G. PULLA REDDY ENGINEERING COLLEGE (Autonomous): KURNOOL

Accredited by NBA of AICTE and NAAC of UGC
Affiliated to JNTUA, Anantapuramu

M.Tech Scheme & Syllabus - Scheme 2025

(Structural Engineering)

G. PULLA REDDY ENGINEERING COLLEGE (Autonomous) : KURNOOL

Vision of the Institution:

To become the choicest institute of technology and a hub of academic and industrial research and development

Mission of the Institution:

To provide conducive academic ambience, excellent infrastructure, continually updated lab equipment and committed and scholarly faculty to realize the vision of the college.

Civil Engineering Department

Vision of the Department:

To make the Civil Engineering Department at G. Pulla Reddy Engineering College (Autonomous), Kurnool; a leader in the education of practice-oriented Civil Engineers that benefit industry and society.

Mission of the Department:

M1: To prepare students for a career in the Civil Engineering Profession by providing technical knowledge and skills imparted by the team of faculty adopting an effective teaching learning process.

M2: To produce quality Engineers who are capable of meeting the demands and challenges of the profession by focusing on latest practices.

M3: To inculcate in its students leadership abilities, research capabilities, ethical values and work culture that would lead towards the betterment of the society.

Program Educational Objectives (PEOs):

PEO1: Apply a broad, fundamental-based knowledge, and technical skills required for achieving professional success.

PEO2: Carry out design works in Civil Engineering, using relevant software tools, following appropriate procedures, keeping the economic and environmental aspects in view.

PEO3: Follow the professional ethics in the practice of the profession showing concern for social responsibilities.

PEO4: Pursue a professional career aimed at effective management of resources and focus on lifelong learning and research.

Program Specific Outcomes (PSOs):

The Civil Engineering Graduates can

PSO1: Plan, analyze and design the components of Engineering structures and transportation systems and estimate the cost of construction.

PSO2: Design and execute the construction of water resources projects and water distribution systems, using Engineering investigations and surveys.

PSO3: Implement the established procedures for conducting laboratory and field investigations on soils and engineering materials aimed at ensuring quality in execution of civil Engineering projects.

PSO4: Demonstrate professional ethics and implement the project management principles including project finance, leading to execution of projects as per design requirement using technical skills and relevant software.

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Two Year M.Tech Degree Program

Scheme of Instruction and Examination

(Effective from 2025-26)

M.Tech- I Semester - Structural Engineering (SE) Scheme-2025

S. No.	Category	Course Title	L	T	P	Credits	CIA Marks	End Exam Marks	Total
I		**Theory**							
1	PC	Advanced Structural Analysis	3	-	-	3	40	60	100
2	PC	Theory of Elasticity	3	-	-	3	40	60	100
3	PE	Professional Elective – I	3	-	-	3	40	60	100
4	PE	Professional Elective – II	3	-	-	3	40	60	100
5	MC	Research Methodology and IPR	2	-	-	2	100	-	100
6	SC	**Skill Enhancement Course** Artificial Intelligence and Applications in Civil Engineering	2	-	-	2	40	60	100
7	AC	Audit Course – I	2	-	-	0	-	-	-
II		**Practical**							
8	PCL	Advanced Concrete Technology Laboratory	-	-	4	2	40	60	100
9	PCL	Computer Aided Design Laboratory	-	-	4	2	40	60	100
	Total		**18**	**-**	**8**	**20**	**380**	**420**	**800**

M.Tech- II Semester - Structural Engineering (SE) Scheme-2025

S. No.	Category	Course Title	L	T	P	Credits	CIA Marks	End Exam Marks	Total
I		**Theory**							
1	PC	Structural Dynamics	3	-	-	3	40	60	100
2	PC	Stability of Structures	3	-	-	3	40	60	100
3	PE	Professional Elective – III	3	-	-	3	40	60	100
4	PE	Professional Elective – IV	3	-	-	3	40	60	100
5	MC	Quantum Technologies and Applications	2	-	-	2	100	-	100
6	AC	Audit Course-II	2	-	-	0	-	-	-
II		**Practical**							
7	PCL	Advanced Structural Engineering Laboratory	-	-	4	2	40	60	100
8	PCL	Advanced Structural Analysis and Design Laboratory	-	-	4	2	40	60	100
9	PCL	Comprehensive Viva Voce	-	-	-	2	-	100	100
	Total		**16**	**-**	**8**	**20**	**340**	**460**	**800**

****Students must undergo an Industry Internship after I Year II Semester for duration of 6 to 8 weeks that will be evaluated in III semester.**

Two Year M.Tech Degree Program
Scheme of Instruction and Examination
(Effective from 2025-26)

M.Tech- III Semester - Structural Engineering (SE) **Scheme-2025**

S. No.	Category	Course Title	L	T	P	Credits	CIA Marks	End Exam Marks	Total
1	PE	Professional Elective – V	3	-	-	3	40	60	100
2	OE	Open Elective (OE)*	3	-	-	3	40	60	100
3	PR	Dissertation Phase – I	-	-	20	10	100	-	100
4		Industry Internship	-	-	-	2	100	-	100
5	CAA	Co-Academic Activities	-	-	-	1	100	-	100
	Total		**6**	**-**	**20**	**19**	**380**	**120**	**500**

* Open Elective through MOOCs

M.Tech- IV Semester - Structural Engineering (SE) **Scheme-2025**

S. No.	Category	Course Title	L	T	P	Credits	CIA Marks	End Exam Marks	Total
1	PR	Dissertation Phase – II	-	-	16	8	100	-	100
2	PR	Project Viva-voce	-	-	-	8	-	100	100
	Total		**-**	**-**	**16**	**16**	**100**	**100**	**200**

List of Professional Elective Courses

Description	Subject Title
Professional Elective-I (PE-I)	Fracture Mechanics
	Advanced Concrete Technology
	Advanced Mathematical Methods
Professional Elective-II (PE-II)	Advanced Reinforced Concrete Design
	Experimental Stress Analysis
	Precast and Prefabricated Structures
Professional Elective-III (PE-III)	Finite Element Methods for Structural Engineering
	Advanced Steel Structures Design
	Theory of Plates and Shells
Professional Elective-IV (PE-IV)	Design of Pre-stressed Concrete
	Design of Bridges
	Structural Health Monitoring
Professional Elective-V (PE-V)	Earthquake Resistant Design of Structures
	Rehabilitation and Retrofitting of Structures
	Design of Tall Buildings

