Strength of Materials, English Universities Press Ltd. London, 2019
4. A.K. Suryanarayana, Testing of Metallic Materials, Prentice Hall of India Pvt. Ltd. New Delhi, 2007
5. C.B. Kukreja,K.Kishore, and Ravi Chawla, Material Testing Laboratory Manual, Standard Publishers & Distributors, 2006

6. James W Dally, Willam F Railey, Experimental Stress analysis, McGarw Hill,2012
7. Baldev Raj, T. Jayakumar and M. Thavasimuthu,Practical Non-destructive testing, Narosa Book Distributors,3rd Edition, 2011

v) COURSE PLAN

Experiment No.	List of exercises/ experiments	No. of hours
1	Tension test on Mild Steel Rod and TMT bars	2
2	Torsion test on Steel wire	2
3	Torsion test on Mild Steel Rod	2
4	Bending Test on wooden beams	2
5	Impact test a. Izod Impact Test b. Charpy Impact Test	2
6	Spring test a. Open Coiled Spring Test b. Closed Coiled Spring Test	2
7	Hardness Test a. Brinell hardness Test b. Rockwell Hardness Test	2
8	Double shear test	2
9	Moment of Inertia of Flywheel	2
10	Bend and rebend test on mild steel specimen	2
11	Verification of Clerk Maxwell's Theorem	2
12	Modulus of Elasticity of Tor Steel Using Strain Gauge	2
13	Fatigue Test for Coupler	2
	Total hours	**26**

* Mandatory number of experiments - 10

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	: 5 marks
Class work/ Assessment /Viva-voce	: 55 marks
Final Assessment	: 40 marks
Total	**: 100 marks**

COURSE OFFERED TO MECHANICAL ENGINEERING BRANCH (S3)

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MEP20A	MATERIAL TESTING LAB	PCC	0	0	2	0	1	2023

i) COURSE OVERVIEW

Goal of this course is to impart practical knowledge to students about the behavior of different materials when subjected to various types of loading. The course details the different mechanical properties of engineering materials.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Identify the behaviour of engineering materials under various forms and stages of loading	Analyse
CO 2	Examine the moment of inertia of rotating bodies	Apply
CO 3	Analyse the toughness, strength and stiffness properties of engineering materials under various loading conditions	Analyse
CO 4	Examine the displacement and strains of materials under various types of loading	Apply

iii) SYLLABUS

Study on stress-strain characteristics of mild steel rod and HYSD bars, Estimation of modulus of rigidity of Steel wire, Estimation of modulus of rigidity of mild steel circular bars and Tor steel, Study on flexural behaviour of wooden beam, Estimation of compressive strength of wooden specimen, Estimation of toughness of steel, Estimation of modulus of rigidity of open coiled and closed coiled springs, Estimation of hardness properties of engineering materials, Determination of shear capacity of mild steel specimen, Determination of moment of inertia of fly wheel, Bend and rebend test on mild steel specimen, Verification of Clerk Maxwell's Reciprocal Theorem, Estimation of modulus of elasticity of Tor steel using strain gauge, study and demonstration of load cells and strain gauges.

iv) REFERENCES

1. T. Davis and Hawk, Testing of Engineering Materials, International Student Edition, McGraw Hill Book Co. New Delhi, 4th Edition, 2005
2. M. L. Gambhir and Neha Jamwal, Building and construction materials-Testing and quality control, McGraw Hill education(India)Pvt. Ltd., 2014

3. K. A. Holes, Experimental Strength of Materials, English Universities Press Ltd. London, 2019
4. A.K. Suryanarayana, Testing of Metallic Materials, Prentice Hall of India Pvt. Ltd.New Delhi, 2007
5. C. B. Kukreja,K. Kishore, and R.Chawla, Material Testing Laboratory Manual,Standard Publishers & Distributors, 2006.
6. J. W. Dally and W.P. Railey, Experimental Stress analysis, McGraw Hill, 2012.

