M. Tech. in Civil Engineering with Structural Engineering

Course Contents

Academic Year 2025-26

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Programme Outcomes for M. Tech. in Civil Engineering with Structural Engineering

The post graduates will have

1. An ability to independently carry out research /investigation and development work to solve practical problems
2. An ability to write and present a substantial technical report/document
3. An ability to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4. An ability to apply knowledge of mathematics, science and engineering.
5. An ability to critically analyze complex engineering problems.
6. Ability to update knowledge and competency with the changing technological advances.

SEM – I

Structural Dynamics [PC-MTSE101]

Course Code	Course Name
PC-MTSE101	Structural Dynamics

Course Objectives

The objectives of this course are

1. Dynamic load, difference between static load and dynamic load and different types of dynamic load.
2. Free vibration analysis of SDOF systems, concept of damping and dynamic analysis of SDOF system to different dynamic loads including ground motion.
3. Frequency domain analysis.
4. Dynamic degrees of freedom, Calculation of frequencies and mode shapes for lumped mass MDOF systems, analysis of MDOF systems subject to dynamic loads using modal analysis.
5. Analysis of system with distributed mass.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Distinguish between static and dynamic loads; understand different types of dynamic loads
2. Understand the elements of single degrees of freedom, concept of damping and free and forced vibrations; able to find the frequency and free vibration response of single degree of freedom (including generalized single degree of freedom) system for different types of dynamic loads including ground motion in time domain.
3. Determine the frequencies and mode shape for various types of freedom lumped mass structures and carry out the dynamic (Damped and un- damped) for different types of dynamic loads including ground motion in time domain.
4. Evaluate the dynamic responses of systems with distributed mass.
5. Apply Fourier series in analysis of systems subjected to periodic loads and will understand the frequency domain analysis.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	2	3	2	1
CO2	3	–	3	3	2	1
CO3	3	1	3	3	3	2
CO4	2	–	3	3	2	2
CO5	3	1	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	**Introduction:** Introduction to structural dynamics, definition of basic problem in	02

	Dynamics, static v/s dynamic loads, different types of dynamic loads	
2	**Single Degree of Freedom (SDOF) Systems:** Un-damped free vibration of SDOF system, natural frequency and period of vibration, damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, logarithmic decrement, computation of damping. Forced vibration, response to harmonic forces, periodic loading, dynamic load factors, and response of structure subjected to general dynamic load, Duhamel's integral, numerical evaluation of dynamic response of SDOF systems subjected to different types of dynamic loads. Numerical methods of evaluation of dynamic response of structures. Distributed mass system idealized as SDOF system, use of Rayleigh's method, response of SDOF system subjected to ground motion. Use of Fourier Series for periodic forces, introduction to vibration isolation, and transmissibility.	12
3	**Introduction to Frequency Domain Analysis:** Response of structure in frequency domain subjected to general periodic and non-periodic /impulsive forces of short duration, use of complex frequency response function, Fourier Response Integral, Discrete Fourier Transforms, Fast Fourier Transforms.	03
4	**Generalized Single-Degree of Freedom System:** Generalized properties, assemblages of rigid bodies, systems with distributed mass and elasticity, expressions for generalized system Properties.	07
5	**Free vibration of Lumped Mass Multi Degree of Freedom (MDOF) System:** Coupled and uncoupled systems, direct determination of frequencies of vibration and mode shapes, orthogonality principle, vibration of MDOF systems with initial conditions, approximate methods of determination of natural frequencies of vibration and mode shapes-vector iteration methods, energy methods and use of Lagrange's method in writing equations of motion	08
6	**Forced Vibration of Lumped Mass Multi Degree of Freedom (MDOF) System:** Decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness, forced vibration of MDOF system, modal analysis, and application to beams and multi storey frames with rigid girders subjected to lateral dynamic loads.	07
7	**Structure with Distributed Mass System:** Use of partial differential equation, free vibration analysis of single span beams with various boundary conditions, determination of frequencies of vibration and mode shapes, forced vibration of single span beams subjected to the action of specified dynamic loads	03

Recommended Books

1. Dynamics of Structures by Clough & Penzien, McGraw-Hill, Computers & Structures, CBS Publishers, 2015
2. Dynamics of Structures: Theory & Applications to Earthquake Engineering by Anil K Chopra, Prentice Hall of India
3. Structural Dynamics by Mario Paz, Springer India, CBS Publishers, 2004
4. Introduction to Structural Dynamics by John M Biggs, CBS Publishers,2014
5. Basic Structural Dynamics by James C Anderson &FarzadNaeim, John Wiley & Sons
6. Fundamentals of Structural Dynamics by Roy R Craig & Andrew J Kurdia, Wiley
7. Mechanical Vibrations by Den P Hartog, McGraw-Hill
8. Dynamics of Structures by Jagmohan L Humar, 3rd Edition, CRC Press,
9. Passive Energy Dissipation Systems in Structural Engineering by Soong T. T. & Dargush G F, Wiley
10. Introduction to Structural Motion Control by Connor J J, Prentice Hall, NJ
11. Active Structural Control by Soong T T, Wiley, NY & Longman Scientific & Technical, England
12. Random Vibrations by N.C.Nigam
13. Structural Dynamics by Meriowich
14. Structural Damping: Applications in Seismic Response Modification by Zach Liang, George C Lee, Gary F Dargush & Jianwei Song, CRC Press
15. MATLAB: An Introduction with Applications by Amos Gilat, Wiley India

Advanced Theory of Structures [PC-MTSE102]

Course Code	Course Name
PC-MTSE102	Advanced Theory of Structures

Course Objectives

The objectives of this course are

1. To learn the force method of analysis of indeterminate structures
2. To understand displacement method of analysis of indeterminate structures
3. To understand the behaviour of curved beams
4. To understand the concept of beams on elastic foundations

Course Outcomes

Upon successful completion of the course, students should be able to

1. Use the force method for analysis of indeterminate structures
2. Use the displacement method for analysis of indeterminate structures
3. Determine stresses developed in curved beams
4. Analyze beams resting on elastic foundations

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	2	1
CO2	3	–	3	3	2	1
CO3	2	–	3	3	2	–
CO4	2	–	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	**Matrix Method of Analysis of Structures – Stiffness Approach:** Introduction, Stiffness coefficients, member stiffness matrix, energy concept, transformation of system forces and displacements to element forces and displacements, transformation of element stiffness matrix to system stiffness matrix, effect of support settlement and temperature changes, spring supports.	05
2	**Matrix Method of Analysis of Structures – Stiffness Approach:** Consideration of Shear effects, Consideration of torsional effects for thin-walled member including torsional bending. Static condensation. Symmetry considerations in structures.	09
3	**Application of Stiffness Matrix Method:** Application to beams, pin jointed plane frames, rigid jointed plane frames and grid structures. Basic concepts associated with computer implementation of stiffness method	06

4	**Matrix Method of Analysis of Structures – Flexibility Approach:** Introduction, flexibility coefficients, member flexibility matrix, transformation of element flexibility matrix to system flexibility matrix, effect of support settlement and temperature changes, application to beams, pin jointed plane frames, rigid jointed plane frames and grid structures.	06
5	**Analysis of Curved Beams Loaded Perpendicular to Plane of Curvature:** Introduction, force developed at a section in a curved beam, sign conventions, torsion factor, analysis of beams curved in plan, circular arc cantilever, semi-circular beam fixed at two ends and subjected to central concentrated load, semi-circular beam subjected to udl and simply supported by three columns spaced equally, circular ring beam. Torsional analysis- Calculation of moments and forces	06
6	**Curved Beams Loaded in the Plane of Curvature:** Circumferential and radial stresses, neutral axis, analysis of crane hooks of different cross sections and chain links.	06
7	**Beams on elastic foundations:** Infinite beam subjected to concentrated load, beam supported on equally spaced discrete elastic supports, Infinite beam subjected to distributed load, semi-infinite beam subjected to concentrated load at its end and near its end, short beams.	04

Recommended Books

1. Aslam Kassimali (2012), "Matrix Analysis of Structures", Cenage Learning
2. C. S. Reddy (2009), "Basic Structural Analysis", Tata McGraw, 779 pages
3. Pandit Gupta (2001),"Matrix Structural Analysis", Tata McGraw-Hill Education, ISBN 0070667358, 602 pages
4. Arthur P. Boresi, Richard J. Smith, "Advanced Mechanics of Materials", Willey, 681 pages
5. Meghre A.S, Deshmukh S.K (2016), "Matrix Method Of Structural Analysis ", Charotar Publishing House, 552 pages
6. Gere Weaver(1980), "Matrix Structural Analysis", Van Nostrand Reinhold Company, ISBN 0442257732, 492 pages

Research Methodology and IPR [PC-MTSE103]

Course Code	Course Name
PC-MTSE103	Research Methodology and IPR

Course Objectives

The objectives of this course are

1. To develop an ability to identify, formulate research problem.
2. To develop an ability to apply knowledge of research methodology to Engineering Problems.
3. To develop critical thinking to find business opportunities and to solve questions related to industries.
4. To get knowledge on various kinds of Intellectual Properties

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the principles of research methodology, including types, objectives, and the scientific research process.
2. Formulate a valid research problem, design an appropriate research framework, and apply effective sampling and data collection techniques.
3. Analyze and interpret data using appropriate tools, and write structured technical and research reports with ethical responsibility.
4. Explain and apply the concepts of Intellectual Property Rights (IPR), including patents, copyrights, and licensing for innovation protection.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	2	2	1	–
CO2	3	2	3	2	3	1
CO3	3	3	2	2	3	2
CO4	–	1	2	–	2	2

Course Content

Module No.	Details	Hrs.
1	**Fundamentals of Research** Introduces the meaning, definition, and purpose of research. Various types of research such as descriptive vs analytical, applied vs fundamental, and quantitative vs qualitative, objectives and characteristics of good research, the scientific method, theory building, and the outcomes of research including new ideas, hypotheses, models, and theories.	04
2	**Formulating and Designing Research** Stages of the scientific research process, formulation of research	04

	problems, criteria for a good research problem, and common errors in selecting one. Concept and basic types of research design, overview of sampling techniques and determining sample size, sample design calculations	
3	**Data Collection and Analysis** Methods of data collection from primary and secondary sources. Data collection tools such as interviews, questionnaires, observations, and surveys, conducting pilot studies and pre-tests, basic measurement and scaling techniques, an overview of data analysis methods, and an introduction to statistical tools such as Excel or SPSS. Hypothesis testing, Z test , Chi Square Test , F test, t Test , Annova test	04
4	**Literature Review, Report Writing, Research Paper writing** Purpose and techniques of conducting a literature review, identifying reliable sources such as books, journals, databases, and web resources, and the process of identifying research gaps and developing hypotheses., Format for structuring research papers and theses, techniques for writing research proposals, proper referencing and documentation practices using citation styles , Guidelines for research paper writing and publication, Ethical responsibilities of researchers, forms of plagiarism, detection tools like Turnitin, consequences of misconduct, importance of reproducibility and accountability in scholarly research.	04
5	**Decision Science and Simulation** Decision Making , Steps in Decision making, types of decision making environment, Decision Models, Decision Tree analysis, Simulation defined, Steps in simulation, Advantages, limitations and Application of simulation, Monte carlo Simulation, Simulation problems in Engineering Systems.	04
6	**Basics of IPR (4 hours)** Nature and types of IPR including patents, copyrights, trademarks. Patenting process in India, role of IPR in academic and industrial research, criteria for innovation and patentability, practical aspects of IPR such as licensing, commercialization, technology transfer, importance of Geographical Indications (GI, traditional knowledge. recent developments in IPR including digital copyright, AI-generated inventions, emerging challenges in the digital era.	04

Recommended Books

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners,(2nd ed), Singapore, Pearson Education.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New

Technological Age", 2016.
5. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
6. N. S. Gopalakrishnan and T. G. Agitha, Principles of Intellectual Property, Lucknow, India: Eastern Book Company, 2009.
7. P. Narayanan, Intellectual Property Law, 4th ed., Kolkata, India: Eastern Law House, 2017.
8. Operation Research Theory and applications , J K Sharma, Trinity Publications 5th Edition 2013

Analysis of Composite Structures [PE-MTSE111]

Course Code	Course Name
PE-MTSE111	Analysis of Composite Structures

Course Objectives

The objectives of this course are

1. To introduce the general set of composite materials
2. To show the advantages of composites over metals
3. To explain the fabrication processes
4. To analyze the structural mechanics of composite materials.
5. To explain the deformation and failure of composite materials under the influence of different loads.
6. To know the effect of hygro-thermal environment on composite materials.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Classify different types of composite materials and describe their mechanical behaviour.
2. Apply lamination theory to analyse the strength and deformation of composite laminates.
3. Evaluate failure modes including delamination and interlaminar stresses.
4. Assess the effects of environmental and hygro-thermal conditions on composites.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	2	2	1	–
CO2	3	2	3	2	3	1
CO3	3	3	2	2	3	2
CO4	–	1	2	–	2	2

Course Content

Module No.	Details	Hrs.
1	Polymer matrix composites in structures. Fibre sand polymeric matrix materials. Fabrication processes.	07
2	Introduction to anisotropic elasticity. Unidirectional composites.	06
3	Micromechanics Interfaces and inter phases in polymer composites. Laminates and lamination theory.	07
4	De lamination in composites. Inter laminar stresses and free edge effects. Stress and failure analysis of laminated composites.	07
5	Hygro thermal and environmental effects.	05

6	Experimental characterization of composites.	05
7	Introduction to metal matrix, ceramic matrix and carbon-carbon composites. Intelligent composites, design approach.	05

Recommended Books

1. Jones R. M. (1975), "Mechanics of Composite Materials", McGraw Hill Kogakusha, Tokyo, ISBN 0070853479, 355 pages
2. Agarwal B. D. and Broutman L. J. (1990), "Analysis and Performance of Fibre composites", John Wiley & Sons, New York., ISBN 0471625728, 741 pages
3. Kaw A. K, "Mechanics of Composite Materials", CRC Press
4. Mukhopadhyay M (2005), "Mechanics of Composite Materials & Structures", Universities Press
5. Christensen R. M. (1991), "Mechanics of Composite Materials" Krieger Publishing Company, ISBN 0894645013, 348 pages
6. Calcote L. R. (1969), "The analysis of Laminated Composite Structures", Van Nostrand Reinhold Co., New York, ISBN 0442156286, 222 pages
7. Holmes M. and Just D. J. (1985), "GRP in structural Engineering", Applied Science Publishers, London. ISBN 0853342326, 298 pages
8. Gibson R. F. (17-Oct-2011), "Principles of Composite Material Mechanics", CRC Press, ISBN 1439850054, 683 pages
9. Reddy J. N., "Analysis of Composite Laminated Plates", McGraw Hill.