Open Elective

OE-301	Green Buildings
OE-302	Road Safety Engineering
OE-303	IoT and its Applications
OE-304	Photovoltaic Systems
OE-305	Integrated Product Design and Development
OE-306	Advanced Numerical Methods and Computational Mathematics
OE-307	Mathematics for Machine Learning and Data Science
OE-308	Statistical Learning Theory and Mathematical Foundations of AI
OE-309	Chemistry of Nano materials and Applications in Engineering
OE-310	Photonics for Engineers

List of Audit Courses

Audit Course – I (AC-I)	English for Research Paper Writing
	Disaster Management
	Essence of Indian Traditional Knowledge
Audit Course – II (AC-II)	Pedagogy Studies
	Personality Development Through Life Enlightenment Skills
	Yoga for Stress Management

Two Year M. Tech Degree Program

Scheme of Instruction and Examination
(Effective from 2025-26)

M.Tech- I Semester - Structural Engineering (SE) **Scheme-2025**

S. No.	Category	Course Title	L	T	P	Credits	CIA Marks	End Exam Marks	Total
I		**Theory**							
1	PC	Advanced Structural Analysis	3	-	-	3	40	60	100
2	PC	Theory of Elasticity	3	-	-	3	40	60	100
3	PE	Professional Elective – I	3	-	-	3	40	60	100
4	PE	Professional Elective – II	3	-	-	3	40	60	100
5	MC	Research Methodology and IPR	2	-	-	2	100	-	100
6	SC	**Skill Enhancement Course** Artificial Intelligence and Applications in Civil Engineering	2	-	-	2	40	60	100
7	AC	Audit Course – I	2	-	-	0	-	-	-
II		**Practical**							
8	PCL	Advanced Concrete Technology Laboratory	-	-	4	2	40	60	100
9	PCL	Computer Aided Design Laboratory	-	-	4	2	40	60	100
	Total		**18**	**-**	**8**	**20**	**380**	**420**	**800**

ADVANCED STRUCTURAL ANALYSIS (ASA)

M.Tech - I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 801	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain matrix methods, element stiffness/flexibility equations, and coordinate transformations for structural analysis.

CO2: Assemble global stiffness matrices from element matrices and apply the direct stiffness method to structural systems.

CO3: Analyze plane trusses, continuous beams, and single-storey/single-bay frames using flexibility method.

CO4: Analyze plane trusses, continuous beams, and single-storey/single-bay frames using Stiffness method.

CO5: Apply special analysis procedures.

UNIT – I

Introduction to matrix methods of analysis – Statistical indeterminacy and kinematical indeterminacy – Degree of freedom – Coordinate system – Structure idealization stiffness and flexibility matrices – Suitability element stiffness equations – Elements flexibility equations – Displacement equations - for truss element, beam element and torsional element. Transformation of coordinates – Element stiffness matrix - and load vector – Local and global coordinates.

UNIT – II

Assembly of stiffness matrix from element stiffness matrix – Direct stiffness method – General procedure – Banded Matrix – Semi bandwidth – Assembly by direct stiffness matrix method.

UNIT – III

Analysis of plane truss – Continuous beams with and without settlement – Plane frame including side sway single storey, single-bay by Flexibility Matrix method.

UNIT – IV

Analysis of plane truss – Continuous beams with and without settlement – Plane frame including sides sway, Single bay- single storey by Stiffness Matrix method.

UNIT – V

Special analysis procedures – Static condensation and sub structuring – Gaussian Elimination Method – Cholesky Method.

Text Books :

1. William Weaver J.R and James M. Gere, *Matrix Analysis of Frames Structures*, CBS Publications.
2. Ashok K Jain, *Advanced Structural Analysis*, New Channel Brothers.
3. Pandit &Gupta, *Matrix Method of Structural Analysis*.

Reference Books :

1. Madhu B. Kanchi, *Matrix Structural Analysis*.
2. J. Meek, *Matrix Methods of Structural Analysis*.
3. Ghali And Neyveli, *Structural Analysis*.
4. Devdas Menon, *Structural Analysis*, Narosa Publishing Housing Pvt. Ltd.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

THEORY OF ELASTICITY (TE)

M.Tech - I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 802	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain plane stress, plane strain, elasticity theory, and related differential equations.

CO2: Solve two-dimensional elasticity problems in rectangular coordinates and apply Fourier series for structural analysis.

CO3: Analyze Two-Dimensional Elasticity Problems In Polar Coordinates For Symmetric And Asymmetric Stress Distributions.

CO4: Determine three-dimensional stress and strain states, principal stresses, maximum shear stresses, and apply general theorems of elasticity.

CO5: Apply methods for solving torsion problems in prismatic bars, shafts, and tubes using energy methods and analytical techniques.

UNIT – I

Introduction to Plane Stress and Plane Strain Analysis

Elasticity – Notation for forces and stresses – Components of stress – Components of strain – Hooke's law. Plane stress-plane strain – Differential equations of equilibrium – Boundary conditions – Compatibility equations – Stress function.

UNIT – II

Two Dimensional Problems in Rectangular Coordinates

Solution by polynomials – Saint Venant's principle – Determination of displacements – Bending of simple beams – Application of Fourier series for two dimensional problems – Gravity loading.

UNIT – III

Two Dimensional Problems in Polar Coordinates

General equation in polar co-ordinates – Stress distribution symmetrical about an axis – Pure bending of curved bars – Strain components in polar coordinates – Displacements for symmetrical stress distributions – Simple problems.

UNIT – IV

Analysis of Stress and Strain in Three Dimensions: Principal stress – Ellipsoid and stress-director surface – Determination of principal stresses – Maximum shear stresses – Homogeneous deformation – Principal axis of strain.

General Theorems: Differential equations of equilibrium – Conditions of compatibility – Determination of displacement – Equations of equilibrium in terms of displacements.

UNIT – V

Torsion of Prismatic Bars

Torsion of prismatic bars – Elliptical cross section – Other elementary solutions – Membrane analogy – Torsion of rectangular bars.