v) COURSE PLAN

Experiment No.	List of exercises/ experiments	No. of hours
1	Tension test on Mild Steel Rod and TMT bars	2
2	Torsion test on Steel wire	2
3	Torsion test on Mild Steel Rod	2
4	Bending Test on wooden beams	2
5	Study on estimation of compression strength of timber specimen	2
6	Impact test a. Izod Impact Test b. Charpy Impact Test	2
7	Spring test a. Open Coiled Spring Test b. Closed Coiled Spring Test	2
8	Hardness Test a. Brinell hardness Test b. Rockwell Hardness Test	2
9	Double shear test	2
10	Moment of Inertia of Fly wheel	2

11	Bend and rebend test on mild steel specimen	2
12	Bending test on steel I Section	2
13	Verification of Clerk Maxwell's Theorem	2
14	Modulus of Elasticity of Tor Steel Using Strain Gauge	2
15	Study/Demonstration of strain gauges and load cells.	2
	Total hours	**30**

vi) CONTINUOUS INTERNAL EVALUATION PATTERN

Attendance	: 5 marks
Class work/ Assessment /Viva-voce	: 55 marks
Final Assessment	: 40 marks
Total	: **100 marks**

MINOR COURSE

BASKET I

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2MB	Infrastructure Health Monitoring	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

This course introduces students to the principles and applications of Structural Health Monitoring (SHM). Students will learn about various sensors and techniques used to assess the condition of civil infrastructure, mechanical systems and aerospace structures. The course emphasizes interdisciplinary approaches, integrating concepts from structural engineering, materials science, sensor technology, data analysis, and computer science.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Understand the fundamental concepts and principles of Structural Health Monitoring.	Understand
CO 2	Identify different types of sensors and instrumentation used for SHM.	Apply
CO 3	Design and implement SHM systems for monitoring civil infrastructure, mechanical systems, and aerospace structures.	Apply
CO 4	Analyze data collected from sensors using statistical and machine learning techniques.	Analyze
CO 5	Evaluate the health condition of structures and interpret monitoring data to assess structural integrity and apply interdisciplinary approaches to address challenges in SHM.	Analyze

iii) SYLLABUS

Introduction to Structural Health Monitoring (SHM): Definition and objectives of SHM- Importance of SHM in engineering practice- Historical developments and current trends

Sensors and Instrumentation for SHM: Types of sensors (strain gauges, accelerometers, displacement sensors, etc.)- Selection criteria and sensor placement- Signal conditioning and data acquisition systems

Data Analysis Techniques: Statistical methods for data interpretation- Time-domain and frequency-domain analysis- Introduction to machine learning algorithms for SHM

SHM Systems and Technologies: Overview of SHM system architecture - Wireless sensor networks for distributed monitoring- Remote sensing techniques (satellite imagery, UAVs)

Case Studies and Applications & Interdisciplinary Approaches in SHM: SHM in civil infrastructure (bridges, buildings, dams)- SHM in mechanical systems (rotating machinery, pipelines)- SHM in aerospace structures (aircraft, satellites)- Integration of structural engineering, materials science, and sensor technology- Collaborative research and industry partnerships- Future directions and emerging trends in SHM

iv) a) TEXTBOOKS

1. H. Sohn, Charles R Farra and F. Hemez, Structural Health Monitoring: A Machine Learning Perspective , 2012
2. Charles R Farrar, and Keith Worden, Structural Health Monitoring: A Machine Learning Perspective, John Wiley &Sons, first edition, 2012-2013
3. Tomonoyi Nagayama and Billie F Spencer Jr,Structural health monitoring using smart sensors, Newmark Structural Engineering Laboratory. University of Illinois at Urbana Champaign, 2007

b) REFERENCES

1. Brankro Glisic,and Daniele Inaud,Fibre optic methods for structural health monitoring, John Wiley & Sons,2008
2. Richard Do, Passive and active sensing technologies for structural health monitoring, University of California, San Diego,2014
3. D. M. Frangopol and M. Mahmoud, Structural Health Monitoring: An Introduction,2008
4. Journal articles and conference papers on SHM research and applications