Advanced Foundation Engineering [PE-MTSE112]

Course Code	Course Name
PE-MTSE112	Advanced Foundation Engineering

Course Objectives

The objectives of this course are

1. The design of foundation requires the consideration of many essential factors with regard to soil data, geology of the site, land use patterns, ground conditions and the type of structure to be built.
2. A detailed understanding of the field situation is also very important apart from theoretical knowledge of the course. This course seeks to provide an overview of the essential features of foundation design.
3. The different aspects of foundation engineering ranging from soil exploration to the design of different types of foundation, including the ground improvement measures to be taken for poor soil conditions have been covered in this course.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Analyse stress distribution and settlement behaviour of shallow and deep foundations.
2. Design appropriate foundation systems based on soil investigation data.
3. Evaluate different methods for ground improvement in problematic soil conditions.
4. Apply concepts of bearing capacity and consolidation in complex field scenarios.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	3	2
CO2	2	–	3	3	2	2
CO3	2	–	3	3	2	3
CO4	3	–	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	**Review of Fundamentals of Soil Mechanics:** Soil, soil formation , soil profiles , weight volume relationship, soil classification, Indian standard method of soil classification, concept of total stress, effective stress and pore water pressure. One dimensional consolidation, Terzaghi's theory, derivation of equation. Determination of av, mv, cc, cv from laboratory test , determination of pc by various methods, field consolidation curve, secondary consolidation, quassi- pre-consolidation , three-dimensional consolidation, practical applications.	07
2	**Shear Strength:** Coulomb's law of shear strength , Mohr's Coulomb's criteria of failure,	07

	shear strength and shear strain behavior of sandy and clayey soils under undrained , drained and consolidated drained conditions, concept of progressive failure , critical void ratio, practical applications. Estimation of stresses in soils, Boussinesque and Westergard theories, Newmark Chart, practical applications	
3	**Sub-surface Ground Geotechnical Investigations:** Direct methods of explorations, influence of type of soils, type of foundations, etc. on the programme of exploration, lateral extent and depth of exploration, bore log details, profiles of soil in various directions, indirect methods, and practical applications.	06
4	**Bearing Capacity of Shallow Foundations:** Type of shallow foundations, gross load and net load , gross and net ultimate bearing capacity, safe bearing capacity, and allowable bearing pressure, modes of failure, criteria of failure , Terzhagi, Meyerhof, bearing capacity in shear, compressibility (including critical rigidity index) criteria, factor of safety. Bearing capacity of clay and sand in settlement, settlement analysis for clay, normally and over consolidated soils, settlement analysis of sand, Schemertmann method, and practical applications.	08
5	**Pile Foundations:** Axially loaded piles, necessity of piles, types of piles, static and dynamic resistance of piles, pile load carrying capacity using dynamic pile formulae and their limitations, pile load carrying capacity using Terzhaghi, Meyerhof, Berznatsv, Vesic, Indian standard 2911 (part -1 & part-2) method, settlement of pile in clay, group of piles, load carrying capacity for sand and clay soils, group efficiency, group settlements, practical applications.	07
6	**Ground improvements:** Various methods, sand drains, stone columns, stabilization, grouting, reinforced earth, geotextiles, diaphragm walls,	05
7	**Caissons & cofferdams:**	02

Recommended Books

1. Taylor D.W. (2013), "Fundamentals of Soil Mechanics", Asia publications Bombay, ISBN 1258768925, 714 pages
2. Karl terzaghi, (1996)," Soil Mechanics in Engineering Practice", John Wiley & Sons, ISBN 0471086584, 549 Pages
3. Joseph E Bowles, (1997)," Foundation Analysis and Design", McGraw-Hill, ISBN 0071188444, 1175 Pages
4. Dr. Alam Singh, "Soil Mechanics and Foundation Engineering Vol. 1, & 2", Standard Book House
5. Dr.Alam Singh, "Geotechnical Application", Standard Book House.
6. Reddy J. N., "Analysis of Composite Laminated Plates", McGraw Hill.

Design of Pre-Stressed Concrete Structures [PE-MTSE113]

Course Code	Course Name
PE-MTSE113	Design of Pre-Stressed Concrete Structures

Course Objectives

The objectives of this course are

1. To understand prestress force and its effect in structural members, prestressing systems and industrial applications.
2. To understand the materials which can be used for prestressed structure. To understand the concept of deflections due to prestressing force along with other forces
3. To understand the concept of composite structures and concordancy of cables.
4. To understand the design concept using prestressing force and familiarize with IS-1343.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply the concept of pre stressing, its types and methods and analyse the losses in pre stressed sections.
2. Analyse and design simple pre stressed flexural members and their end zones.
3. Analyse and understand the behaviour of prestressed composite sections and indeterminate members.
4. Demonstrate the use of relevant IS code provisions for analysis and design of prestressed structures.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	3	2	1
CO2	2	1	3	3	3	1
CO3	2	1	3	3	3	2
CO4	2	1	3	3	2	2

Course Content

Module No.	Details	Hrs.
1	Introduction to basic concepts and general principles of pre- stressed concrete, materials used in prestressed concrete and methods and techniques of prestressing, prestressing systems.	04
2	Analysis of prestressed concrete sections for flexure considering loading stages, computational of sectional properties, critical sections under working loads for pretensioned and post tensioned members, load balancing method of analysis of prestressed concrete beams, losses in prestress, application to simply supported beams and slabs, concept of debonding of cables in pre tensioned units.	10
3	Design philosophy of prestressed concrete sections, permissible stresses	10

	in concrete and steel, design approaches using working stress method as per IS 1343 – 2012, limit state of collapse – flexure and shear as applied to prestressed concrete beams, kern points, choice and efficiency of sections, cable profile and layouts, cable zone, deflection of prestressed concrete sections.	
4	End zone stresses in prestresses concrete members, pretension transfer bond, transmission length, end block of post tensioned members.	05
5	Design of simply supported pre-tensioned and post tensioned slabs and beams.	05
6	Analysis and design of composite prestressed concrete structures, concept and behaviour of long term creep and relaxation of prestressed members.	04
7	Introduction to application of prestressing to continuous beams, linear transformation and concordance of cables.	04

Recommended Books
1. T. Y. Lin, "Design of Prestressed Concrete Structures", John Wiley Publishers
2. N. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill
3. Y. Guyon, "Prestressed Concrete", Contractors Record Ltd.
4. R. H. Evans & E. W. Bennette, "Prestressed Concrete", McGraw Hill Book Co.

Advanced Concrete Technology [PE-MTSE114]

Course Code	Course Name
PE-MTSE114	Advanced Concrete Technology

Course Objectives
The objectives of this course are 1. To expose the students to advancement in concrete technology.

Course Outcomes
Upon successful completion of the course, students should be able to 1. Design high-performance concrete mixes using IS codes and supplementary materials. 2. Evaluate concrete durability and behaviour under environmental and load conditions. 3. Select and apply appropriate special concrete types for specific engineering applications. 4. Perform quality control and non-destructive testing on concrete structures.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	2	–	3	3	3	2
CO3	2	–	3	3	2	3
CO4	2	2	2	2	3	2

Course Content

Module No.	Details	Hrs.
1	Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and Surface area and grading, gap graded and aggregates.	05
2	Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin& GGBS in concrete Rheological behavior of concrete, requirements of workability of concrete, Durability & Effect of environmental conditions, Strength & maturity of hardened concrete, Impact, Dynamic and fatigue behaviour of concrete, shrinkage and creep of concrete, behaviour of concrete under fire.	10
3	Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing, Hot weather and cold weather concreting, Guniting (Shotcreting).	07

4	Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method.	05
5	Quality control and quality assurance of concrete, Acceptance criteria, Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test.	05
6	Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete, Mass concrete, high performance concrete, Pumpable concrete, Self-Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete.	04
7	Recycling & re-use of industrial waste material. Deterioration and repair technology of concrete, Distress and type of repairs, crack sealing techniques.	06

Recommended Books

1. Gambhir M.L., "Concrete Technology", Tata McGraw Hill, 2nd Edition, 1995.
2. M.S.Shetty, "M.S.Shetty", S.Chand& Company New Delhi, 2005.
3. P.KumarMehata, Paulo & J.M. Monteiro, "Concrete microstructure, properties & materials", Prentice Hall INC &Mcgraw Hill USA.
4. Short &Kenniburg, "Light Weight Concrete", Asia Publishing House, Bombay, 1963.
5. Orchard D.F, "Concrete Technology -Vol I. & II", Applied Science Publishers, 4th Edition, 1979.
6. Neville A.M., J.J.Brook, "Properties of Concrete", Addison Wesley, 1999.

Non Linear Analysis [PE-MTSE121]

Course Code	Course Name
PE-MTSE121	Non Linear Analysis

Course Objectives

The objectives of this course are

1. To introduce the students to the concepts of plastic analysis of steel structures including continuous beams, single/multiple span rigid jointed portal frames and single bay gable frames.
2. To introduce the students to the concepts of elastic stability of structures.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Evaluate the shape factor, determine the collapse load of single and multiple span beams, pin jointed frames, single/multiple span rigid jointed portal frames and single bay gable frames.
2. Determine the fully plastic moment of a section under the effect of axial force and shear force.
3. Determine buckling loads of prismatic, non-prismatic members, beam-columns, single bay single storey portal frames.
4. Analyse thin walled open cross sections for torsional buckling, combined buckling due to torsion and flexure and analyse the beams for lateral buckling.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	3	2
CO2	3	1	3	3	3	2
CO3	3	1	3	3	3	2
CO4	3	1	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	Plastic Analysis: Concepts of plastic analysis of steel structures, stress strain relations. Shape factor- Plastic modulus, plastic hinge, fully plastic moment, moment curvature relations. Use of statistical and mechanism methods for calculation of collapse load, Lower and upper bound theorems, various types of failure mechanisms.	07
2	Collapse load analysis of pin jointed frames, Determination of collapse load Single and multiple span beams carrying various types of loads, single/multiple span rigid jointed portal frames and single bay gable frames.	08
3	Effect of axial force and shear force on the fully plastic moment of a section. Design of beams and single span rigid jointed frames subjected to a system of proportionate loading as per Indian code provisions.	07

4	Elastic stability: Geometric Non linearity –Basic Concepts. Elastic buckling of bars with various end conditions, Euler's formula, buckling of non-prismatic members, use of energy method and finite difference method for evaluation of critical load analysis of single storey members.	07
5	Analysis of beam-columns, buckling of continuous beams. Buckling of single bay single storey portal frames. P-delta Analysis.	05
6	Torsional buckling: Pure torsion of thin walled open cross section, warping and warping rigidity, Torsional buckling of columns, combined buckling of members under torsion and flexure.	05
7	Lateral buckling of beams, lateral buckling of beams in pure bending, lateral torsional buckling of cantilever and S.S. beams.	03

Recommended Books

1. Lord Baker & Jacques Heyman (1980), "Plastic Design of Steel frames", Cambridge University Press, ISBN-0521297788, 238 pages.
2. Michael. R, Horne & B. G. Neal (2014), "Plastic Theory of Structures", Elsevier, ISBN9781483188454, 188 pages.
3. Alexander Chajes (1974), "Principles of Structural Stability Theory", Prentice Hall, ISBN-9780137099641, 336 pages.
4. NGR Iyengar (2007), "Elastic Stability of Structural Elements", Macmillan, 440 pages.
5. M. L. Gambhir (2004), "Stability Analysis & Design of Structures", Springer Science & Business Media, 535 pages.
6. Lynn. S. Beedle (1997), "Plastic Design of Steel Frames", John Wiley & Sons, Australia Limited, ISBN-978047109862, 406 pages.
7. Stephen Timoshenko & James. M. Gere, "Theory of Elastic Stability", Tata McGraw Hill
8. Chai H Yoo & Subg Lee (2011), "Stability of Structures: Principles & Applications", Elsevier, 536 pages.
9. George Simites & Dewey H Hodges (2006), "Fundamentals of Structural Stability", Butterworth-Heineman, 480 pages.