Text Books :

1. Timoshenko, S., *Theory of Elasticity and Plasticity*, McGraw Hill Book Company.

2. Papoov, Advanced *Strength of Materials*, McGraw Hill Book Company.
3. Sadhu Singh, *Theory of Elasticity and Plasticity*, Khanna Publishers.
Reference Books :
1. Chen, W.F. and Han, D.J., *Plasticity for Structural Engineers*, Springer–Verlag, New York.
2. Lubliner, J., *Plasticity Theory*, MacMillan Publishing Co., New York.
3. Y.C. Fung, *Foundations of Solid Mechanics*, PHI Publications.
4. L.S. Srinath, *Advanced Mechanics of Solids*, Tata McGraw Hill Book Company.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS
(RMIPR)
(Mandatory Course)

M.Tech - I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
MC101	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	2	100	-	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: -		

Course Outcomes : At the end of the course the student will be able to

CO1: Recall key concepts and terminology related to research design, data collection, and intellectual property rights.

CO2: Explain the importance of research design and data analysis in research studies, and describe the concept of intellectual property rights.

CO3: Design a research study, including data collection and analysis methods, and apply intellectual property rights principles to protect research findings.

CO4: Analyze research studies to identify strengths and limitations, and evaluate the effectiveness of data collection and analysis methods.

CO5: Assess the impact of intellectual property rights on research and innovation, and evaluate the effectiveness of research designs and methods.

CO6: Develop a comprehensive research plan, including a detailed research design, data collection and analysis methods, and a plan for protecting intellectual property.

UNIT – I

Fundamentals of Research Methodology

Overview of research process and design – Types of research – Approaches to research (Qualitative vs. Quantitative) – Observation studies, experiments and surveys – Use of secondary and exploratory data to answer the research question – Importance of reasoning in research and research ethics – Documentation styles (APA/IEEE etc.) – Plagiarism and its consequences.

UNIT – II

Data Collection and Sources

Importance of data collection – Types of data – Data collection methods – Data sources – Primary, secondary and big data sources – Data quality & ethics – Tools and technology for data collection.

UNIT – III

Data Analysis and Reporting

Overview of multivariate analysis – Experimental research, cause-effect relationship, and development of hypotheses – Measurement systems analysis, error propagation, and validity of experiments – Guidelines for writing abstracts, introductions, methodologies, results, and discussions – Writing research papers & proposals.

UNIT – IV

Understanding Intellectual Property Rights

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types

and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.
UNIT – V
Patents Patents – Objectives and benefits of patent, Concept, Features of patent, Inventive step, Specification – Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.
Text Books :
1. Stuart Melville and Wayne Goddard, *Research Methodology: An introduction for Science & Engineering students*, Juta and Company Ltd., 2004.
2. Catherine J. Holland, *Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*, Entrepreneur Press, 2007.
Reference Books :
1. Cooper Donald R, Schindler Pamela S and Sharma JK, *Business Research Methods*, Tata McGraw Hill Education 11th ed., 2012.
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners.*
3. David Hunt, Long Nguyen, Matthew Rodgers, *Patent Searching: Tools & Techniques*, Wiley, 2007.
4. Deborah E. Bouchoux, *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 6th Edition,* Cengage 2024.
5. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, 5th Edition, University of Chicago Press, 2024.
6. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, *Professional Programme Intellectual Property Rights, Law and Practice*, September 2013.
7. Peter Elbow, *Writing with Power*, Oxford University Press, 1998.

ARTIFICIAL INTELLIGENCE AND APPLICATIONS IN CIVIL ENGINEERING (AIACE)

(Skilled Course)

M.Tech - I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
Skilled Course SCSE01	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	2	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the concepts, history, and branches of Artificial Intelligence with relevance to civil engineering applications.

CO2: Apply machine learning models and algorithms to solve civil engineering problems.

CO3: Develop artificial neural network and deep learning models for infrastructure and structural engineering applications.

CO4: Utilize fuzzy logic and expert systems to handle uncertainty in engineering decision-making.

CO5: Give correct Prompts for different AI tools to get the required output.

UNIT – I

Introduction To AI: Introduction to AI – Definition of AI – Historical evolution of AI – AI types – Brief introduction to the branches of AI – Machine learning – Natural language processing – Computer vision – Robotics – Expert systems – Artificial neural networks – Evolutionary computation – Cognitive computing, and swarm intelligence.

UNIT – II

Machine Learning: Introduction to machine learning – Different kinds of machine learning, Supervised, unsupervised – Applications of different ML techniques and applications in civil engineering.

UNIT – III

Artificial Neural Networks (ANN): Introduction – Biological Noron – Motivation – Appropriate problems in ANN learning – **Perceptron's** – The representational power of perceptions – Multilayer networks – Back propagation. Applications of neural networks in highway/ infrastructure construction management and other civil engineering domains.

UNIT – IV

Uncertainty and Ambiguity: Fuzzy logic – Linguistic variables – Fuzzy sets – Membership functions – Fuzzy set operations – Fuzzy expert systems – Fuzzification, Defuzzification – Fuzzy rules – Fuzzy inferences. Fuzzy inference system – Illustrative examples of engineering applications of fuzzy logic with specific reference to civil engineering.

UNIT – V

Introduction to Prompt Engineering: What is Prompt Engineering? – A simple introduction to the art of crafting effective instructions (prompts) for Large Language Models (LLMs) – Understanding prompts as the way to communicate with and control AI tools – Using LLMs to enhance productivity, automate routine tasks, and aid in problem-solving. The core principles of writing good prompts. • **Clarity and Specificity**: The importance of giving clear, detailed instructions. • **Providing Context**: How to give the AI background information for better results. • **Assigning a Persona**: Telling the AI to "act as" a specific

professional (e.g., a structural engineer, a project manager). • **Iterative Refinement**: The process of improving prompts based on AI responses. Practical applications in civil engineering. **Ethical Considerations in AI**: Discussing bias, accountability, and societal impact.

Text Books :

1. Afaq Ahmad, Nikos D. Langaros, Vagelis Pleveris, *Artificial Intelligence and Machine learning Techniques for Civil Engineers, IGI Global*.

2. Pijush Samui, Dwarakadas Pralhaddas Kothari, *Artificial Intelligence in Civil Engineering,* Lambert Academic Publishing.