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Structural Health Monitoring (SHM): Definition and objectives of SHM- Importance of SHM in engineering practice- Historical developments and current trends	6
II	Sensors and Instrumentation for SHM: Types of sensors (strain gauges, accelerometers, displacement sensors, etc.)- Selection criteria and sensor placement- Signal conditioning and data acquisition systems	8
III	Data Analysis Techniques: Statistical methods for data interpretation- Time-domain and frequency-domain analysis- Introduction to machine learning algorithms for SHM	9
IV	SHM Systems and Technologies: Overview of SHM system architecture - Wireless sensor networks for distributed monitoring- Remote sensing techniques (satellite imagery, UAVs)	10

V	Case Studies and Applications & Interdisciplinary Approaches in SHM: SHM in civil infrastructure (bridges, buildings, dams)- SHM in mechanical systems (rotating machinery, pipelines)- SHM in aerospace structures (aircraft, satellites)- Integration of structural engineering, materials science, and sensor technology- Collaborative research and industry partnerships- Future directions and emerging trends in SHM	**12**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

BASKET II

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2MD	Watershed Management	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to equip the students to acquire an overall knowledge about watershed and watershed management. Course imparts basic knowledge about surface and groundwater hydrology, soil and water conservation, watershed modelling with the use of modern techniques etc. It will also provide guidance for the students to undertake project and research work in the field of watershed management.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the characteristics of watershed and the concept of watershed management	Understand
CO 3	Utilize the study of Soil Erosion and Conservation measures for the proper management of watershed	Apply
CO 4	Make use of the study of hydrologic components and well hydraulics in the management of Watershed	Apply
CO 5	Apply the concepts of water harvesting for effective water conservation in watersheds	Apply
CO 6	Apply the principles of Watershed Management and modern techniques for watershed modelling with case studies	Apply

iii) SYLLABUS

Concept of Watershed- Watershed, Types, Characteristics of Watershed, Types of channels and characteristics -Watershed Management- Concept and Relevance in India, Necessity and Principles of Watershed Management, Problems and constraints

Integrated and Multidisciplinary Approach of Watershed Management- Socio Economical Aspects and Application of PRA tools for Participatory Watershed Planning

Soil Erosion and Conservation Measures - Land Capability Classification – Soil Erosion- Introduction, Factors Affecting, Types and Causes of Erosion, Estimation of Soil Loss From Erosion, Methods to control Soil Erosion, Soil Water relationship, Methods of Water Application

Hydrologic Components of Watershed- Hydrologic Cycle, Precipitation, Types and measurement, Infiltration, Evapotranspiration, Runoff, Measurement of Yield from Watershed, Well Hydraulics

Water Harvesting in Watershed- Introduction, Techniques of Water Harvesting, Indigenous Water Harvesting Methods in India-Hydrologic Design of Recharge structures- Different methods

Modern Methods in Watershed Management and modelling- Watershed Modeling - Application of GIS- Remote Sensing – Decision Support Systems and Knowledge Based systems in Modeling- Case studies in Watershed Management.

iv) a) TEXT BOOKS

1. Gupta S.R, Text Book of Watershed Hydrology, Indian Council of Agricultural Research,1st Edition, 2023
2. Murty J. V. S., Watershed Management, NewAge Publishers 2nd Edition ,2017
3. Suresh R., Watershed Planning and Management, Standard Publishers, First Edition, 2017
4. Subramanya K., Engineering Hydrology, McGraw Hill, Fourth Edition July 2017
5. Singh R.V., Watershed Planning and Management, Singh Raj Vir , 3rd Edition, 2016
6. Das M.M, Saika M.D, Watershed Management, PHI Learning Pvt.Ltd., Dec.2013
7. Ghanshyam D., Hydrology and Soil Conservation Engineering including Watershed Management, PHI Learning Pvt.Ltd., NewDelhi, 2nd Edition, 2009