Numerical Methods [PE-MTSE122]

Course Code	Course Name
PE-MTSE122	Numerical Methods

Course Objectives

The objectives of this course are

1. To master basic Programming fundamentals, Fundamentals of numerical methods
2. Determine errors present in numerical solutions to engineering problems.
3. Utilize programming logic, structure and syntax to develop multifunctional algorithms to solve engineering problems
4. Identify and classify the numerical problem to be solved.
5. Choose the most appropriate numerical method for its solution based on characteristics of the problem
6. Understand the characteristics of the method to correctly interpret the results.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Solve nonlinear and linear equations using iterative and direct numerical techniques.
2. Apply numerical differentiation and integration techniques to engineering problems.
3. Develop algorithms for interpolation, curve fitting, and solution of differential equations.
4. Evaluate accuracy and errors in numerical computations.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	3	2
CO2	3	–	3	3	2	2
CO3	2	–	3	3	2	3
CO4	3	–	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	Programming fundamentals, Fundamentals of numerical methods, Error analysis;	06
2	Curve fitting, Interpolation and extrapolation	06
3	Differentiation and integration	06
4	Solution of nonlinear algebraic and transcendental equations	06
5	Elements of matrix algebra	06
6	Solution of systems of linear equations, Eigen value problems, differential equations.	06
7	Computer oriented algorithms; Numerical solution of different problems.	06

Recommended Books

1. J.H. Wilkinson (1965), "The Algebraic Eigenvalue Problem", Oxford University Press, ISBN 0198534183,608 pages
2. K.E. Atkinson (1989), "An Introduction to Numerical Analysis", J. Wiley and Sons, ISBN0471624896, 712 pages
3. G.E. Golub and C.F. Van Loan (1989), "Matrix Computations", Johns Hopkins University Press, ISBN 1421407949, 756 pages.

Structural Optimization [PE-MTSE123]

Course Code	Course Name
PE-MTSE123	Structural Optimization

Course Objectives

The objectives of this course are

1. To introduce the concepts of design optimization and review major conventional and modern optimization methods used in structural optimization applications.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Formulate optimisation problems and apply classical optimisation techniques.
2. Use linear and nonlinear programming methods for structural design problems.
3. Implement dynamic programming and penalty function approaches.
4. Optimise structural performance using finite and iterative methods.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	2	2
CO2	2	–	3	3	3	2
CO3	2	–	3	2	3	3
CO4	3	2	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	**Introduction to optimization:** Historical development, engineering applications of optimizations	02
2	**Classical optimization technique:** Single variable optimization. Multivariable optimization with no constraints, multivariable optimization with equality and quality constraints	06
3	**Linear programming:** Simple method- simplex algorithm **Non-linear programming:** One dimensional methods - elimination methods unrestricted search-exoustive search - Fibonacci method-golden section method – interpolation method, quadratic & cubic interpolation method- direct root method	06
4	**Non-linear programming:** Unconstrained optimization technique –direct search methods – random search, univariable and pattern search methods-descent methods-gradient of a function-steepost descent method –fletcher – reeves conjugate gradient method, quasi newton methods, dividon Fletcher powells	10

	variable metric method **Non-linear programming:** Constrained optimization techniques –direct method – method of physible direction- indirect method- transformation techniques – basic approach in the penalty function method – interior and exterior penalty function methods	
5	Introduction to dynamic programming	06
6	Introduction to CPM and PERT	06
7	Applications of the above methods to some structural problems	06

Recommended Books

1. Rao S. S. (2009), "Optimization - Theory and Applications", John Wiley & Sons, ISBN 0470183527, 813 pages
2. Gass S.I (2003), "Linear Programming", McGraw Hill Book.Co, ISBN 0486432847, 532 pages
3. SrinathL.S(2001),"PERT and CPM - Principles and Applications", Affiliated East-West Press (Pvt.) Ltd, ISBN 8185336202.
4. Wagner H.M, (1975), "Principles of Operation Research", Prentice Hall of India, ISBN 0137095929, 1039 pages

Advanced Design of Steel Structures [PE-MTSE124]

Course Code	Course Name
PC-BTC501	Advanced Design of Steel Structures

Course Objectives

The objectives of this course are

1. To develop clear understanding of concepts, and practical knowledge of modern Civil Engineering techniques for design of steel structures.
2. Use of various relevant IS codes for designing steel structures.
3. To encourage students and faculty to interact with industry, alumni and other reputed institutes for purpose of better understanding of industry requirements
4. To deal with social, environmental and economic issues

Course Outcomes

Upon successful completion of the course, students should be able to

1. Design steel members under tension, compression and bending using IS codes.
2. Design and detail welded and bolted connections in structural steel.
3. Analyse and design industrial steel structures and high-rise systems.
4. Analyse and design gantry girders, lattice towers, and chimneys.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	3	3	1
CO2	2	1	3	3	3	1
CO3	3	1	3	3	3	2
CO4	3	1	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	**Review of basic design of structural steel elements:** Tension members, compression members, flexural members	06
2	**Design of connections:** Review of basic connection design, Design of moment resistant bolted and welded beam end connections.	06
3	**Round Tubular Structural Members:** Properties of steel tubes, design of tension and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses	04
4	**Gantry Girder:** Loads acting on gantry girder. Analysis and design of gantry girder.	06
5	**Lattice Tower:** Different configurations of lattice towers, loads acting on lattice towers, analysis and design of lattice tower including welded or bolted	06

	connections for members.	
6	**Steel Chimney:** Forces acting on chimney, design of self- supporting welded chimney and its components including design of base.	06
7	Introduction to structural steel systems for high rise buildings and industrial structures, types of lateral load resisting systems and their applicability	06

Recommended Books

1. Design of steel structures: Subramanian, Oxford Press.
2. Design of steel structures: Negi L.S., Tata McGraw Hill
3. Design of steel structures: Kazimi S.M. A. & Jindal R.S., Prentice Hall of India.
4. Design of steel structures: Krishnamachar B.S, &Ajitha Sinha D.
5. Design of steel structures: Arya and Ajmani, New Chand & Bros.
6. Design of steel structures, Vol I & II: Ramchandran, Standard Book House, New Delhi.
7. Design of steel structures: Dayaratnam, Wheeler Publication, New Delhi
8. Comprehensive design of steel structures: Punamia, A.K. Jain &Arun Kumar Jain, Laxmi Publicalions Pvt. Ltd.
9. Design of steel structures: I C Sayal&Salinder Singh, Standard Publishers & Distributors.
10. Steel structures, Controlling behaviour through design: R. Englekirk, Wiley
11. Design of steel structures: Breslar, Lin and Scalzi, John Willey, New York.
12. Design of steel structures: Mac. Ginely T.
13. Structural steel work: Reynolds TJ., Kent L.E. &Lazenby, D.W., English University Press.

Advanced Solid Mechanics [PE-MTSE131]

Course Code	Course Name
PE-MTSE131	Advanced Solid Mechanics

Course Objectives

The objectives of this course are

1. This course will expand on the basic principles established in Solid Mechanics.
2. Methods of three-dimensional stress and strain analysis will be extended to allow the student to obtain solutions using analytical and/or numerical methods. These will include the analyses of principal stresses and strains, three dimensional Mohr's circles, strain gauge experimentation and failure criteria.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply stress/strain correlations for engineering problems
2. Derive governing differential equations to solve engineering problems like calculation of displacement, torsion in bars etc
3. Apply failure theories for engineering problems

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	1
CO2	3	–	3	3	3	2
CO3	3	–	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	**Revision:** Stress transformation and strain transformation at a point in an elastic body, 3-D Problems, rigid body translation and rotation of an element in space. Generalized Hook's law, separation of elastic strain rigid body displacement for a general displacement field u,v,w. Principal stresses and strains.	07
2	**Two dimensional problems in elasticity:** Plain stress and Plain strain problems. Differential equations of equilibrium and compatibility equations. Boundary conditions, stress functions.	06
3	**Problems in rectangular coordinates:** Polynomial solutions, cantilever loaded at the end, simply supported beam under uniformly distributed load, linear loading.	05
4	**Two dimensional problems in polar coordinates:** Stress distribution symmetrical about an axis, pure bending of curved bars, displacement for symmetrically loaded cases, bending of curved	06

	bars by forces at end. Effect of a circular hole in a plate under in-plane loading.	
5	**Three dimensional problems in elasticity:** Differential equation of equilibrium in 3D, condition of compatibility determination of displacement, principle of superposition, uniqueness theorem, problems of rods under axial stress bar under its own weight pure bending of prismatic rods, Bending of cantilever, stress functions circular and rectangular section non-symmetrical cross section. Shear center for different cross section of bars Torsion of prismatic bars of elliptical rectangular triangular and other sections. Membrane analogy-torsion of narrow rectangular bars. Torsion of hollow shafts and thin tube.	10
6	**Energy theorems**: Application of complimentary energy theorems to the problems of elasticity. **Failure theories:** Types of theories of failure and their application Maximum principle stress theory, Maximum shear stress theory Maximum principle strain theory, Maximum total strain energy theory Distortion energy theory	04
7	**Strain Guage Technique:** Strain measurement by resistance gauges, types of strain gauges, Equipment for indicating and recording strains transducer and its application.	04

Recommended Books

1. C.K.Wang (December 1963) , "Applied Elasticity", MCGRAW-HILL INC.,US, ISBN 0070681252, 537 pages
2. Timoshenko (1970), "Theory of Elasticity", McGraw-Hill Publishing Company, ISBN 0070858055,608 pages
3. Shames I. H (1964), "Mechanics of Deformable Solids", Prentice Hall India
4. Srinath L. S (2009)," Advanced mechanics of solids", Tata McGraw-Hill Education, ISBN 0070139881, 504 pages
5. Mohammad Ameen (January 2008), "Computational Elasticity: Theory of Elasticity, Finite and Boundary Element Methods" Alpha Science International Ltd, ISBN: 978-1842654491,532 pages
6. J. Chakrabarti (2006), "Theory of plasticity", Elsevier/Butterworth-Heinemann, ISBN 0750666382, 882 pages
7. Timoshenko S (2004), "Strength of Materials Vol – I & II", CBS Publishers & Distributors, ISBN 8123910304 ,298 pages
8. Boresi A. P (2002)," Advanced mechanics of materials", John Wiley & Sons, ISBN 0471438812,681 pages

Advanced Concrete Lab [PC-MTSE151]

Course Code	Course Name
PC-MTSE151	Advanced Concrete Lab

Course Outcomes

Upon successful completion of the course, students should be able to

1. Design high grade concrete and study the parameters affecting its performance.
2. Perform Non Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behaviour of structural/ elements

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	2
CO2	2	2	2	3	3	2
CO3	2	2	2	3	2	2

Course Content

Module No.	
1	Mix design of high strength concrete
2	Stress-Strain curve of high strength concrete
3	Cube compressive strength, cylindrical comp. strength of concrete and relation between them.
4	Split tensile strength and Modulus of rupture
5	A. Flexural strength of beam. B. Shear strength of beam
6	Non-Destructive Tests A. Study of Rebound Hammer test on concrete B. Ultrasonic Pulse Velocity test on Concrete C. Study of half-cell Potentiometer and measurement of corrosion in RCC. D. Core removal from concrete structure and compression testing E. Carbonation Test on concrete

Numerical Analysis Lab [SE-MTSE101]

Course Code	Course Name
SE-MTSE101	Numerical Analysis Lab

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply numerical methods such as Bisection and Newton-Raphson to find roots of non-linear equations.
2. Solve systems of linear equations using direct and iterative techniques, including Gauss Elimination, Gauss-Jordan, and Gauss-Seidel methods.
3. Implement curve fitting using the method of least squares and assess the quality of approximation.
4. Evaluate definite integrals using numerical integration techniques like the Trapezoidal and Simpson's rules.
5. Solve ordinary differential equations using Euler and Runge-Kutta methods and analyse the accuracy of the results.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	2
CO2	2	–	3	3	2	2
CO3	2	–	2	2	2	2
CO4	2	–	3	3	3	2

Course Content

Module No.	Details
1	Find the Roots of Non-Linear Equation Using Bisection Method
2	Find the Roots of Non-Linear Equation Using Newton's Method
3	Curve Fitting by Least Square Approximations.
4	Solve the System of Linear Equations Using Gauss - Elimination Method
5	Solve the System of Linear Equations Using Gauss - Seidal Iteration Method
6	Solve the System of Linear Equations Using Gauss - Jorden Method.
7	Integrate numerically using Trapezoidal Rule.
8	Integrate numerically using Simpson's Rules.
9	Numerical Solution of Ordinary Differential Equations By Euler's Method
10	Numerical Solution of Ordinary Differential Equations By Range- Kutta Method

Constitution of India (Indian Knowledge System Course) [IK-MTSE101]

Course Code	Course Name
PC-BTC501	Constitution of India (Indian Knowledge System Course)

Course Objectives

The objectives of this course are

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

Course Outcomes

Upon successful completion of the course, students should be able to

1. Describe the historical development and philosophical foundations of the Indian Constitution, including the role of the Drafting Committee.
2. Explain the Fundamental Rights, Directive Principles, and Fundamental Duties, and their significance in ensuring constitutional governance.
3. Analyse the structure, powers, and functioning of the Legislature, Executive, and Judiciary in India.
4. Interpret the framework of local governance and the role of the Election Commission in strengthening democratic processes.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	–	–	–	2
CO2	2	–	–	–	–	3
CO3	2	–	–	–	–	3
CO4	2	–	–	–	–	3