3. Munesh Chandra Trivedi and Ankit Srivastava, *Introduction to Artificial Intelligence and Machine Learning*, Khanna Publishing House.

Reference Books :

1. Phillip D Wassermann, *Neural Computing Theory and Practice*.

2. S. Rajasekharan, G A Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms and its Applications*, PHI Learning.

3. Web Resource: https://www.kaggle.com/whitepaper-prompt-engineering

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED CONCRETE TECHNOLOGY LABORATORY [ACT (P)]

M.Tech - I Semester : SE						Scheme : 2025		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	Continuous Internal Assessment	End Exam	Total
CE 803	PCL	-	-	4	2	40	60	100
						End Exam Duration : 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Prepare concrete mixes for ordinary, high-strength, and self-compacting concrete, and cast standard test specimens.

CO2: Measure and evaluate the fresh properties of self-compacting concrete.

CO3: Determine mechanical properties of concrete, including compressive strength, split tensile strength, flexural strength, and modulus of elasticity.

CO4: Perform durability tests such as permeability, rapid chloride permeability, carbonation studies, and non-destructive tests on concrete.

CO5: Conduct bending tests on reinforced concrete beams and design concrete mixes using mineral admixtures for enhanced performance.

List of Experiments

1. Fineness test of cement – Determination of specific surface area.
2. Workability tests – Slump test and compaction factor test.
3. Flow properties of concrete – Flow table test, V-funnel test, L-box ratio.
4. Mix design and casting of conventional concrete specimens – Cubes, cylinders, beams.
5. Mix design and casting of self-compacting concrete specimens – Cubes, beams, cylinders.
6. Mix design and casting of high-strength concrete specimens – Cubes, beams, cylinders.
7. Study on the stress-strain curve of different grade of concrete.
8. Correlation between cube strength, cylinder strength, split tensile strength, and modulus of rupture.
9. Non-destructive testing of concrete.

Demonstration:

10. Segregation and bleeding tests – Evaluating uniformity of fresh concrete.
11. Effect of admixtures on fresh concrete properties – Workability, flow, and setting behavior.

Reference Books :

1. Neville A. M., *Properties of Concrete*, 5th Edition, Prentice Hall, 2012.
2. Shetty M. S., *Concrete Technology*, S. Chand and Co., 2006.
3. A.R. Santha Kumar, *Concrete Technology*, Oxford University Press.

COMPUTER AIDED DESIGN LABORATORY [CAD (P)]

M.Tech - I Semester : SE						Scheme : 2025		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
CE 804	PCL	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		-	-	4	2	40	60	100
						End Exam Duration : 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Analyze and design determinate and indeterminate beams using Excel templates.

CO2: Perform design and analysis of one-way and two-way slabs, plane and space frames, and multi-storeyed buildings under various loading conditions.

CO3: Design roof trusses, rectangular and circular water tanks, and foundations using spreadsheet-based calculations.

CO4: Analyze and design different types of staircases with accurate consideration of loads and geometry.

CO5: Apply theoretical structural engineering principles to practical design problems using computational tools efficiently.

List of Experiments

1. Analysis and design of determinate beams with Excel template development.
2. Analysis and design of indeterminate beams with Excel template development.
3. Analysis and design of One way slab beams with Excel template development.
4. Analysis and design of Two way slab beams with Excel template development.
5. Analysis and design of plane frames with Excel template development.
6. Analysis and design of space frames with Excel template development.
7. Analysis and design of a multi-storeyed building subjected to dead load, live load, and wind load using STAAD.
8. Analysis and design of a multi-storeyed building subjected to dead load, live load, and earthquake load using STAAD.
9. Analysis and design of King roof trusses including wind load calculation using Excel spreadsheets.
10. Analysis and design of Queen roof trusses including wind load calculation using Excel spreadsheets.
11. Analysis and design of rectangular water tanks with Excel template development.
12. Analysis and design of circular water tanks with Excel template development.
13. Analysis and design of footings and column foundations with Excel template development.
14. Analysis and design of open well type staircases with Excel template development.
15. Analysis and design of dog-legged type staircases with Excel template development.

Two Year M.Tech Degree Program
Scheme of Instruction and Examination
(Effective from 2025-26)

M.Tech- II Semester - Structural Engineering (SE) **Scheme-2025**

S. No.	Category	Course Title	L	T	P	Credits	CIA Marks	End Exam Marks	Total
I		**Theory**							
1	PC	Structural Dynamics	3	-	-	3	40	60	100
2	PC	Stability of Structures	3	-	-	3	40	60	100
3	PE	Professional Elective – III	3	-	-	3	40	60	100
4	PE	Professional Elective – IV	3	-	-	3	40	60	100
5	MC	Quantum Technologies and Applications	2	-	-	2	100	-	100
6	AC	Audit Course-II	2	-	-	0	-	-	-
II		**Practical**							
7	PCL	Advanced Structural Engineering Laboratory	-	-	4	2	40	60	100
8	PCL	Advanced Structural Analysis and Design Laboratory	-	-	4	2	40	60	100
9	PCL	Comprehensive Viva Voce	-	-	-	2	-	100	100
	Total		**16**	**-**	**8**	**20**	**340**	**460**	**800**

****Students must undergo an Industry Internship after I Year II Semester for duration of 6 to 8 weeks that will be evaluated in III semester.**

STRUCTURAL DYNAMICS (SD)

M.Tech - II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 805	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the theory of vibrations, free and forced oscillations, and the significance of damping in structural systems.

CO2: Formulate and solve equations of motion for SDOF systems under various types of dynamic loading.

CO3: Analyze MDOF systems, determine natural frequencies, mode shapes, and compute dynamic responses using modal analysis.

CO4: Apply practical vibration analysis methods such as Stodola and Holzer for determining structural response.

CO5: Perform basic earthquake analysis of structures using SDOF and MDOF models, and analyze flexural vibrations of continuous beams.

UNIT – I

Theory of Vibrations: Introduction – Elements of a vibratory system – Degrees of freedom – Continuous systems – Lumped mass idealization – Oscillatory motion – Simple harmonic motion – Pictorial representation of S.H.M – Free vibrations of single degree of freedom (SDOF) systems – Undamped and damped – Critical damping – Logarithmic decrement – Forced vibrations of SDOF systems – Harmonic excitation – Dynamic magnification factor – Bandwidth – Fundamental objective of dynamic analysis – Types of prescribed loading – Methods of discretization – Formulation of the equations of motion.