(b) REFERENCES

1. Venkateswarlu B. Field Manual on Watershed Management,Central Rainfed Institute for Dryland Agriculture, Hyderabad, Revised Edition, 2013
2. Sudha V.M, Watershed Management: Case Studies (General Management), ICFAI University Press, 2008
3. Common Guidelines for Watershed Development Projects, Govt.of India, Revised Edition 2011
4. Rajora R., Integrated Watershed Management:Field Manual for Equitable, Productive and Sustainable Development, First Edition, 2019

v) COURSE PLAN

Module	Contents	No. of hours
I	Concept of Watershed- Watershed, Types, Characteristics of Watershed, Types of channels and characteristics Watershed Management- Concept and Relevance in India, Necessity and Principles of Watershed Management, Problems and constraints. Integrated and Multidisciplinary Approach of Watershed Management- Socio Economical Aspects and Application of PRA tools for Participatory Watershed Planning	9
II	Soil Erosion and Conservation Measures - Land Capability Classification – Soil Erosion- Introduction, Factors Affecting, Types and Causes of Erosion, Estimation of Soil Loss From Erosion, Methods to control Soil Erosion, Soil Water relationship, Methods of Water Application	9
III	Hydrologic Components of Watershed- Hydrologic Cycle, Precipitation, Types and measurement, Infiltration, Evapotranspiration, Runoff, Measurement of Yield from Watershed, Well Hydraulics	9
IV	Water Harvesting in Watershed- Introduction, Techniques of Water Harvesting, Indigenous Water Harvesting Methods in India Hydrologic Design of Recharge structures- Different methods	9
V	Modern Methods in Watershed Management and modelling- Watershed Modeling - Application of GIS- Remote Sensing – Decision Support Systems and Knowledge Based systems in Modeling	9
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test : 2

Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

BASKET III

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2MF	Urban Transportation Planning	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to introduce to the students the concept of transportation planning and impart in-depth knowledge on the four-stage planning process and to highlight the need for sustainable transportation.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Identify the need for transportation planning, the challenges related to transportation and its interaction with urban structure and land use	Apply
CO 2	Explain the concept of travel demand and its role in transportation planning	Understand
CO 3	Apply standard techniques for the collection of data used in four-stage planning process	Apply
CO 4	Apply standard procedures for the four-stage modelling in transportation planning.	Apply
CO 5	Outline the concepts of land use transport models, sustainable approaches to transportation planning and comprehensive mobility plan	Understand

iii) SYLLABUS

Introduction, Urban travel characteristics, issues and challenges, detrimental effects of traffic on environment, Urban structure. Hierarchy of transportation facilities, transportation and land use.

Urban transport demand, modelling based on consumer behaviour of travel choices. Basic principles of travel demand analysis and assumptions, systems approach to planning. Stages of transportation planning process, Trip-based and Activity-based approaches, selection of study area, zoning, sampling techniques, data collection methods.

Trip generation, trip distribution, modal split, traffic assignment. Land use models, Comprehensive Mobility Plan, sustainable transportation, transport demand management, quick response techniques.

iv) a) TEXT BOOKS

1. C Jotin Khisty and B Kent Lall, Transportation Engineering –An Introduction,Pearson Education, 3rd edition, 2017
2. C.S. Papacostas and P D Prevedouros, Transportation Engineering and Planning, Prentice Hall, 3rdedition, 2015

b) REFERENCES

1. Micheal D Meyer and Eric J Miller, Urban Transportation Planning: A Decision Oriented Approach, McGraw Hill, 2nd edition, 2001.
2. Hutchinson B G, Principles of Urban Transport Systems Planning, Mc-Graw Hill, Original edition, 1974.
3. James S. Garber and Lester A Hoel, Traffic and Highway Engineering, Cengage Learning, 5th edition, 2015.