Course Content

Module No.	Details	Hrs.
1	History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)	04
2	Philosophy of the Indian Constitution: Preamble Salient Features	04
3	Contours of Constitutional Rights & Duties: • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies	04

	• Directive Principles of State Policy • Fundamental Duties.	
4	Organs of Governance: • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions	04
5	Local Administration: • District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. • Pachayati raj: Introduction, PRI: Zila Pachayat.	04
6	Elected officials and their roles, CEO Zila Pachayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy	04
7	Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women	04

Recommended Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

SEM – II

Finite Element Analysis [PC-MTSE201]

Course Code	Course Name
PC-MTSE201	Finite Element Analysis

Course Objectives

The objectives of this course are

1. To understand mathematical modelling and numerical formulation of engineering problems.
2. To learn about concepts of elements and their properties.
3. To understand finite element methods and its application for solution of structural mechanics problems.
4. To understand finite element methods and its application for solution of non-linear and dynamics problems

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the fundamental concepts of mathematical modelling, governing equations, and approximate methods such as collocation, least squares, Galerkin, and Rayleigh-Ritz methods.
2. Describe the basic steps of the Finite Element Method and apply various formulation techniques including direct, variational, and weighted residual approaches.
3. Develop interpolation functions and shape functions for one, two, and three-dimensional finite elements, including isoparametric and serendipity elements.
4. Apply finite element techniques for structural analysis of one-dimensional and two-dimensional problems, including trusses, beams, frames, and CST elements, and interpret non-linear and dynamic behaviour of structural systems.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	2	2
CO2	3	–	3	3	2	2
CO3	2	–	3	3	2	2
CO4	3	–	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	**Introduction** Mathematical Modelling of Engineering Problems, Types of governing equations, Solution methodologies, numerical modelling, approximate method of analysis – method of point collocation, method of collocation by sub region, method of least squares, Galerkin's method, Rayleigh-Ritz method	05
2	**Finite Element Method:**	06

	General Steps in FEM, Direct approach, variational approach, energy approach and weighted residual approach.	
3	**Finite Elements and Interpolation Functions:** Interpolation functions, one two and three dimensional elements – linear, quadratic, Cubic and Lagrangian Interpolation function, Isoparametric elements, Serendipity elements Shape Functions, Sub-Parametric and super parametric elements, Infinite elements	06
4	**One Dimensional Finite Elements:** Linear spring, Truss element, Space truss, Beam Element. Application to analysis of beams, trusses, plane frames and grids Multilinear springs, compression and tension only springs.	06
5	**Two Dimensional Finite Elements:** Two dimensional stress analysis, CST element for plane stress and plane strain, triangular elements for axi-symmetric analysis, rectangular elements, isoparametric formulation	06
6	**Introduction to Non-Linear Analysis:** Geometric Non-Linearity-Geometric Stiffness of an Axial Element. Stability of Bar- Spring System. General Formulation of Geometrically Non Linear Problem. Geometric Stiffness of Beam- Column and Triangular Elements. Non-Linear Material Behavior. Non- Linear Spring- Elasto Plastic Analysis by FEM- Elasto Plastic Analysis of a truss- Two Dimensional Element Formulations- General Formulation of a physically Non-Linear Problem	06
7	**Introduction to Dynamic Analysis by FEM:** Formulation of Inertial Properties- Lumped Mass vs Consistent Mass Matrices –Condensation and Assembly of Mass Matrices- Formulation of Damping Properties- Free Vibration, Steady – State and Transient Response Analysis for Simple Problems.	06

Recommended Books

1. Desai Y.M, Eldho T.I, Shah A.H (2011) ,"Finite Element Method With Applications in Engineering ", Pearson Education India , ISBN 8131724646 , 492 pages
2. Krishnamoorthy C.S, (1994), "Finite Element Analysis", Tata McGraw Hill, ISBN 0074622102, 710pages
3. William B. Bickford, (1990),"First Course in The Finite Element Method", ISBN 0256079730, 649 pages
4. Rajshekaran S. (2008), "Finite Element Analysis", Wheeler publishing, ISBN 8121923149, 630 pages
5. O. C. Zienkiewicz,K. Morgan (2000), "Finite Elements and Approximation", Dover publications, ISBN 0486453014, 352 Pages
6. J.N. Reddy, (2008), "Non linear Finite Element Analysis", Oxford University Press, ISBN 0195692039,
7. Cook R.D., Malkus D.S. and Plesha,(2001), "Concepts and Applications of Finite Element Analysis", John Wiley & Sons (Asia) PvtLtd.ISBN0471356050, 736 pages.

8. Weaver W and Johnston P.R., "Finite Element for Structural Analysis", Prentice Hall

Earthquake Engineering [PC-MTSE202]

Course Code	Course Name
PC-MTSE202	Earthquake Engineering

Course Objectives

The objectives of this course are

1. The importance of the earthquake engineering.
2. Basics of earthquake engineering : causes of earthquake, types of earthquakes, seismic waves, structure of earth, and measurement of earthquake.
3. Concept of Response Spectrum: ground motion parameters, response spectrum, characteristics of response spectrum, and methods of construction of response spectrum.
4. Analysis of the structure subjected to earthquake ground motion. Provisions of IS 1893-2016 and calculation of earthquake loads
5. Importance of ductility in earthquake resistant design of structures and provisions of IS 13920 (2016)
6. Practical knowledge by conducting some basic experiments in structural dynamics.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Describe earthquake phenomenon, their causes and effects on structures
2. Apply knowledge of structural dynamics in evaluation of structural response to earthquake ground motion
3. Characterize the ground motion in the form of response spectra and construct response spectra and evaluate the structural response to earthquake ground motion using response spectra
4. Perform Seismic analysis of structure, incorporating the provision of IS -1893-2016; and IS 13920- 2016

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	3	2	2
CO2	3	1	3	3	3	2
CO3	3	1	3	3	3	2
CO4	3	1	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	**Review of Structural dynamics:** Review of dynamic analysis of SDOF and MDOF systems subjected to various types of dynamic loads including earthquake ground motion.	02
2	**Seismological background:** Seismicity of a region, earthquake faults and waves, structure of earth, plate tectonics, elastic-rebound theory of earthquake, intensity and	06

	magnitude of earthquake, measurement of ground motion, seismogram, earthquake frequency, local site effects, seismo-tectonics and Seismicity of India. Effect of near-field and far-field earthquake ground motions	
3	**Characterization of ground motion:** Earthquake response spectra, factors influencing response spectra, design response spectra for elastic systems, peak ground acceleration, response spectrum shapes, deformation, pseudo-velocity, pseudo- acceleration response spectra. peak structural response from the response spectrum, response spectrum characteristics, construction of site-specific response spectra.	06
4	**Deterministic earthquake response:** Types of earthquake excitation, lumped SDOF elastic systems. translational excitation, lumped MDOF elastic systems, systems with distributed mass and elasticity, translational excitation, time history analysis, multi storied buildings with symmetric plans, multi storied buildings with unsymmetric plans, torsional response of unsymmetric plan building, distributed - parameter elastic systems, translational excitation, combining maximum modal responses using mean square response of a single mode, SRSS and CQC combination of modal responses. **Earthquake response of inelastic buildings:** Allowable ductility and ductility demand, building with weak or soft storey.	07
5	**I. S. code method of seismic analysis:** Equivalent static method and its limitation, response spectrum method, IS 1893-2016 provisions for seismic analysis of buildings and water towers, seismic evaluation and retrofitting, types of structural system used in building to resist earthquake loads.	09
6	**Seismic Design Considerations for RC Buildings:** Choice of earthquake resisting systems for low-rise, medium-rise and high-rise buildings, Principles of member design, ductile detailing, Earthquake Resistant Design of beams and columns, Design of Beam-Column Joints, Design of Shear Walls with ductile detailing, Drift and lateral stability criteria.	07
7	**Seismic Design Considerations for Steel Structures:** Performance of steel structures in the past earthquakes, Design philosophy for steel structures, Capacity design concept, Ductility of steel buildings, Seismic design and detailing of Moment Resistant Frames (MRFs); Beams and columns, Panel Zones and Connections, Seismic design and detailing of Concentric Brace Frames (CBFs)	05

Recommended Books

1. Dynamics of Structures by Anil K Chopra, Prentice Hall of India
2. Structural Dynamics of Earthquake Engineering: Theory & Application using MATHEMATICA & MATLAB by S Rajasekaran, Woodhead Publishing Ltd.
3. Earthquake Resistance Design & Risk Reduction by David Dowrick, Wiley India
4. Seismic Analysis of Structures by T K Dutta, John Wiley & Sons (Asia) Pvt.Ltd
5. Seismic design of RC buildings : Theory and Practice by S.N.Manohar, S.N.Madhekar
6. ,Springer (2015)
7. Earthquake Resistant Design of Structures by Manish Shrikhande, Pankaj Agrawal
8. I.S. Codes No. 1893, 4326, 13920 (All latest codes)
9. Fundamentals of Earthquake Engineering by N M Newmarks& E Rosenblueth, Prentice Hall
10. Earthquake Spectra & Design by N M Newmarks& W J Hall, Earthquake Engineering Research Institute, Berkeley, California
11. Dynamics of Structures by Clough &Penzien, McGraw-Hill, Computers & Structures
12. Fundamentals of Earthquake Engineering by Amr S Elnashai& Luigi Di Sarno, Wiley India
13. Fundamentals of Earthquake Resistant Construction by Ellis L Krinitzsky, James P Gould & Peter H Edinger, Wiley India
14. Elementary Seismology by C R Richter, W.H. Freeman & Company, San Francisco

Seminar/Mini Project [PC-MTSE203]

Course Code	Course Name
PC-MTSE203	Seminar/Mini Project

Course Outcomes

Upon successful completion of the course, students should be able to

1. Identify a relevant research or problem area in structural engineering through comprehensive literature review and gap analysis.
2. Formulate technical objectives and develop appropriate methodology for the selected seminar or mini project work.
3. Perform simulations, analysis, design, or modelling tasks using suitable engineering software tools or laboratory methods.
4. Prepare a well-structured technical report.
5. Deliver a professional technical presentation.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	3	2
CO2	3	-	3	2	3	2
CO3	3	-	3	3	3	2
CO4	2	3	-	1	-	-
CO5	2	3	-	1	-	-

Course Content

Students are expected to select topics keeping in mind the following points :

- Literature review on recent advances in any Structural Engineering sub-discipline (e.g., earthquake engineering, concrete technology, FEM, sustainable materials).
- Analytical, numerical or experimental work of limited scope.
- Use of structural engineering software (e.g., ETABS, STAAD Pro) for simulation/analysis/design.
- Model studies or material testing in laboratory (optional).
- Critical comparison of codal provisions (e.g., IS vs Eurocode).
- Case study analysis of structural failures or successful engineering projects.

The rubrics for evaluation shall be as follows :

Criteria	Excellent (9–10)	Good (7–8)	Satisfactory (5–6)	Needs Improvement (≤4)
Topic Selection & Relevance	Highly relevant, innovative, aligns with current trends in structural engineering.	Relevant and well-defined; moderate novelty.	Common topic but somewhat relevant.	Irrelevant or poorly defined topic.
Literature Review	Comprehensive, recent references, critical	Adequate review with	Limited scope, mostly	Incomplete, lacks

	analysis included.	good references, some critical insight.	descriptive.	coherence, outdated references.
Problem Definition & Objectives	Clear problem statement, measurable objectives, strong justification.	Reasonably clear with defined scope.	Objectives not very specific or measurable.	Vague or missing objectives.
Methodology / Technical Work	Well-planned, correct tools used (software/lab/analysis), validated approach.	Properly structured, technically sound.	Basic methodology, lacks depth or rigour.	Poor or incorrect method, unstructured approach.
Data Analysis / Results	Results well interpreted, graphs/tables clear, findings discussed analytically.	Good results with reasonable discussion.	Basic analysis, limited interpretation.	Poor analysis, irrelevant or unsubstantiated results.
Report Quality	Well-written, professional format, error-free, follows citation norms.	Clear language, structured well, minor errors.	Acceptable format but lacks clarity or consistency.	Poorly written, unorganised, full of errors.
Presentation Skills	Confident, clear, engages audience, excellent visuals.	Clear and logical, minor issues with timing or visuals.	Understandable but lacks flow or visual quality.	Poor communication, unreadable slides, disorganised.
Question Handling	Precise, logical responses, good command over subject.	Can answer most questions with some clarity.	Struggles with deeper questions.	Unable to answer or vague/unrelated answers.
Overall Technical Depth	Demonstrates detailed understanding and critical thinking.	Good grasp of subject and concepts.	Basic understanding, limited insight.	Lacks understanding or technical foundation.