UNIT – II

Single Degree of Freedom System: Formulation and solutions of the equation of motion – Free vibration response – Response to harmonic, periodic, impulsive and general dynamic loading – Duhamel integral.

UNIT – III

Multi Degree of Freedom System: Selection of the degree of freedom – Evaluation of structural property matrices – Formulation of the MDOF equations of motion – Undamped free vibrations – Solution of eigen value problem for natural frequencies and mode shapes – Analysis of dynamic response – Normal coordinates – Uncoupled equations of motion – Orthogonal properties of normal modes – Mode superposition procedure.

UNIT – IV

Practical Vibration Analysis: Stodola method – Fundamental mode analysis – Analysis of second and higher modes – Holzer's method – Basic procedure – Transfer matrix procedure.

UNIT – V

Introduction to Earthquake Analysis: Introduction – Excitation by rigid base translation – Lumped mass approach – SDOF and MDOF system – I.S. code methods of analysis. ***Continuous System:*** Introduction – Flexural vibrations of beams – Elementary case – Equation of motion – Analysis of undamped free shapes of simple beams with different end conditions – Principles of application to continuous beams.

Text Books:
1. A.K. Chopra, *Structural Dynamics for Earthquake Engineering*, Pearson Publications.
2. Clough & Penziem, *Dynamics of Structures*.
3. Roy. R. Craig, *Structural Dynamics*, John willy & fours.
Reference Books:
1. Mario Paz, *Structural Dynamics*.
2. I.S:1893(Latest) - *Code of Practice for Earthquakes Resistant Design of Structures*.
3. Anderson R.A., *Fundamentals of Vibration*, Amerind Publishing Co.,1972.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

STABILITY OF STRUCTURES (SOS)

M.Tech - II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 806	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Formulate and solve beam-column problems for different support conditions and axial loads.

CO2: Analyze elastic buckling of straight, eccentrically loaded, and built-up columns using energy methods.

CO3: Evaluate inelastic and torsional buckling behavior of bars, thin-walled sections, and combined torsion-flexure cases.

CO4: Apply mathematical methods like Ritz, Timoshenko, and Galerkin for solving structural stability problems.

CO5: Analyze lateral buckling of simply supported beams and rectangular plates under pure bending and compressive forces.

UNIT – I

Formulations Related to Beam Columns: Concept of stability, differential equation for beam columns – Beam column with concentrated loads – Continuous lateral load – Couples – Beam column with built in ends – Continuous beams with axial load – Application of trigonometric series – Determination of allowable stresses.

UNIT – II

Elastic Buckling of Bars: Elastic buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns – Energy methods – Buckling of a bar on elastic foundation – Buckling of a bar with intermediate compressive forces and distributed axial loads – Buckling of bars with change in cross section – Effect of shear force on critical load – Built up columns.

UNIT – III

Inelastic Buckling and Torsional Buckling: Buckling of straight bars – Double modulus theory – Tangent modulus theory – Pure torsion of thin walled bar of open cross section – Non–uniform torsion of thin walled bars of open cross section-torsional buckling – Buckling under torsion and flexure.

UNIT – IV

Mathematical Treatment of Stability Problems: Buckling problem orthogonality relation – Ritz method, Timoshenko method, Galerkin method.

UNIT – V

Lateral Buckling of Simply Supported Beams and Rectangular Plates: Beams of rectangular cross section subjected for pure bending – Derivation of equation of rectangular plate subjected to constant compression in two directions and one direction.

Text Books:

1. Bleich, *Stability of Metallic Structure*, McGraw Hill.
2. Chen & Atsuta, *Theory of Beam Columns – Vol.I*, McGraw Hill.

3. Timoshenko, S, and Gere, *Theory of Elastic Stability*, McGraw Hill Book Company, 1973.
Reference Books:
1. Smitses, *Elastic Stability of Structures*, Prentice Hall,1973.
2. Brush and Almorth, *Buckling of Bars Plates and Shells*, McGraw Hill Book Company,1975.
3. Chajes, A, *Principles of Structural Stability Theory*, Prentice Hall, 1974.
4. Ashwini Kumar, *Stability Theory of Structures*, Tata McGraw Hill Publishing Company Ltd., New Delhi,1985.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

QUANTUM TECHNOLOGIES AND APPLICATIONS (QTA)

(Mandatory Course)

M.Tech - II Semester : SE				Scheme : 2025			
Course Code	Hours/Week			Credits	Maximum Marks		
MC102	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	2	100	-	100
Sessional Exam Duration : 2 Hrs				End Exam Duration: --			

Course Outcomes : At the end of the course the student will be able to

CO1: Explain fundamental quantum concepts conceptually.

CO2: Distinguish classical information systems from quantum information frameworks.

CO3: Identify the principal theoretical limitations in building quantum computers.

CO4: Describe the conceptual basis of quantum communication and computation.

CO5: Discuss current applications, technological trajectories, and career opportunities in the quantum domain.

UNIT – I

Foundations of Quantum Theory and Technologies: Transition from classical to quantum physics. Key conceptual principles: Superposition, Entanglement, Uncertainty, Wave-particle duality. Quantum states and measurement; the role of the observer. Representative quantum systems: electrons, photons, atoms. Concept of quantization and discrete energy levels. Strategic relevance of quantum technologies. Overview of major domains: Computing, Communication, Sensing. Global quantum initiatives: India's National Quantum Mission, EU Quantum Flagship, USA, China.

UNIT – II

Conceptual Structure of Quantum Information: Qubits: qualitative understanding using spin and polarization. Classical bits vs quantum bits: distinctions and implications. Quantum systems (non-engineering perspective): trapped ions, superconducting qubits, photonics. Coherence and decoherence mechanisms. Abstract notions: quantum states, measurement operators, Hilbert space – interpretation without mathematics. Entanglement and non-locality as foundational resources. Quantum vs classical information principles; philosophical considerations.

UNIT – III

Building a Quantum Computer – Challenges and Requirements: Conceptual prerequisites for functional quantum hardware. Fragility of quantum states: decoherence, noise, stability issues. Requirements: isolation, error resilience, scalability, control. Why maintaining entanglement is difficult; theoretical necessity of quantum error correction. Comparative overview of hardware platforms (superconducting circuits, trapped ions, photonics). Current progress vs. scientific constraints; conceptual view of quantum software's role.