v) COURSE PLAN

Module	Contents	No. of hours
I	Need for transportation planning- Characteristics of urban travel, transportation issues and challenges, detrimental effects of traffic on the environment. Urban Structure- types and properties - centripetal, grid, linear, directional, movement and accessibility – hierarchy of transportation facilities. Transportation and land use - Role of urban activity analysis in transportation planning, Transportation impacts on activity system, Land use transportation interaction.	8
II	Role of demand analysis in transportation planning- Classification of urban transport demand and factors affecting demand, modelling based on consumer behaviour of travel choices. Basic principles of travel demand analysis and assumptions. Transportation planning process - Systems approach, elements/stages of transportation planning process - goal, objectives and constraints, Trip-based and Activity-based approaches for transportation planning	9
III	Data collection – Definition of study area, zoning- selection of cordon, sampling techniques and sample size, sources of data and types of surveys for planning, evaluation of survey accuracy.	10

	Trip Generation- Factors influencing grip generation, methods of forecasting trip generation rates- expansion factor, linear regression, category analysis.	
IV	Trip Distribution - growth factor methods, synthetic methods, gravity models, opportunity model. Modal Split - factors influencing modal split, types of mode split models – trip end, trip interchange, logit model. Traffic assignment- purpose, elements of transportation networks nodes and links, methods for traffic assignment.	**9**
V	Land use models- Selection of land use model, Lowry model structure, features, Model equation system. Sustainable transportation - features, facilities, transit-oriented development, non-transport solutions to transport problems, Transportation demand management, quick response techniques for demand estimation. Comprehensive mobility plan- objectives and activities involved, Application of GIS in transport planning.	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Tests	:	20 marks
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

HONOUR COURSE

BASKET I

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2HB	Advanced Mechanics of Solids	VAC	3	0	0	0	3	2023

PREREQUISITE: MECHANICS OF SOLIDS

i) COURSE OVERVIEW

Objective of this course is to expose the students to the advanced concepts of mechanics of materials and enhance their problem-solving skills. The course aims to understand the stresses and strains in 2D and 3D solid bodies. It introduces students to the elements of theories of elasticity, failure and failure criteria. Students will be able to understand concepts, principles and governing equations in dealing with elastic solids. After this course students will be in a position to find mechanical behaviour of elastic materials by determining the stress strains produced by the application of load.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the concepts and principles related to the analysis of elastic solids in 3D.	Understand
CO 2	Calculate the stress tensor and strain tensor of structure subjected to external loads by applying the constitutive relation between stresses and strains	Apply
CO 3	Applying the basic concepts of stress transformation, determine the principal stresses and strain using graphical method	Apply
CO 4	Compute the Factor of Safety against structural failure using different failure theories	Apply
CO 5	Applying the various techniques of stress analysis, determine the structural response of standard cross sections of isotropic materials due to applied torsion	Apply

iii) SYLLABUS

Stress Tensor, Transformation of stress, Principal Stress, Stress Invariants, Plane stress, Mohr's Circle in Two Dimensions.

Strain Tensor, Strain Transformation, Spherical and Deviatorial Strain Tensor, Principal Strains, Strain Invariants, Mohr Circle for strain, Strain Rosettes.

Strain Energy Density, Internal Energy Density, Generalized Hooke's Law, Anisotropic Elasticity, Isotropic Elasticity, Displacements-strains and compatibility-equilibrium equations and boundary conditions

Modes of failure, yield failure criteria, Maximum Principal Stress Criteria, Maximum Shear stress criteria, Maximum Strain Criteria, Maximum Strain Energy Density Criteria, Von Mises Criteria, fatigue, Stress Concentration Factor, Palm Miner Rule, SN Curve

Torsion of a cylindrical bar of circular cross section- St.Venant's semi inverse method-stress function approach-elliptical, equilateral triangle & narrow rectangular cross sections - Prandtl's membrane analogy-Hollow thin wall torsion members

iv) (a) TEXT BOOKS

1. Arthur P Boresi,Richard J Schmidt, Advanced Mechanics of Materials, John Wiley & Sons, 6th edition, 2002.
2. Robert D Cook, Warren C Young, Advanced Mechanics of Materials, Prentice Hall, 2nd edition, 1999.
3. L S Srinath, Advanced Mechanics of Solids, Tata McGraw Hill, 3rd edition, 2009.