Bridge Engineering [PE-MTSE211]

Course Code	Course Name
PC-BTC501	Bridge Engineering

Course Objectives

The objectives of this course are

1. To learn IRC Loading criteria
2. To understand fundamentals of Bridge design
3. To understand the principles of long span bridge design

Course Outcomes

Upon successful completion of the course, students should be able to

1. Understand the different loadings on Bridges & the components of different types of Bridges.
2. Understand the behaviour and suitability of various bridge types
3. Analyse the different types of bridges and design their various components.
4. Understand the different construction methods for bridge construction and their impact on bridge design.
5. Apply the Indian code provisions for analysis and design of bridge components.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	2	2	2	-
CO2	-	-	2	2	3	-
CO3	2	-	3	3	3	-
CO4	2	-	2	2	2	2
CO5	2	2	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	Classification and components of bridges, historical perspective, layout and planning, investigations for bridges, choice of type of the bridges, conceptual bridge design, bridge aesthetics. Bridge appurtenances.	07
2	Loading standards for highway and railway bridges (IRC, IRS)	05
3	Analysis and design of RC and PSC bridge decks: Slab culvert bridges, slab-and-beam bridges, load distribution in slabs and beams, behavior of skew bridge decks, box girder bridges	09
4	Behavior, analysis and design of steel bridge decks: girder bridges, truss bridges, arch bridges.	05
5	Bearings, substructure and foundations, piers and abutments of different types, shallow and deep foundations –design and constructional aspects	08
6	Modern methods of construction of concrete, steel and composite bridges, their impact on analysis and design, construction stage analysis.	06

	Introduction to analysis and design of long span bridges: suspension and cable stayed bridges, balanced cantilever construction, segmental construction.	
7	Introduction to seismic design of bridges	02

Recommended Books

1. Raju N. K (1988), "Design of Bridges", Oxford and IBH Publishing, ISBN 8120417410.
2. Victor D. J (2007), "Essentials of Bridge Engineering" , Oxford & IDH, ISBN 8120417178, 495 pages.
3. T.R Jagdeesh& M.A Jayaram,(2009), " Design of Bridge Structures", Prentice Hall India Private Ltd. New Delhi, 360 pages
4. Ponnuswamy S (2008), "Bridge engineering", Tata McGraw-Hill Education, ISBN 0070656959, 747 pages
5. Raina V.K(1994), " ConcreteBridge Practice", Tata McGraw Hill, ISBN 0074623621, 756 pages
6. Tomlinson M.J (2001), "Foundation Design And Construction " , Prentice Hall , ISBN 0130311801, 584 pages
7. FIB recommendations.

Analysis of Offshore Structures [PE-MTSE212]

Course Code	Course Name
PE-MTSE212	Analysis of Offshore Structures

Course Objectives

The objectives of this course are

1. To understand wave and ocean structure interaction under various types of Hydrodynamic and aerodynamic loading

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the principles of wave mechanics, wave generation, and small and finite amplitude wave theories relevant to offshore engineering.
2. Identify and classify different types of offshore structures and evaluate the associated environmental and hydrodynamic loads using appropriate methods and standards.
3. Apply static and dynamic analysis techniques to offshore structural systems, including the use of Morison equation and response to wind, wave, and current loads.
4. Design and assess offshore structural elements such as jacket platforms, mooring systems, and pipelines in accordance with relevant codes of practice.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	2	2
CO2	3	–	3	3	3	2
CO3	3	–	3	3	3	3
CO4	3	2	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	Wave Mechanics: Wave generation process, small and finite amplitude wave theories.	06
2	Types of offshore structures, planning and design aspects, Loads and structural forms of different types of offshore structures.	06
3	Wave loads regular and random, loads due to wind, tides and currents. Operational environment. Wind forces: Wave forces on vertical, inclined cylinders, structures – current forces and use of Morison equation.	06
4	Short and long term statistics of wind; static wind load; effect of size, shape and frequency; Aerodynamic admittance function and gust factor, spectral response due to wind for various types of structures;	06
5	Static and dynamic analysis of fixed structures.	06
6	Different types of offshore structures, foundation modeling, structural	06

	Modeling, Static method of analysis, Foundation analysis, Dynamics analysis of offshore structures, Design of platforms, Jacket tower and mooring cables and pipe lines	
7	Codes of Practices (latest versions) such as API R-2A, Bureau Veritas	06

Recommended Books

1. Brebbia C.A. and Walker (1978): Dynamic Analysis of offshore structures", Newness butterworth, London, 1978.
2. Sarpakaya T. and Isaacson M.(1981): Mechanics of Wave Forces on Offshore Structures", Van NostrandRainhold, NewYork, 1981.
3. Hallam M.G., Heaf N.J. and Wootton, L.R. (1978): "Dynamics of Marine Structures", CIRIA Publicartions, Underwater Engg. Group, London, 1978.
4. Graff W.J. (1981): "Introduction to Offshore Structures", Gulf Publishing Co., Houston, Texas, 1981.
5. Clough R.W. and Penzien J. (1992): "Dynamics of Structures", IInd Edition, McGraw hill, 1992.
6. Simiu E. and Scanlan R.H. (1978): wind effects on Structures", Wiley,New York, 1978.
7. Codes of Practices (latest versions) such as API R-2A, bureau Veritas etc.

Deterioration, Instrumentation and Rehabilitation of Structures [PE-MTSE213]

Course Code	Course Name
PE-MTSE213	Deterioration, Instrumentation and Rehabilitation of Structures

Course Objectives

The objectives of this course are

1. To impart knowledge on laboratory/field testing of Civil Engineering Structures.
2. To expose students to state-of-the-art Instrumentation for Structural analysis results and techniques for Rehabilitation of RC, Steel and Masonry structures.
3. To inculcate aptitude for quality control and strengthening of civil structures.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the working principles of various transducers and apply them for measuring displacement, velocity, acceleration, and strain in structural systems.
2. Analyse strain data to determine stresses and loads in structures and assess their performance under static and dynamic conditions.
3. Describe the properties and applications of special concretes and evaluate methods for preventing corrosion and addressing structural cracking.
4. Apply appropriate non-destructive testing techniques and rehabilitation strategies for RC, steel, and masonry structures in line with relevant codal provisions.

CO-PO Mapping

CO → / PO ↓	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	–	3	3	2	2
CO2	3	–	3	3	3	2
CO3	2	–	3	3	2	3
CO4	3	2	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	Study of various transducers, Principle of their working, displacement, velocity, acceleration, etc., strain gauge & piezoelectric type of transducers.	10
2	Strain measurements, strain gauges (static and dynamic), calculation of stresses and loads from measurements of strains and deflections.	05
3	Special concrete constructions: fibre reinforced concrete; fibre wrapping, Special concrete like lightweight concrete, ferro cement, fly ash concrete, High performance concrete, concrete admixtures.	06
4	Corrosion of steel and concrete: Theory and prevention	06
5	Cracks in buildings: causes and remedial measures.	06
6	Techniques for Rehabilitation of RC, Steel and Masonry structures	06
7	Non-destructive testing of concrete, steel structures, Various NDT tests,	07

	codal provisions, Proof Load testing.	

Recommended Books
1. Singh, Sadhu; Experimental Stress Analysis, Khanna Publishers. 2. Soisson, H.E.; Instrumentation in Industry; John Willey & Sons; NY; 1975 3. Boomfield, J.P.; Corrosion of Steel in Concrete; E& FN SPON; 1997 4. Ganesan, T.P.; Model Analysis of Structures; University Press; 2000 5. IS: 13935; Repair and Seismic Strengthening of Bulidings- Guidelines; Bureau of Indian Standard; New Delhi; 1993 6. SP: 25; Causes and Prevention of Cracks in Buildings; Bureau of Indian Standard; New Delhi; 1984

Advanced Design of Concrete Structures [PE-MTSE221]

Course Code	Course Name
PE-MTSE221	Advanced Design of Concrete Structures

Course Objectives

The objectives of this course are

1. To introduce the students to different design philosophies applied to reinforced concrete structures.
2. To introduce the students to the design of special reinforced concrete structures.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Analyse and design reinforced concrete sections using ultimate load theory and rectangular stress block concepts, including singly and doubly reinforced and tee sections.
2. Interpret the concept of limit design and apply moment-curvature relationships and ultimate load methods to the analysis of continuous beams and portal frames.
3. Perform yield line analysis of reinforced concrete slabs using virtual work and equilibrium methods under different boundary conditions.
4. Design complex reinforced concrete systems including flat slabs, silos, bunkers, and various foundation types in accordance with relevant codes of practice.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	2
CO2	3	–	3	3	3	2
CO3	3	–	3	3	3	2
CO4	3	2	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	**Ultimate Load analysis of concrete structures:** Stress strain characteristics of concrete and reinforcing steel, review of elastic theory and ultimate strength theory, Whitney's rectangular stress block, analysis and design of singly and doubly rectangular and tee sections.	06
2	**Concept of limit design:** Introduction to the concept of limit design. Moment curvature relationship of reinforced concrete sections, rotation capacity of sections, ultimate load analysis by Cambridge and Baker's method. Application to continuous beams and simple rectangular portal frames.	06
3	**Yield line analysis:** Yield line analysis of slabs, virtual work and equilibrium method. Application to orthotropically reinforced rectangular slabs with various boundary conditions under uniformly distributed loads.	06

4	**Reinforced concrete design by limit state method:** Review of limit state method as per IS 456:2000. Limit state collapse in flexure, direct compression, compression with bending, shear and torsion, limit state of serviceability for deflection and cracking, applications to beam-slab system of typical residential, office, industrial floors and rectangular portal frames and gable ended frames.	06
5	**Design of different slab systems:** Analysis and Design of Two-way Slab System without Beams (Flat Plate and Flat Slabs), Two-way Slabs with Beams.	06
6	**Silos and bunkers:** Lateral pressure as per Janssen's and Airy's theories, design consideration for square, rectangular and circular shapes, design of hoppers and supporting structures.	06
7	**Design of RCC foundations :** Raft foundations, Pile cap with different arrangements of piles	06

Recommended Books

1. G. S. Ramaswamy, (2005), "Design and Construction of Concrete Shell Roofs ", CBS Publishers & Distributors, ISBN 8123909905.
2. Karve S.R. and Shah V. C (1994), "Design of Reinforced Cement Concrete Structures using Limit State Approach", Structures Publishers, ASIN B007I29ARC.
3. Krishna Raju (2016), Advanced Reinforced Concrete Design (IS : 456-2000) , CBS Publishers & Distributors, ISBN: 9788123929606, 8123929609, 488 Pages.
4. V. Ramkrishnan & P. D. Arthur (1964), "Ultimate Strength Design for Structural Concrete", Wheeler Publishing Co, Pitman, 264 pages.
5. P. C. Verghese, (2005), "Advanced Reinforced Concrete Design", PHI Publishers, ISBN-10: 812032787X, 560 pages.

Theory of Plates [PE-MTSE222]

Course Code	Course Name
PE-MTSE222	Theory of Plates

Course Objectives

The objectives of this course are

1. To enable students to acquire the analytical and numerical methods needed for the solution of different types of plates and thin slabs.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Express various types of loadings on a plate in terms of Fourier series.
2. Apply the Navier and Levy solutions for rectangular plates with different boundary conditions and loading.
3. Obtain solutions for circular plates.
4. Use finite difference methods to obtain plate deflections and moments, and also apply available finite-element programs to plate problems.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	1
CO2	3	–	3	3	3	2
CO3	2	–	3	3	2	2
CO4	3	–	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	**Introduction**: Introduction to theory of plates with small and large deflections, distinction between plate and shell action.	06
2	**Pure bending of thin plates**: Curvature at a point, circle of curvature, moment curvature relationships, relationship between twisting moment and twist of surface.	06
3	**Classical plate theory**: Classical Small-Deflection Theory of Thin Plates, Plate Equation in Cartesian Coordinate System, Boundary Conditions of Kirchhoff's Plate Theory	06
4	**Symmetrical bending of thin circular plates with small deflections under axi-symmetrical transverse loads:** Differential Equation of Circular Plates, Circular plates different support conditions, plates with overhangs, plates with coaxial circular opening. Circular plates subjected to different loads.	06

5	**Small deflection theory for laterally loaded thin rectangular plates**: Rigorous Solution of Plate Equation, Rectangular plates subjected to transverse load, Transverse shears and bending moments, corner effects	06
6	**Series solutions of governing differential equation:** Various support conditions, Navier's and Levi's solution for uniformly distributed, uniformly varying load and concentrated loads	06
7	**Numerical technique for solution of plate equations:** Use of numerical techniques for the solution of plates, concept of influence surface; study of simply supported plate with continuous edge moments,	06

Recommended Books

1. D Timoshenko, (1989), "Theory of Plates and Shells", McGraw-Hill, 580 pages
2. Varadan T.K and Bhaskar K, "Analysis of Plates Theory and Problems", Narosa Publishing House, ISBN 8173192561, 198 pages
3. N.K. Bairagi(1984)," Plate Analysis", Khanna Publishers, 310 pages
4. Bhavikatti (2015), "Thoery of Plates & Shells", New Age International
5. R.Szilard(1974), "Theory and Analysis of Plates, "John Wiley & Sons, ISBN 0471429899,1024 pages

Reliability Based Civil Engineering Design [PE-MTSE223]

Course Code	Course Name
PE-MTSE223	Reliability Based Civil Engineering Design

Course Objectives

The objectives of this course are

1. Random variables, probability and statistics, Monte Carlo simulation, Variation reduction techniques
2. Concept of failure of a structure
3. Reliability based design , Application of reliability analysis to structural members and structural systems