UNIT – IV

Quantum Communication and Computing: (Redundant explanations removed, retaining only unique themes.) Quantum vs classical communication paradigms. Essentials of Quantum Key Distribution (QKD) and its security rationale. Entanglement-enabled communication protocols. Concept of the Quantum Internet and secure global networking. Introduction to quantum computing and quantum parallelism. Conceptual comparison of classical and quantum gate operations. Challenges: decoherence, noise, and the necessity of error correction frameworks.

UNIT – V
Applications, Industry, and Future Directions: Application domains: Healthcare and drug discovery, Material science and chemistry, Optimization and logistics, Quantum sensing and precision timing. Case studies: IBM, Google, Microsoft, Psi Quantum. Ethical, societal, and policy considerations. Barriers to adoption: cost, skilled workforce, standards. Emerging research and career landscapes; India's strategic opportunity in the global quantum ecosystem.
Text Books:
1. Nielsen & Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 2010.
2. Rieffel & Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone,* MIT Press, 2019.
Reference Books:
1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Kaye, Laflamme, Mosca, *An Introduction to Quantum Computing*, OUP, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, CUP, 2013.
4. Susskind & Friedman, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
5. Rosenblum & Kuttner, *Quantum Enigma*, OUP, 2011.
6. Benenti et. al., *Principles of Quantum Computation and Information*, World Scientific, 2004.
7. DST India and Meit Y: *Official Quantum Mission Reports,* 2020 onwards.
8. *Quantum Flagship EU: Roadmaps and Strategy Documents.*
Online Learning Resources:
1. IBM Quantum Experience & Qiskit Textbook Coursera – *Quantum Mechanics and Quantum Computation (UC Berkeley) edX – Quantum Internet & Quantum Computers.*
2. YouTube – Michael Nielsen, *Quantum Computing for the Determined*.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED STRUCTURAL ENGINEERING LAB [ASE (P)]

M.Tech - II Semester : SE						Scheme : 2025		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
CE 807	PCL	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		-	-	4	2	40	60	100
						End Exam Duration : 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Determine compressive, tensile, and flexural strengths of concrete and RCC members.

CO2: Assess structural performance using destructive tests like bending, shear, and axial load tests.

CO3: Evaluate concrete quality and reinforcement condition using NDT techniques (Rebound Hammer, UPV, Half-Cell Potential).

CO4: Assess durability characteristics through rapid chloride penetration and carbonation tests.

CO5: Apply test results to assess structural integrity, serviceability, and repair requirements for concrete structures.

List of Experiments

1. Compression Test on Concrete Cubes – Determination of compressive strength.
2. Compression Test on Concrete Cylinders – Standard strength evaluation.
3. Flexural Test on RCC Beams (Single Point Load) – Bending and cracking behavior.
4. Flexural Test on RCC Beams (Two-Point Load) – Moment distribution and failure patterns.
5. Split Tensile Test on Cylindrical Specimens – Indirect tensile strength.
6. Rebound Hammer Test (NDT) – Surface hardness and strength estimation.
7. Ultrasonic Pulse Velocity Test (NDT) – Homogeneity and quality of concrete.
8. Carbonation Depth – Durability assessment.
9. Stress – Strain curve for different grades of Concrete.
10. Study of Correlation between Compressive Strength, Tensile Strength and Flexural Strength of Concrete.
11. Shear Test on Slabs / Beams – Determination of one-way or two-way shear strength.
12. Load Testing of Columns – Axial load behavior and failure mode.
13. Load Testing of Walls – Axial and lateral load evaluation.
14. Half-Cell Potential / Corrosion Assessment of Reinforced Concrete – Estimation of reinforcement corrosion probability.

ADVANCED STRUCTURAL ANALYSIS AND DESIGN LAB [ASAD (P)]

M.Tech - II Semester : SE						Scheme : 2025		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
CE 808	PCL	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		-	-	4	2	40	60	100
						End Exam Duration : 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Analyze and design bridge decks using grillage analogy and structural design principles.

CO2: Perform analysis and design of PEB structures and gantry girders under applied loads.

CO3: Design high-rise multi-storeyed buildings with different systems including shear walls and flat slabs.

CO4: Design raft foundations for flat slab and beam-slab structural systems.

CO5: Apply theoretical knowledge and computational tools to perform practical structural analysis and design projects efficiently.

List of Experiments

1. Analysis of a Bridge Deck by Grillage Analogy
2. Analysis and Design of a PEB Structure
3. Analysis and design of a Gantry Girder
4. Analysis and design of a High-Rise Multi storied Building
5. Analysis and design of a Highrise Multi storey Building with shear wall
6. Analysis and design of a Highrise Multi storey Building with Flat Slab System
7. Analysis and design of Flat Slab Raft foundation
8. Analysis and design of Beam Slab Raft foundation

LIST OF PROFESSIONAL ELECTIVE COURSES

Description	Subject Title
Professional Elective-I (PE-I)	Fracture Mechanics (FMECH)
	Advanced Concrete Technology (ACT)
	Advanced Mathematical Methods (AMM)
Professional Elective-II (PE-II)	Advanced Reinforced Concrete Design (ARCD)
	Experimental Stress Analysis (ESA)
	Precast And Prefabricated Structures (PPFS)
Professional Elective-III (PE-III)	Finite Element Methods for Structural Engineering (FEMSE)
	Advanced Steel Structures Design (ASSD)
	Theory of Plates and Shells (TPS)
Professional Elective-IV (PE-IV)	Design of Pre-stressed Concrete (DPSC)
	Design of Bridges (DB)
	Structural Health Monitoring (SHM)
Professional Elective-V (PE-V)	Earthquake Resistant Design of Structures (ERDS)
	Rehabilitation and Retrofitting of Structures (RRS)
	Design of Tall Buildings (DTB)

PROFESSIONAL ELECTIVE COURSES

Description	Subject Title
Professional Elective-I (PE-I) (in I sem.)	1. Fracture Mechanics (FMECH)
	2. Advanced Concrete Technology (ACT)
	3. Advanced Mathematical Methods (AMM)
Professional Elective-II (PE-II) (in I sem.)	1. Advanced Reinforced Concrete Design (ARCD)
	2. Experimental Stress Analysis (ESA)
	3. Precast and Prefabricated Structures (PPFS)

FRACTURE MECHANICS (FMECH)
(Professional Elective - I)

M.Tech- I Semester : SE						Scheme : 2025
Course Code	Hours/Week			Credits	Maximum Marks	
CE809	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs	

Course Outcomes : At the end of the course the student will be able to

CO1: Acquire basic skills in fracture mechanism of brittle materials.