(c) REFERENCES

1. Stephen Timoshenko, Strength of Materials Vol II, CBS Publishers, 3rd edition, 2002
2. S.P. Timoshenko, J.N. Goodier, Theory of elasticity, McGraw Hill, 3rd edition, 2nd reprint,2010

v) COURSE PLAN

Module	Contents	No. of hours
I	Definition of stress at a point, Stress Notation, Stress Tensor, Normal stress and Shearing Stress on an oblique plane, Transformation of stress, Principal Stress, Stress Invariants, Octahedral Stress, Mean and Deviator Stress, Plane stress, Mohr's Circle in Two Dimensions, Differential Equations of motion of a deformable body.	**9**
II	Types of Strain, Deformation of a deformable body, Strain Tensor, Strain Transformation, Spherical and Deviatorial Strain Tensor, Principal Strains, Strain Invariants, Octahedral Strains, Mohr Circle for strain, Equations of Compatibility for Strain, Strain Rosettes	**9**
III	Strain Energy Density, Complementary Internal Energy Density, Generalized Hooke's Law, Anisotropic Elasticity, Isotropic Elasticity, Displacements-strains and compatibility-equilibrium equations and boundary conditions	**8**

IV	Modes of failure, yield failure criteria, Maximum Principal Stress Criteria, Maximum Shear stress criteria, Maximum Strain Criteria, Maximum Strain Energy Density Criteria, Von Mises Criteria, fatigue, Stress Concentration Factor, Palm Miner Rule, SN Curve	**9**
V	Torsion of a cylindrical bar of circular cross section- St.Venant's semi inverse method-stress function approach-elliptical, equilateral triangle & narrow rectangular cross sections - Prandtl's membrane analogy-Hollow thin wall torsion members	**10**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

BASKET II

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2HD	Environmental Pollution Control Techniques	VAC	3	0	0	0	3	2023

i) COURSE OVERVIEW

The course is designed to impart knowledge on the fundamental aspects of environmental pollution and its control techniques among students. It helps the learners to understand the sources of environmental pollution, characteristics of pollutants, waste treatment techniques and empower the learners to adopt appropriate strategies to control the environmental pollution.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the sources, effects and control methods of air pollutants	Understand
CO 2	Explain the sources, effects and treatment methods of water pollutants	Understand
CO 3	Identify appropriate method to manage and treat industrial wastewater	Apply
CO 4	Identify different practices adopted for solid waste management of a community	Apply
CO 5	Explain the environmental protection laws and acts implemented in India to abate the environmental pollution	Understand

iii) SYLLABUS

Air pollution: Sources, Effects and Control of gaseous and particulate pollutants Water Pollution: Sources, Effects, Physico-chemical and Biological Treatments

Industrial Pollution: Characteristics, Pretreatment of industrial wastes. Essential elements of an Environmental Management System (EMS)

Solid waste management: Type, Source and Management - Waste minimization strategies.

Administrative and Legislative control of environmental pollution

iv) (a) TEXT BOOKS

1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, Environmental Engineering, McGraw Hill Education, 2017.
2. C.S. Rao, Environmental Pollution Control Engineering, New Age International (P) Ltd., Publishers, 3rd edition, 2018.
3. M. N. Rao & H.V.N. Rao, Air Pollution, Tata McGraw Hill Co. Ltd, Delhi, 2001.
4. Santosh Kumar Garg, Waste Disposal and Air Pollution Engineering, 42nd edition, Khanna publishers, 2021.