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the concepts of uncertainty, random variables, and probability distributions relevant to structural safety and reliability.
2. Apply simulation techniques such as Monte Carlo methods and reliability indices including First Order Second Moment and Hasofer-Lind methods to quantify structural reliability.
3. Evaluate reliability-based design formats, including the development and calibration of partial safety factors for load and resistance models.
4. Analyse structural members and systems using advanced reliability methods such as Bayesian and response surface approaches, including time-varying reliability.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	2
CO2	3	–	3	3	3	3
CO3	3	–	3	3	3	2
CO4	3	–	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	**Revision:** General introduction to structural safety and reliability and reliability. Concept of uncertainty in reliability-based analysis and design. Course outline.	10
2	Random variables. • Probability axioms and probability functions. • Conditional probability. • Common probability distributions. • Correlation between random variables. • Random vectors and functions of random variables	04

3	Monte Carlo simulation, Variation reduction techniques.	05
4	Concept of failure of a structure. • Reduced variable space and basic definition of reliability index. • First order second moment index. • Hasofer-Lind reliability index. • Rackwitz-Fiessler reliability index.	06
5	Reliability-based design code and its development. • Load and resistance factor design format. • Calibration of partial safety factors. • Uncertainty models for load and resistance.	05
6	Second order reliability method. • Bayesian approach. • Response surface approach. • Time-varying reliability. • Summary.	06
7	Application of reliability analysis to structural members and structural systems	06

Recommended Books

1. Srinath L., Raghavan. M., Ingaiah K., Gargesha G, Pant B. and Ramachandra K., Experimental Stress Analysis, Tata McGraw Hill Company, New Delhi, 1984.
2. Dally J. W. and Riley W. F., Experimental Stress Analysis, McGraw Hill Book Co. 1977.
3. Ang, A.H.S. & Tang, W.H. (1975), "Probability Concepts in Engineering Planning and Design: Volume 1 - Basic Principles", Wiley, New York, ISBN 3857480939
4. Benjamin, J.R. & Cornel, C.A. (1970), "Probability, Statistics and Decision for Civil Engineers", McGraw-Hill, New York, 684 pages
5. Ellingwood, B. et al.(1980), "Development of a Probability Based Load Criterion for American National Standard A58", US Department of Commerce, Special Publication NBS-577.
6. Ranganathan R. (1990), "Reliability Analysis and Design of Structures", McGraw-Hill, New Delhi, ISBN 0074603140, 354 pages

Theory of Shells [PE-MTSE224]

Course Code	Course Name
PE-MTSE224	Theory of Shells

Course Objectives

The objectives of this course are

1. To enable students to acquire the analytical and numerical methods needed for the solution of different types of shells

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the structural behaviour of thin shells, including membrane and bending actions, and classify shell forms based on geometric properties and curvatures.
2. Apply membrane theory to analyse stress resultants in cylindrical and revolution shells subjected to symmetric and axisymmetric loads.
3. Evaluate bending behaviour in open and closed cylindrical shells using approximate and exact theories, considering various boundary conditions and stiffness coefficients.
4. Analyse shells of revolution and shallow shells using advanced moment and approximate theories, and assess the impact of edge effects in structural performance.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	2	1
CO2	3	–	3	3	3	2
CO3	3	–	3	3	3	2
CO4	3	–	3	3	3	3

Course Content

Module No.	Details	Hrs.
1	Introduction to structural behavior of thin shells, membrane and bending actions.	04
2	**Mathematical representation of a shell surface:** Principal curvatures, Gauss curvature. Classification of Shells	05
3	**Membrane theory of thin shells:** Stress resultants, application to cylindrical shell under symmetric loads and surfaces of revolution under axi-symmetric loads	05
4	**Bending theory of open circular cylindrical shells:** With special emphasis to approximate theories of Finsterwalder and Schorer theories: Introduction to DKJ Flugge and other exact theories: Different boundary conditions for single and multiple shells.	05
5	**Bending theory of closed cylindrical shell:** Stiffness coefficients at free edges along radial and rotational directions;	05

	Bending theory of spherical shells. Geckeler's approximations, Stiffness coefficients	
6	**Moment theory of shells of revolution:** Introduction, Governing equations, Shells of revolutions under axi-symmetrical loads, Approximate method for solutions of governing equations.	06
7	**Approximate theories of shell analysis and their application:** Introduction, the semi membrane theory of cylindrical shells, The Donnel-Mushtari Vlasov theory of thin shells, Theory of shallow shells, Edge effects.	06

Recommended Books

1. Stephen Timoshenko, S. Woinowsky-Krieger (2003), "Theory of Plates and Shells", Textbook Publishers, ISBN 0758184093, 580 Pages
2. R. Chandrashekara, (1987), "Analysis of Thin Concrete Shells", McGraw Hill Book Co, ISBN 0074515683, 288 Pages
3. Ramaswamy G.S., (1984),"Design and Construction of Concrete Shell Roofs", Krieger Pub Co; ISBN 0898740010, 745 Pages
4. N.K. Bairagi, (1990), "Shell Analysis", Khanna Publishers, Delhi ,
5. V.V. Novozhilov, (1970), "Thin Shells", Kluwer Academic Publisher, ISBN 900164550X, 429 Pages
6. Bhavikatti (2015), "Theory of Plates & Shells", New Age International.

Operations Research [OE-MTSE201]

Course Code	Course Name
OE-MTSE201	Operations Research

Course Objectives

The objectives of this course are

1. To impart knowledge in concepts and tools of Operations Research.
2. To understand mathematical models

Course Outcomes

Upon successful completion of the course, students should be able to

1. Formulate and solve linear and non-linear programming problems relevant to civil engineering projects using graphical, simplex, and dual methods.
2. Apply optimisation techniques such as CPM/PERT, dynamic programming, and network flow models for effective planning, scheduling, and resource allocation in construction and infrastructure projects.
3. Analyse inventory control and material management problems in civil engineering using deterministic and probabilistic models.
4. Evaluate construction operations and project strategies using decision-making tools such as game theory, simulation, and sensitivity analysis.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	3	2
CO2	2	–	3	3	3	3
CO3	3	–	2	2	3	2
CO4	3	–	2	2	3	3

Course Content

Module No.	Details	Hrs.
1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	06
2	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method	06
3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.	06
4	Scheduling and sequencing - single server and multiple server models - deterministic inventory models	06
5	Probabilistic inventory control models - Geometric Programming.	06
6	Sensitivity analysis - parametric programming	06
7	Competitive Models, Single and Multi-channel Problems,	06

	Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	

Recommended Books
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008 2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982. 3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008 4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009 5. Pannerselvam, Operations Research: Prentice Hall of India 2010 6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Legal Aspects in Construction [OE-MTSE202]

Course Code	Course Name
OE-MTSE202	Legal Aspects in Construction

Course Objectives

The objectives of this course are

1. To describe fundamentals of common law and understand bid cycle
2. To explain Indian contract act and demonstrate the concept contract administration
3. To summarize students with Laws applicable to construction activity
4. To interpret various acts in connection with construction activities

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the fundamental principles of contract law, key legal terms, and the relevance of the Indian Contract Act 1872 in the context of construction projects.
2. Interpret and apply contract documents, correspondence, and legal provisions related to dispute resolution, claims, delays, and contract administration.
3. Analyse various types of construction contracts, tendering procedures, bid evaluation systems, and contract signing processes in public and private sector projects.
4. Evaluate legal frameworks applicable to construction such as Arbitration and Conciliation Act, Evidence Act, and labour laws, and assess professional liability in engineering practice.

CO PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	3	2
CO2	2	–	3	3	3	3
CO3	3	–	2	2	3	2
CO4	3	–	2	2	3	3

Course Content

Module No.	Details	Hrs.
1	Basic Law	03
2	Contract Administration a. What is a Contract? Understanding Construction Contracts. Contract as per the Law. The necessity and importance of administering the contract. Difference in Management and Administration. b. Understanding legal contract, Void and Voidable contract, Understanding various terms like Waiver, Selection, Estoppels, Constructive notice, Express and Implied Terms, Ad-idem, Terms of contract, etc. c. Understanding the Indian Contract Act 1872 and the importance and relevance of various sections of the Act.	09

	d. Interpretation of Contract e. Importance of correspondence during the progress of work. Methods of writing letters. Common dos and don'ts in administering the contract. f. Areas of Disputes and Differences in Contract. Method of handling various situations, Extra Item, Extension of time, LD etc.	
3	Construction Contract a. Types of Contracts; b. Stages and parts in the Tendering process; c. Preparation of Tender documents; Prequalification and registration of contractors; d. Study of contract conditions for bidding; e. Pre-bid conference and site surveys; f. Bid/No bid analysis; Preparation and submission of bids; g. Evaluation of Tenders; Multi-criteria bid evaluation system; h. Letter of acceptance and contract signing.	08
4	Understanding Delays, Types of Delays and Analysis of Delays. Various types of claims. Understanding the legality of claims.	06
5	Alternative Dispute Resolution, Arbitration and Conciliation Act 1996	06
6	Principle of Evidence Act, Limitation Act, Principle Act, Workmen's Compensation Act, Employer's Liability Act, Payment of wages Act, Contract Labour Act.	05
7	Standard Form of Contract (Indian and International) Professional Liability	05

Recommended Books

1. Bajirao Shankarrao Patil (1986); "Legal Aspects of Building & Engineering Contracts"
2. S.B. Patil. 471p.
3. G. T. Gajria, Kishore Gajria (2000); "Law Relating To Building & Engineering Contracts In India", Lexisnexis Butterworths India. ISBN 13: 9788187162162. 538p.
4. P. C. Markanda, Naresh Markanda (2013); "Law Related To Arbitration and Conciliation" Lexisnexis Butterworths India. ISBN 13: 9788180388132. 1570p.
5. Edward R. Fisk, Wayne D. Reynolds (2013); "Construction Project Administration" Pearson Education. ISBN 13: 9780133149258. 432p.
6. Indian Contract Act 1872
7. Arbitration Conciliation Act 1996.4. All Referred Bare Acts
8. CPWD Manual Volume I & II, A Handbook For Government Officials And Contractors

Business Analytics [OE-MTSE203]

Course Code	Course Name
OE-MTSE203	Business Analytics

Course Objectives

The objectives of this course are

1. The main objective of this course is to give the student a comprehensive understanding of business analytics methods.
2. Understand and critically apply the concepts and methods of business analytics. Identify, model and solve decision problems in different settings.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Describe the role of a business analyst and explain stakeholder dynamics, requirement types, and the importance of effective requirement gathering.
2. Analyse various life cycles including system, project, and requirement life cycles relevant to business analysis processes.
3. Apply structured techniques to transform stakeholder needs into formal models using tools such as UML, BPMN, and data flow diagrams.
4. Evaluate and manage business requirements through prioritisation, change control, and the use of analytical tools while exploring emerging trends like data storytelling and collaborative intelligence.

CO PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	1	1
CO2	2	–	2	2	2	–
CO3	3	2	3	2	3	–
CO4	2	2	2	3	3	2

Course Content

Module No.	Details	Hrs.
1	Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.	06
2	Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.	06
3	Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.	07
4	Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship	06

	Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling	
5	Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools	06
6	Recent Trands in: Embedded and collaborative business intelligence	06
7	Visual data recovery, Data Storytelling and Data Journalism.	05

Recommended Books

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Cost Management of Engineering Projects [OE-MTSE204]

Course Code	Course Name
OE-MTSE204	Cost Management of Engineering Projects

Course Objectives
The objectives of this course are 1. Cost management is to reduce the Project cost expended by Direct Costs and indirect costs 2. Establish systems to help streamline the transactions between corporate support departments and the operating units.

Course Outcomes
Upon successful completion of the course, students should be able to 1. Explain the strategic cost management process and apply cost concepts such as relevant, differential, and opportunity cost in engineering decision-making. 2. Analyse cost estimation methods including analogous and parametric techniques, and develop project control budgets from engineering, procurement, and construction perspectives. 3. Interpret financial statements and working capital metrics to assess project profitability and optimise cash flow and resource allocation. 4. Apply earned value management, cash flow analysis, and financial controls to manage direct and indirect project costs effectively, including GST and insurance considerations.

Course Content		
Module No.	**Details**	**Hrs.**
1	Introduction and Overview of the Strategic Cost Management Process	06
2	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	06
3	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre-project execution main clearances and documents	07
4	**Cost Estimations** Methods of cost estimation – Analogous estimates – Parametric estimates & cost aggregation method – Contingency reserve and management reserve in project cost estimations - Cost baseline & cost budgeting, Developing Project Control Budget. Understanding the cost estimates from	06

	Engineering, Procurement and Construction point of view.	
5	**Financial Statements** Understanding Financial Statements, EBITDA, PBIT, PAT, Financial Ratios for understanding Profitability and healthy Cash Flow management	06
6	**Working Capital Management** Working Capital Basics - Working Capital Issues in Projects - Estimating Working Capital - Working Capital ratios - Inventory Ordering Cost - Economic Order Quantity (EOQ) - Work In Progress (WIP).	06
7	**Project Cash flow Management** Project Cash flow, Components of Cash flow - Impact of Cash flow on Project Performance - Construction cumulative cost curves - Earned Value Management concept, Direct & Indirect Cost in Projects, Project overheads, Understanding the aspects of GST, Project Insurance.	05

Recommended Books

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd
6. Prasanna Chandra (2011); "Financial Management", Tata McGraw-Hill Education. ISBN 13: 9780071078405. 1026p.

Artificial Intelligence in Engineering [OE-MTSE205]

Course Code	Course Name
OE-MTSE205	Artificial Intelligence in Engineering

Course Objectives

The objectives of this course are

1. To introduce the students to the various soft computing techniques.
2. To prepare the student for the application of artificial intelligence techniques in engineering.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain basics of soft computing techniques.
2. Apply artificial intelligence techniques to the engineering problems.