CO2: Apply fracture mechanics theory to calculate stress areas.

CO3: Calculate the "energy release rate" around crack tips.

CO4: Examine crack growth due to fatigue

CO5:

UNIT – I

Summary of Basic Problems and Concepts: Introduction – A crack in a structure – The stress at a crack tip – The Griffith criterion – The crack opening displacement criterion – Crack propagation – Closure.

UNIT – II

The Elastic Crack – Tip Stress Field: The airy stress function – Complex stress functions – Solution to crack problems – The effect of finite size – Special cases – Elliptical cracks – Some useful expressions.

UNIT – III

The Crack Tip Plastic Zone: The Irwin plastic zone correction – The Dugdale approach – The shape of the plastic zone – Plane stress versus plane strain – Plastic constraint factor – The thickness effect.

UNIT – IV

The Energy Principle: The energy release rate – The criterion for crack growth – The crack resistance (R curve) – compliance, the J integral (definitions only).

Plane Strain Fracture Toughness: The standard test – Size requirements – Non-linearity – Applicability.

Plane Stress and Transitional Behaviour: Introduction – An engineering concept of plane stress – The R curve concept.

UNIT – V

The Crack Opening Displacement Criterion: Fracture beyond general yield – The crack tip opening displacement – The possible use of the CTOD criterion.

Determination of Stress Intensity Factors: Introduction – Analytical and numerical methods – Finite element methods, Experimental methods (an Ariel views only).

Text Books :

1. David Broek, Battelle, *Elementary Engineering Fracture Mechanics*, Columbus Laboratories, Columbus, Ohieo, USA.
2. John M. Barsom, Stanley T. Rolfe, Ross H. Forney., *Fracture and Fatigue Control in Structures.*
3. Surender P Shah, Stuart E Swartz, *Rock and Other Quasi-Brittle Materials*, Wiley 1995.

Reference Books :

1. Elfgren L, Routledge, *Analysis of Concrete Structures by Fracture Mechanics*, 1990.
2. Victor C. Li and Z P Bazant, *Fracture Mechanics- Applications to Concrete*, ACI SP118.
3. C.T. Suri and Zh jin, *Fracture Mechanics*, Elsevier Academic Press, 2012.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED CONCRETE TECHNOLOGY (ACT)
(Professional Elective – I)

M.Tech- I Semester : SE						Scheme : 2025	
Course Code	Hours/Week			Credits	Maximum Marks		
CE 810	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs						End Exam Duration: 3 Hrs	

Course Outcomes : At the end of the course the student will be able to

CO1: Explain cement properties, hydration process, and the role of chemical admixtures in concrete.

CO2: Assess aggregate properties, grading, and suitability for concrete mixes.

CO3: Evaluate fresh and hardened concrete properties, workability, strength, and curing requirements.

CO4: Analyze elasticity, shrinkage, and creep characteristics of concrete under various conditions.

CO5: Design concrete mixes as per IS, ACI, and other codes, and apply knowledge of special concretes for practical applications.

UNIT – I

Cements and Admixtures: Portland cement – Chemical composition – Hydration, setting and fineness of cement – Structures of hydrated cement – Mechanical strength of cement gel – Water held in hydrate cement paste – Heat of hydration of cement – Influence of compound composition on properties of cement – Tests on physical properties of cement – I.S. specifications – Different types of cements – Admixtures.

UNIT – II

Aggregates: Classification of aggregate – Particle shape and texture – Bond strength and other mechanical properties of aggregate, specific gravity, bulk density, porosity, absorption and moisture in aggregate – Soundness of aggregate – Alkali–aggregate reaction, Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine and coarse aggregates, gap graded aggregate – Maximum aggregate size.

UNIT – III

Fresh Concrete: Workability – Factors affecting workability – Measurement of workability by different tests – Effect of time and temperature on workability – Segregation and bleeding – Mixing and vibration of concrete – Quality of mixing water.

Hardened Concrete: Water/Cement ratio-Abram's law – Gel space ratio – Effective water in mix – Nature of strength of concrete – Strength in tension and compression- Griffith's hypothesis – Factors affecting strength – Autogeneous healing – Relation between compression and tensile strength – Curing and maturity of concrete, influence of temperature on strength – Steam curing – Testing of hardened concrete – Compression tests – Tension tests – Factors affecting strength – Flexure tests – Splitting tests – Non-destructive testing methods.

UNIT – IV

Elasticity, Shrinkage and Creep: Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Early volume changes – Swelling – Drying shrinkage – Mechanism of shrinkage – Factors affecting shrinkage – Differential shrinkage – Moisture movement

carbonation shrinkage-creep of concrete – Factors influencing creep – Relation between creep and time – Nature of creep – Effect of creep.

UNIT – V

Mix Design: Proportioning of concrete mixes by various methods – ACI and IS code method – Factors in the choice of mix proportions – Durability of concrete – Quality control of concrete – Statistical methods – High strength concrete mix design.

Special Concretes: Light weight concretes – Light weight aggregate concrete – Cellular concrete – No fines concrete – High density concrete – Fiber reinforced concrete – Different types of fibers – Factories affecting properties of FRC – Applications polymer concrete – Types of polymer concrete - Properties of polymer concrete and applications.

Text Books :

1. A.M. Neville, *Properties of Concrete*, Pearson Publication, 4th Edition.
2. M.S. Shetty, *Concrete Technology,* S. Chand &Co.
3. A.R. Santha Kumar, *Concrete Technology*, Oxford University Press, New Delhi.