(b) REFERENCES

1. Nelson Leonard Nemerow, Industrial Waste Treatment: Contemporary Practice and Vision for the Future, Butterworth- Heinemann Inc, 1st edition, 2006.
2. Arcadio P. Sincero and Gregoria A. Sincero, Environmental Engineering: A Design Approach, Pearson Education Services Pvt. Ltd., 2nd edition, 2016.
3. M. N.Rao, A. K. Datta, Wastewater Treatment, Oxford & IBH Publishing Co. Pvt. Ltd, Bombay, 2020.

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to environmental pollution. Air pollution – Sources – Primary pollutants, Secondary pollutants Criteria pollutants– Effects. Control of gaseous pollutants. Control of particulate pollutants Automobile pollution control, Air Pollution Mitigation Measures- Ambient air quality standards	**9**
II	Water pollution – Sources – Various Pollutants – Effects, Physico-chemical and Biological Treatment – Screening, Skimming, Sedimentation, Coagulation, Filtration, Trickling Filters, Activated sludge process. Oxidation ponds	**9**
III	Industrial Pollution - Characteristics of industrial wastes: physical, chemical and biological. Pre-treatment of industrial wastes: waste volume reduction, Waste strength reduction, neutralization, Equalization and proportioning, High rate anaerobic methods, Essential elements of an Environmental Management System (EMS). Case Studies on industrial waste management	**9**

IV	Solid waste management: Type and source of solid waste, characteristics, Collection, segregation, transportation and processing, Waste minimization strategies – Reduction - Recycling – Reuse, Disposal - composting, sanitary landfill, incineration, Hazardous Waste Treatment and Disposal, Biological and chemical treatment of hazardous wastes, Landfill disposal of hazardous waste, Bio remediation of hazardous waste disposal sites. Case Studies on solid waste management	**9**
V	Administrative and Legislative control of environmental pollution, Important Environmental rules and regulations, Environmental protection acts and rules, Environmental Management Plan, identification and mitigation of environmental impacts	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Test (2 Numbers)	:	10 marks each
Assignment/Project/Case study etc.	:	15 marks
Total	**:**	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum marks	:	30 Marks
Test Duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum marks	:	**60 Marks**
Exam Duration	:	3 Hours

BASKET III

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CEL2HF	Geographical Information System	VAC	2	0	2	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the fundamental concepts and components of the Geographical Information System (GIS) and enable them to identify the requirements for the development of the GIS module for various applications.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the basic concepts, data types and operations in GIS	Understand
CO 2	Apply various approaches of spatial data analysis and their significance in decision making	Apply
CO 3	Apply the application of GIS and allied technologies across diverse fields	Apply
CO4	Make use of GIS Software to gather and process data to develop a simple model	Apply
CO5	Apply the concepts of LiDAR Remote sensing for urban modelling	Apply

iii) SYLLABUS

Basic concepts of GIS, history of GIS, components of GIS geospatial data, attribute data, GIS operations, application of GIS, popular GIS software's. Co-ordinate system: GeographicCo-ordinate system, Map Projections, commonly used Map Projections, Projected coordinate system, Georeferencing, Geometric Transformations.

Data structure-Vector Data model, Raster Data model, Types of Raster data, Data inputs to GIS platform, Metadata, Vector to Raster conversion, Digitization. Database management and map making: Geodatabase management, Attribute data management. Cartography and map making elements.

GIS Data Processing – Vector data Analysis- Buffering, Overlay Point-in-Polygon, Line-in polygon, Polygon-in-polygon, Distance measurement, Pattern analysis, Map manipulation, Network Analysis. Raster Data Analysis- Local operations, Neighborhood operation, Zonal Operation, other Raster data operations.

Advanced Applications: Introduction to terrain mapping, DEM and TIN, terrain mapping techniques, Slope and aspect, Web-GIS. Data quality analysis – Sources of error – Components of data quality.