CO and PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	2	–	1	1
CO2	3	–	3	3	3	2

Course Content

Module No.	Details	Hrs.
1	Introduction to Soft computing techniques- soft computing techniques, importance, types of soft computing techniques, advantages and limitations.	06
2	Introduction to Fuzzy logic: Fuzzy sets Fuzzy set operations- Fuzzy Relations-Cardinality of Fuzzy Relations-Operations on Fuzzy Relations-Properties of Fuzzy relations- Membership Functions-Features of Membership functions- Fuzzification-Methods of Membership value Assignments- Fuzzy Rule Base-Defuzzification-Defuzzification methods-Fuzzy logic controller (Block Diagram)	06
3	Artificial Neural Networks: Basic Concepts-Neural network Architectures- Single layer feed forward network-Multilayer feed forward network- Recurrent Networks-Characteristics of Neural Networks-Learning methods. Perceptron networks-Back Propagation Networks-Radial base function network-Hopfield network- Kohonen Self organizing maps.	10
4	Fundamentals of genetic algorithms and Genetic Programming: Basic concepts- working principle - encoding different methods - fitness function, reproduction-different methods. Genetic modelling in heritance-Crossover mutation-convergence of genetic algorithm. Basic difference between genetic algorithm and genetic programming.	10

5	Introduction to Hybrid systems: Concept of hybrid system and its significance in general to water resources problems, Neural network, fuzzy logic and genetic algorithm hybrids - Neuro fuzzy hybrids- neuro genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propagation network- Fuzzy back propagation networks -fuzzy logic controlled genetic algorithms.	10

Recommended Books

1. Rajasekharan, S. and Vijayalakshmi, G.A.Pai, -Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, Prentice Hall India.
2. Sivanandam, S.N and Deepa, S.N. -Principles of Soft Computing, Wiley India
3. Ross Timothy J, -Fuzzy logic with Engineering Applications, McGraw Hill, New York.
4. Haykins S. -Neural Networks a Comprehensive foundation, Pearson Education.
5. Goldberg, D.E. -Genetic Algorithms in Search Optimization and Machine Learning, Pearson Education
6. Recent Literature

Earthquake Engineering and Model Testing Lab [SE-MTSE201]

Course Code	Course Name
SE-MTSE201	Earthquake Engineering and Model Testing Lab

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the fundamental concepts of earthquake-resistant and performance-based seismic assessment
2. Model the stiffness, strength, and ductility of structural components
3. Apply non-linear static and dynamic analysis methods
4. Analyse structural response through free and forced vibration tests on shake table

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	2	2	3	2
CO2	-	-	3	3	3	2
CO3	2	-	3	3	3	2
CO4	3	3	3	3	3	2

Course Content

Module No.	Details
1	Concepts of Earthquake Resistant Design: Force based vs. displacement-based design, performance-based design, seismic input characteristics and their effect on seismic design, study of ASCE 41
2	Modelling for Performance Based Design: Back-bone curve, Idealized component models, estimation and modelling of stiffness, strength and ductility of RC, and steel structures
3	Methods for non-linear seismic analysis of Structures Nonlinear static and dynamic analysis methods : NLSPA, NLTH (selection and scaling of time histories –ASCE-41, PEER database)
4	Direct Displacement-Based Design: Structure performance objectives, performance levels (structural and NSE) and limit states; P-Delta effects; Torsion; Capacity design for direct displacement-based design.
5	Performance-Based Design: Structural and non-structural performance, quantification of performance
6	Free vibration analysis on model : Natural frequency and Damping of frames – (Time domain)
7	Forced vibration analysis on shake table : Response Analysis of Frames subjected to ground motion

Structural Design Lab [PC-MTSE251]

Course Code	Course Name
PC-MTSE251	Structural Design Lab

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply relevant IS codes to design residential or commercial buildings using structural analysis software.
2. Develop complete structural models and perform analysis and design of various structural elements including beams, slabs, columns, and footings.
3. Interpret and validate structural outputs to ensure code compliance and functional safety.
4. Prepare detailed structural drawings using CAD tools for execution-level documentation

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	3	3	3	–
CO2	2	–	3	3	3	–
CO3	2	2	2	3	3	1
CO4	–	3	2	2	2	1

Course Content

Module No.	Details
1	**Introduction to Structural Systems and IS Codes:** • Overview of building systems – Load-bearing and Framed structures • Types of loads as per IS 875 (Part 1 to 5) • Introduction to IS 456:2000, IS 13920:2016, IS 800:2007, and IS 1893:2016 • Structural design philosophy – Working Stress, Limit State Method • Typical design workflow in real-world projects
2	**Software-Based Structural Modelling:** • Introduction to software tools: STAAD Pro / ETABS / SAP2000 (any one) • Setting up geometry, supports, materials, and sections • Load assignment: Dead Load, Live Load, Wind Load, Seismic Load • Load combinations as per IS codes • Modelling tips for multistorey buildings • Analysis: Linear static and Response spectrum analysis
3	**RCC Element Design:** • Design of slabs (one-way, two-way, cantilever) • Design of beams: flexure, shear, torsion • Design of columns: axial and biaxial bending • Design of isolated and combined footings • Design for ductility as per IS 13920

	• Output interpretation: Reinforcement detailing and member capacity
4	**Detailing and Drafting using CAD:** • Introduction to structural CAD drafting standards • Preparation of General Arrangement Drawings (GAD) • Column layout plans, Beam layout plans, Slab layout • Footing plans and Sectional elevations • Detailing of reinforcements for slab, beam, column, footing • Introduction to bar bending schedules and sheet preparation
5	**Design of Staircase, Lift Well, and Retaining Walls:** • Structural modelling and design of staircase • Lift pit detailing and analysis • Design of cantilever and counterfort retaining walls • Drafting of sections and reinforcements
6	**Wind and Seismic Design Considerations:** • Wind analysis using IS 875 (Part 3) • Seismic design as per IS 1893:2016 • Concepts of Response Spectrum and Time History methods • Equivalent static method and base shear calculation • Structural modelling for seismic loads
7	Final Project – Complete Building Design and Drawing • End-to-end design of a G+3 or G+5 Residential or Commercial Building • Load calculation, modelling, analysis, and design • Preparation of final CAD drawings: plans, sections, details • Generation of design reports, BBS, and submission-ready documentation
Deliverables: • Structural design report with all load cases and design calculations • Full CAD set of drawings • Bar bending schedule (BBS) • Final presentation of project **Software to be Used:** • Structural Design Software: STAAD Pro / ETABS / SAP2000 • Drafting Software: AutoCAD • Optional: MS Excel for manual checks and BBS preparation	

English for Technical Writing [AE-MTSE201]

Course Code	Course Name
AE-MTSE201	English for Technical Writing

Course Outcomes

Upon successful completion of the course, students should be able to

1. Demonstrate improved writing skills and enhanced readability by applying principles of technical English proficiency.
2. Apply structured writing processes and strategies to produce high-quality research papers and user-oriented technical documents across various genres.
3. Adhere to professional conventions in research writing, including clarity, style, design, and layout to create well-structured written materials.
4. Prepare effectively for campus placement by developing professional reports, resumes, and participating confidently in group discussions and interviews.
5. Present research content with clarity, precision, and confidence through well-organized oral and written presentations.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	-	-	2
CO2	-	3	2	-	2	2
CO3	-	3	2	-	2	2
CO4	-	3	-	-	2	3
CO5	-	3	2	-	2	3

Course Content

Module No.	Details	Hrs.
1	**Foundations of Academic English in Research:** Academic English - MAP (Message-Audience-Purpose) - Language Proficiency for Writing - Key Language Aspects - Clarity and Precision - Objectivity - Formal Tone - Integrating References - Following Academic Conventions Word Order - Sentences and Paragraphs - Link Words for Cohesion - Avoiding Redundancy / Repetition - Breaking up long sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title and Sub-headings	05
2	**Advanced Reading Skills for Researchers:** Reading Academic Texts – Barriers – Reading Strategies-Critical Reading Strategies - Skimming and Scanning - Primary Research Article vs. Review Article - Reading an Abstract - Analysing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes	03
3	**Report Writing and Proposals:**	06

	Report writing: Objectives of report writing, Language and style in a report, Types of reports. Formats of reports: Memo, Letter, and Project report Survey based. (A Computer- aided presentation of the Project report) - Technical paper writing- Proposal writing. Business & Technical writing: Types of meetings, Notice, Agenda, Minutes of the meetings, Strategies for conducting effective. **Mastery In Revising, Editing, And Proofreading:** Effective Revisions - Restructuring Paragraph - Editing vs Proofreading Editing for Clarity and Coherence - Rectifying Sentence Structure Issues - Proofreading for Grammatical Precision – Spellings - Tips for Correspondence with Editors	
4	**Grammar Refinement for Research Writing:** Advanced Punctuation Usage - Grammar for Clarity - Complex Sentence Structures - Active- Passive Voice - Subject-Verb Agreement - Proper Use of Modifiers - Avoiding Ambiguous Pronoun References - Verb Tense Consistency - Conditional Sentences	04
5	**Presentation Language Skills:** Written vs. Spoken English - Dynamic Vocabulary for Presentations – Expressive Language for Audience Engagement - Q&A Session Preparation Strategies - Language for Clear and Impactful Slides - Adapting Language Style to Different Audiences-	03
6	**Employment Skills:** Group Discussion -SWOT Analysis- Interview Skills: Preparation and Presentation- Meaning and types of interviews (F2F, telephonic, video, etc.) Dress Code- Background Research-Do's and Don'ts- (STAR Approach) for facing an interview-Interview procedure -Important questions generally asked in a job interview (open and closed ended questions)-Simulation- Observation of exemplary interviews- Comment critically on simulated interviews -Elevator Pitch-Crafting effective elevator pitch - structure concise and relevant speeches-Mock Interviews.	06
7	**Resume Skills:** Preparation and Presentation- Introduction of resume and its importance- Difference between a CV, Resume and Bio data-Essential components of a good resume.- Common Errors-Common errors people generally make in preparing their resume Prepare a good resume of her/his considering all essential component	03
End Semester would be 50 marks of presentation and report (conducted before hand) and 50 marks for the final written end semester paper		

Recommended Books
1. Bailey. S. 2015. Academic Writing: A Handbook for International Students. London and New York: Routledge.

2. Craswell, G. 2004. Writing for Academic Success. Sage Publications.
3. Creme, P. & M. Lea. 2008. Writing at University: A guide for students. Open University Press.
4. Oshima, A. & Hogue, A. 2005. Writing Academic English, Addison-Wesley, New York
5. Swales, J. & C. Feak. 2012. Academic Writing for Graduate Students: Essential Skills and Tasks. Michigan University Press.
6. Wallwork, Adrian. 2015. English for Academic Research: Grammar, Usage and Style, Springer, New York
7. English for Writing Research Papers, Springer, New York.

Project Planning and Management [AE-MTSE202]

Course Code	Course Name
AE-MTSE202	Project Planning and Management

Course Objectives

The objectives of this course are

1. Understand the roles and responsibilities of civil /structural and Construction engineer in practice.
2. Understand the important activities and the sequence in which they are to be carried out.
3. Learn the importance of accuracy and correctness in work and how this is achieved.
4. Understand the skills required by a civil /structural and Construction engineer.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Have a clear understanding of Project Planning and Management; the stages and activities in project execution
2. Draw upon the academic knowledge gained in college to achieve efficiency in actual practice.
3. Appreciate the developments in Civil/Structural engineering, Construction and the continuous upgradation of knowledge and skills.
4. Approach industry with enthusiasm, motivation, confidence and a strong pride in the profession

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	2	–	2	3
CO2	2	2	2	–	2	3
CO3	–	–	–	–	–	3
CO4	–	2	–	–	–	3

Course Content

Module No.	Details	Hrs.
1	**Project and Project Management:** • Project and its features • Project Management and Its Importance • •Change in approach in the seventh edition of PMBOK Guide • Project Management Principles • Project Performance Domains • Important components of Project Management	07
2	**Project Planning:** • Project Charter and Project Management Plan • Project Scope and Schedule Management	07

	• Project Cost and Quality Management • Project Resource and Risk Management	
3	**Introduction and Early work:** • Roles and challenges of the Civil and structural engineer • Construction Management overview • Surveying activity for a project • Geotechnical Investigation for a project **Basic Design of a Project:** • Plot Layout Planning, • Construction strategy • Tendering and Contract strategy for a project • Design basis for the project • Important codes, specifications and standards • Site Development	07
4	**Global design:** • Important engineering principles and concepts • Preliminary structural analysis and design • Tender Document and specification • Quantity and cost estimation and monitoring • Piling in a project • Material Estimation for ordering	07
5	**Detailed Design:** • Detailed computer analysis and design of structures, • 3D computer modelling, BIM and interaction with other engineering disciplines like Mechanical, Electrical and Plumbing (MEP) . • 2D Detailed construction drawings for Reinforced concrete, Steel and Architecture	07
6	**Construction Stage:** • Steel fabrication drawings and concrete bar bending schedules. • Construction management • Present and future trends in Civil and Structural engineering & construction • Essential skills required by a Civil Structural and Construction Engineer	07

Recommended Books

1. PMBOK Guide Seventh edition -PMI
2. PMBOK Guide Sixth edition -PMI
3. Koontz, O'Donnell &Weihrich (2010); "Management", Mcgraw Hill. ISBN-13: 9780070144958. 464p.
4. Chinowsky, Paul S. & Songer, Anthony D. (2011) "Organization Management in Construction". Routledge. ISBN-13: 978-0415572613. 216p.
5. Sears, Keoki S, (2008) "Construction Project Management: A Practical Guide to Field Construction Management". Wiley. ASIN: B00HQ1CNE2.
6. Frank Harris (2013); "Modern Construction Management", Ronald Mccaffer Wiley

Blackwell Publications. ISBN-13: 978-0470672174. 572p.
7. Wagner.Harvey M (1975) "Principles of Management Science" Prentice Hall College Div. ISBN-13: 978-0137095353. 612p.
8. Snell, Scott & Bohlander George (2009) "Managing Human Resources" South-Western Cengage Learning; ISBN-13: 978-0324593310. 864p.
9. Dessler, Gary (2008) "Human Resource Management" Prentice Hall. ISBN-13: 978- 0131746176. 801p.
10. Dharwadkar P. P (1992); "Management In Construction Industry" Oxford & IBH Luthans.
11. V. J. Davies, K. Tomasin (1996); "Construction Safety Handbook", Thomas Telford, London. Isbn-13: 9780727725196. 303p.
12. PSG Design Data Book, PSG College, Coimbatore (2012)
13. Construction Safety Manual Published By National Safety Commission of India.
14. "Safety Management in Construction Industry" – A Manual for Project Managers. Nicmar Mumbai.
15. "IS For Safety In Construction – Bureau Of Indian Standards.
16. Girimaldi and Simonds (1989); "Safety management", AITBS, New Delhi. ISBN: 9780939874989.651p.
17. Stranks, Jeremy (2010) "Health and Safety at Work: An Essential Guide for Managers", Kogan Page Publishers. ISBN 13: 9780749461201. 352p

SEM – III

Disaster Management [VE-MTSE301]

Course Code	Course Name
VE-MTSE301	Disaster Management

Course Objectives

The objectives of this course are

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches,
5. planning and programming in different countries, particularly their home country or the countries they work in.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Differentiate between various types of natural and man-made disasters, and explain their causes, characteristics, and impacts.
2. Identify disaster-prone regions in India and evaluate the socio-economic and ecological repercussions of major disaster events.
3. Apply risk assessment techniques and remote sensing tools to monitor, predict, and evaluate disaster threats for effective preparedness.
4. Propose appropriate disaster mitigation strategies and assess the role of structural and non-structural measures in reducing vulnerability.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	–	–	2	3
CO2	2	–	–	–	3	3
CO3	3	–	2	2	3	3
CO4	2	–	2	2	3	3

Course Content

Module No.	Details	Hrs.
1	**Introduction** Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	04
2	**Repercussions of Disasters and Hazards** Economic Damage, Loss of Human and Animal Life, Destruction of	04

	Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	
3	**Disaster Prone Areas in India** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.	04
4	**Disaster Preparedness and Management** Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.	04
5	**Risk Assessment** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	06
6	**Disaster Mitigation** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	06

Recommended Books

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

Introduction to Sustainability and Sustainable Development [VE-MTSE302]

Course Code	Course Name
VE-MTSE302	Introduction to Sustainability and Sustainable Development

Course Objectives

The objectives of this course are

1. This course provides an in-depth understanding of sustainability and sustainable development goals to create a better- informed engineer, which will lead to a more sustainable action by all and for all.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain the core concepts and evolution of sustainability and sustainable development at national and global levels in an engineering context
2. Examine industrial-environmental interactions and system-based approaches to societal sustainability challenges.
3. Apply sustainable engineering principles in practice.
4. Evaluate tools and strategies for assessing sustainability using efficiency and sufficiency principles.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	–	2	3	–	2	2
CO2	3	–	3	2	3	2
CO3	3	–	3	3	3	2
CO4	3	–	3	2	3	2

Course Content

Module No.	Details	Hrs.
1	**Introduction**: What is sustainability and sustainable development? – definitions, Concept & components of sustainability **Limits to exponential growth on a finite planet**, Complexity of growth and equity, Environmental issues and crisis, Resource degradation, greenhouse gases, global warming, desertification, social insecurity, industrialization, globalization. **An Engineers role in sustainability**	02
2	**Sustainability perspective for Energy, Materials, Water, Food and Shelter:** World energy usage, Problems with fossil fuels Alternatives - reduction, efficiency, renewable energy. Impacts of material production, sources of waste, Problems with current waste management, Suggestions for reducing the impact of material use Water resource and use worldwide, Associated problems with current water systems, Sustainable water management, World food production, Usage of resources and environmental impacts, Alternatives - organic/local Current building styles and associated problems, Retrofit vs new build Sustainable	08

	Architecture	
3	**Social & Economic Sustainability** Social sustainability - Components - equality, diversity, democracy, social cohesion, Issues - gender issue, poverty, environmental degradation, peace & justice, social sustainability performance - community engagement, community development, empowerment, health, volunteerism, etc. Economic sustainability - Relationship between macroeconomics policies, poverty and environment, Trade-offs between economic growth, social equity, and environmental sustainability, Role of international environmental agreements, green economy and climate change policies.	06
4	**Governance for Sustainable Development Systems**: Socio-economic policies for sustainable development, Strategies for implementing eco-development programmes, Policy responses to environmental degradation, Public participation- Demographic dynamics and sustainability, Integrated approach for resource protection and management.	05
5	**Strategies and measurements of SD**: Introduction to Sustainability assessment, Environment Sustainability metrics – simple and complex indicators, Sustainability methods and assessment - green buildings, Renewable energy, CSR, Biodiversity, Technologies, human development index (HDI), sustainability development index (SDI), LCA	04
6	**The road to Sustainable Development** - National and International Contribution: National Contribution: Societal transformations. Institutional theory, Rural and Urban development, Action plan for implementing sustainable development International Contribution - Brundtland, Rio summit, SDGs, Conventions, Protocols & Agreements, Action plan for implementing sustainable development, Moral obligations and Operational guidelines, Role of developed countries in the sustainable development.	03

Recommended Books

1. Harris, J.M., Basic Principles for Sustainable Development, Global Development and Environment Institute, working paper 00-04. Available at: http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF
2. Mackenthun, K.M., Basic Concepts in Environmental Management, 1 st edition, Lewis Publication, London, 1998.
3. Hjorth, P. and A. Bagheri, Navigating towards Sustainable Development: A System Dynamics Approach, In Futures, 38(1): 74-92, 2006.
4. Mog, J.M., Struggling with Sustainability - A Comparative Framework for Evaluating Sustainable Development Programs, World Development 32(12): 2139-2160, 2004.
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-
6. Rating System, TERI Publications – GRIHA Rating System
7. Indian Green Building Council, IGBC Green Buildings rating system (New & Existing) - Abridged Reference Guide, Pilot Version, 2017.

8. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure (PDF – 68 kb)
9. Courses to refer - Sustainability and Engineering : https://rdmc.nottingham.ac.uk/bitstream/handle/internal/112/Engineering%20Sustailability

Safety in Construction [VE-MTSE303]

Course Code	Course Name
VE-MTSE303	Safety in Construction

Course Objectives

The objectives of this course are

1. This course aims to make the students well-versed with Construction Safety Management system, major Construction Safety hazards, the latest safety and health regulations and the Indian Standards applicable to the construction industry.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Identify, assess and manage potential hazards effectively.
2. Implement and monitor safety protocols.
3. Develop comprehensive safety audit reports.
4. Understand the legal and regulatory requirements for construction safety.

CO-PO Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	–	2	–	3	3
CO2	2	–	2	–	3	3
CO3	2	3	–	–	2	3
CO4	2	–	–	–	2	3

Course Content

Module No.	Details	Hrs.
1	Introduction to Construction Safety, Occupational Health and Safety, Safety Terminology, Heinrich's Accident Triangle, Construction Safety Management System and its four Pillars, Safety Organisation	06
2	Safety Objectives, Safety Policy, Making Safety Policy effective, Safety Risk Management, Construction Hazard Identification, Job Hazard Analysis, Construction Risk Assessment	04
3	Safety Assurance, Internal Safety Audits, Incident investigation Safety promotion, Safety Training, Safety Communication	04
4	OSHA's Fatal Four Construction Hazards, Fall protection In Construction, Fall Prevention, Fall Arrest systems, Struck-by in Construction, Hierarchy of Controls, Five levels of Hierarchy	04
5	Electrocutions in Construction, Electricity as a Construction Risk Common causes of electrical emergencies, Caught-between in Construction, Caught-between Hazards, OSHA's Safety and Health Regulations for Construction	04
6	Legal Requirements for Construction Safety in India, The Building and	04

	Other Construction Workers Act, 1996, The Maharashtra BOCW Rules, 2007. Indian Standards Applicable to Construction Sites, Personal Protective Equipment, Fire Safety in Construction, Fire hazard control measures, Concrete Construction Safety Hazards	

Field/Community Engagement Project [FP-MTSE301]

Course Code	Course Name
FP-MTSE301	Field/Community Engagement Project

Course Objectives

The objectives of this course are

1. To expose students to real-world challenges in structural engineering through direct fieldwork or professional practice.
2. To promote social responsibility and engagement by addressing structural or infrastructural issues affecting communities.
3. To provide a platform for applying theoretical knowledge to practical problems through site visits, internships, or community-driven projects.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Identify and define real-world structural engineering problems through field study, community interaction, or professional internship.
2. Apply engineering principles and technical skills to address community-based infrastructure challenges or professional tasks.
3. Document field or internship experiences through a structured technical report and presentation, demonstrating analytical thinking and problem-solving ability.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	2	3
CO2	3	3	3	3	3	3
CO3	3	3	2	2	2	3

Course Content

Modes of Engagement (any one or a combination):

- Field Project: Hands-on work in infrastructure assessment, retrofitting solutions, structural health monitoring, etc.
- Community Project: Design and implementation of small-scale infrastructure (e.g., footbridges, shelter designs) in collaboration with local bodies or NGOs.
- Internship: Minimum 4 weeks of internship at a reputed structural engineering consultancy, construction firm, research lab, or government agency

Dissertation Phase -I [DS-MTSE301]

Course Code	Course Name
DS-MTSE301	Dissertation Phase -I

Course Content
Dissertation Phase–I is intended to initiate students into the process of independent research in structural engineering. During this phase, typically in the third semester, students are expected to identify a specific research area aligned with their academic interests and professional goals. The selection of the dissertation topic should be done in consultation with a faculty supervisor and must reflect current challenges, innovations, or gaps in the structural engineering domain. Students will begin with an extensive and critical literature review on their chosen topic, studying research papers, technical reports, codes, and case studies to understand the background, existing work, and scope for further research. The outcome of this phase should be a well-defined problem statement, clear research objectives, and a feasible methodology that lays the foundation for the main dissertation work in the following semester. Students are required to prepare a detailed seminar report comprising the problem context, significance, literature review, methodology, and expected outcomes. They will present this report in a seminar format before an internal evaluation panel. The seminar will assess the student's ability to synthesise knowledge, articulate research ideas, and justify the direction of their intended work. In addition to the literature survey, the student must also begin initial stages of work during this phase. This may include analytical modelling, preliminary simulations, identification of relevant tools and software, setup of experimental frameworks, or field data collection plans—depending on the nature of the study. These foundational tasks are expected to validate the feasibility of the research and demonstrate early engagement with the problem. Students must document their findings and initial progress in a technical report, which will include the background, objectives, methodology, early outcomes (if any), and a detailed review of relevant literature.

SEM – IV

Stress Management by Yoga [CC-MTSE401]

Course Code	Course Name
CC-MTSE401	Stress Management by Yoga

Course Objectives

The objectives of this course are
1. To achieve overall health of body and mind
2. To overcome stress

Course Outcomes

Upon successful completion of the course, students should be able to
1. Explain the eight limbs of yoga (Ashtanga) and demonstrate an understanding of ethical principles like Yam and Niyam for personal and social well-being.
2. Practise selected yogic asanas and pranayama techniques, and describe their physical, mental, and emotional benefits.
3. Apply yogic values and lifestyle disciplines such as ahimsa, satya, shaucha, and swadhyay to cultivate holistic well-being and self-awareness.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	–	2	–	–	–	3
CO2	–	–	–	–	1	3
CO3	–	2	–	–	–	3

Course Content

Module No.	Details	Hrs.
1	Definitions of Eight parts of yog. (Ashtanga)	08
2	Yam and Niyam. Do`s and Don't's in life. • Ahinsa, satya, astheya, bramhacharya and aparigraha • Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	08
3	Asan and Pranayam • Various yog poses and their benefits for mind & body • Regularization of breathing techniques and its effects-Types of pranayama	08

Recommended Books

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Dissertation Phase -II [DS-MTSE401]

Course Code	Course Name
DS-MTSE401	Dissertation Phase -II

Course Content
Seminar (Pre –Synopsis) This phase involves detailed execution of the proposed research through analytical modelling, simulation, experimentation, or field-based study. The focus is on achieving research objectives, validating results, and critically analysing findings within the context of structural engineering. Students must submit a well-documented dissertation and a presentation that reflects technical competence, systematic methodology, and original contribution. The report should include results, interpretations, comparison with literature, conclusions, and future scope. **Dissertation and Viva Voce** A viva voce will be conducted to assess the student's understanding, problem-solving approach, and ability to defend the work before a panel comprising internal and external examiners.