Introduction to remote sensing, LiDAR system components, characteristics of LiDAR data, LiDAR remote sensing platforms. Registration of LiDAR data, LiDAR filtering, DTM generation, point cloud processing, 3D urban modelling.

iv) (a) TEXT BOOKS

1. Kang Tsung Chang, Introduction to Geographic Information Systems, 9th edition, Tata McGraw Hill Publishing Co. Ltd, 2020
2. George Joseph, C Jeganathan, Fundamentals of Remote Sensing, 3rd edition, Universities Press, 2018
3. Peter A Burrough,Rachel A McDonnell, Christopher D Llyod, Principles of Geographical Information systems, International 3rd edition, Oxford University Press, 2016
4. Alfred Leick, GPS Satellite Surveying,1st edition, John Wiley & Sons, 2015.
5. Michael Kennedy, Integrating GIS and the Global Positioning System, 2nd edition, CRC Press, 2002
6. Jie Shan,Charles K Toth, Topographic laser ranging and scanning: Principles and processing, 2nd edition, CRC Press, 2018

(b) REFERENCES

1. Jonathan Iliffe,Roger Lott, Datums and Map Projections for Remote Sensing, GIS and Surveying, 2nd edition, Whittles Publishing, 2008.
2. Thomas Lillesand and Ralph Kiefer,Jonathan Chipman, Remote Sensing and Image Interpretation, 7th edition, John Wiley and Sons, Inc, 2015.
3. Peter A Burrough and Rachel A McDonnell, Principles of Geographical Information System, 3rd edition, Oxford University Press, 2015.

v) COURSE PLAN

Module	Contents	No. of hours
I	Basic concepts of GIS, history of GIS, components of GIS-Geospatial Data, Attribute data, GIS operations, application of GIS, popular GIS Softwares. Geographic co-ordinate system, Map projections, commonly used map projections, projected co-ordinate system, georeferencing, geometric transformation	6
II	Data structure - vector data model, raster data model, Types of raster data, data inputs to GIS platform, metadata, vector to raster conversion, digitization. Geodatabase management, attribute data management.cartography and map making elements.	6

III	GIS Data Processing –Vector data Analysis- Buffering, Overlay-Point-in-Polygon, Line-in-polygon, Polygon-in-polygon, Distance measurement, Pattern analysis, Map manipulation, Network Analysis. Raster Data Analysis- Local operations, Neighborhood operation, Zonal Operation, other raster data operations.	**6**
IV	Advanced Applications: Introduction to terrain mapping, DEM and TIN, terrain mapping techniques, slope and aspect, Web GIS. Data quality analysis – Sources of Error – Components of data quality. Construction	**6**
V	Introduction to remote sensing, LIDAR system components, characteristics of LIDAR data, LIDAR remote sensing platforms-airborne platforms, space borne platforms, ground-based platforms, bathymetric mapping systems, registration of LIDAR data, point cloud processing, 3D urban modelling, mobile LIDAR mapping.	**6**
	Total hours	**30**

Exercise No.	Module	Title of the Exercise	No. of hours
1	I	An Introduction to application, scales, identification of objects	3
2		Extraction of Physical features from top sheets	
3		Creating Vector Data Model	
4	II	Creating Raster Data Model	3
5		Creating Cartesian Coordinates System	
6		Creating TIN to understand the surface elevation	
7	III	Buffering tool	3
8		Overlay Analysis from Selected Layers	
9		Calculating Nearest Neighbor Point in GIS	
10	IV	DEM to understand the Surface elevation	3
11		Conversions - format change	
12		Creating Rainfall Variability and Intensity Map	
13	V	Working with Analysis Tools Clip and Extract	3
14		Importing GPS data into GIS	
15		Creating a Simple Model	
		Total hours	**15**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 marks
Continuous Assessment Tests	:	20 marks
Assignment	:	5 marks
Assessment of Lab work	:	20 marks
Lab exam	:	10 marks
Total	:	**60 marks**

vii) END SEMESTER EXAMINATION

Maximum marks	:	**40 Marks**
Exam Duration	:	2 Hours