Reference Books :

1. P.K. Mehta And J.M. Monteiro, *Concrete: Micro Structure, Properties and Materials,* McGraw Hill Publishers.
2. Krishna Raju, *Design of Concrete Mix*, CBS Publishers.
3. A.M. Neville, *Concrete Technology*, Pearson Publication.
4. M.L. Gambhir, *Concrete Technology* Tata McGraw Hill Publishers, New Delhi.
5. J. Prasad & C.G.K. Nair, *Non-Destructive Test and Evaluation of Materials,* Tata McGraw Hill Publishers, New Delhi.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED MATHEMATICAL METHODS (AMM)
(Common to SE & CM and SE) (Professional Elective – I)

M.Tech- I Semester : Common to SE & CM and SE				**Scheme : 2025**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
CE 811	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs				**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the concept and steps of calculus of variation.

CO2: Solve ordinary and partial differential equations numerically.

CO3: Solve the initial and boundary value problems numerically.

CO4: Solve the 1-D and 2-D problems using finite element method.

CO5: Identify, formulate and solve structural engineering problems.

UNIT – I

Calculus of Variation: Functionals – Euler's equation – Solution of Euler's equation – Isoperimetric problems – Several dependent variables – Functionals involving higher order derivatives – Hamilton's principle – Lagrange's equations.

UNIT – II

Numerical Solution of Ordinary Differential Equations & Eigen Values and Eigen Vectors

Numerical Methods: Eigen values and Eigen vectors – General method – Power method – Spectral method.

Numerical Solution of Ordinary Differential Equations: Taylor Series Method, Picard's method, Euler's method, Modified Euler's method & R.K. Method.

UNIT – III

Numerical Solution of Partial Differential Equations: Elliptical equations standard five points formula – Diagonal five point formula – Solution of Laplace equation by Leibmann's iteration method – Poisson's equation and its applications.

UNIT – IV

Numerical Solution of Partial Differential Equations: Parabolic equations Bender – Schmidt method-Bender – Schmidt recurrence equation – Crank-Nicholson difference method.

UNIT – V

Finite Element Method: Weighted residual methods, least square method, Gelarkin's method – Finite elements – Interpolating over the whole domain – One dimensional case, two dimensional case – Application to boundary value problems.

Text Books :

1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers.
2. Steven C. Chapra and Raymond P. Canale, *Numerical Methods for Engineers*, McGraw Hill Book Company.

Reference Books :

1. Curtis F. Gerald, *Applied Numerical Analysis*, Addeson Wesely Publishing Company.
2. C-Xavier, *C-Language and Numerical Methods*, New Age International Publishers.
3. M.K. Jain, S.K.R. Lyengar, R.K. Jain, *Computational Methods for Partial Differential Equations.*

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED REINFORCED CONCRETE DESIGN (ARCD)
(Professional Elective – II)

M.Tech- I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 812	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Calculate deflections of reinforced concrete beams and slabs using IS 456.

CO2: Estimate crack widths in RC members and design deep beams according to various standards.

CO3: Analyze and design flat slabs and plates for one-way and two-way shear, torsion effects, and openings.

CO4: Design plain concrete walls and shear walls, considering bracing, slenderness, in-plane forces, and detailing rules.

CO5: Apply fire-resistant design principles for RC members and evaluate the structural performance under high-temperature conditions.

UNIT – I

Deflection of Reinforced Concrete Beams and Slabs: Introduction – Deflection of beams and slabs – Deflection due to imposed loads – Short-term deflection of beams due to applied loads – Calculation of deflection by IS 456 – Deflection of continuous and cantilever beams by IS 456 – Deflection of slabs.

UNIT – II

Estimation of Crack Width in Reinforced Concrete Members and Design of Deep Beams: Introduction – Factors affecting crack width in beams – Mechanism of flexural cracking calculation of crack widths – Simple empirical method – Estimation of crack width in beams by IS 456 – Shrinkage and thermal cracking (only descriptive).

Deep Beams: Introduction – Minimum thickness – Design of deep beams by IS 456 – Checking for local failures – Detailing of deep beams.

UNIT – III

Shear in Flat Slabs: Introduction – Checking for one-way (wide beam) shear – Two-way (punching) shear permissible punching shear – Shear due to unbalanced moment (torsional moments) (only descriptive) – Effect of openings in flat slabs – Shear in two-way slabs with beams.

UNIT – IV

Design of Plain Concrete Walls and Shear Walls: Introduction – Braced and unbraced walls – Slenderness of walls – Eccentricities of vertical loads at right angles to wall – Empirical design method for plane concrete walls carrying axial load – Design of walls for in-plane horizontal forces.

Design of Shear Walls: Introduction – Classification of shear walls – Classification according to behavior – Loads in shear walls – Design of rectangular and flanged shear walls – Derivation of formula for moment of resistance of rectangular shear walls.

UNIT – V

Design of Reinforced Concrete Members for Fire Resistance: Introduction – ISO 834

standard heating conditions – Grading or classification – Effect of high temperature on steel and concrete – Effect of high temperatures on different types of structural members – Fire resistance by structural detailing from tabulated data – Analytical determination of the ultimate bending moment capacity of reinforced concrete beams under fire, other considerations.
Text Books :
1. P. Purushothaman, *Reinforced Concrete Structural Elements: Behaviour, Analysis and Design,* Tata McGraw Hill.
2. C.E. Reynolds and J.C. Steedman, *Reinforced Concrete Desigers Hand Book,* A View Point Publication.
3. Varghese P C, *Advanced Reinforced Concrete Design*, Prentice Hall of India.
Reference Books :
1. P. Dayaratnam, *Limit State Design of Reinforced Concrete Structures*, Oxford & IBH Publishers.
2. N. Krishna Raju, *Advanced RCC*, CBS Publishers & Distributors.
3. Devdas Menon & Unnikrishna Pillai, *Reinforced Cement Concrete Structures*, Tata McGraw Hill.
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EXPERIMENTAL STRESS ANALYSIS (ESA)

(Professional Elective – II)

M.Tech- I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 813	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the principles, merits, and applications of experimental stress analysis.

CO2: Select and apply appropriate strain measurement techniques for structural components using various strain gauges.

CO3: Utilize strain rosettes and non-destructive testing methods to evaluate stresses in concrete structures.

CO4: Apply the theory of photoelasticity to analyze stress patterns in experimental models.

CO5: Conduct two-dimensional photo elastic experiments, interpret fringe patterns, and scale results to prototype stresses accurately.

UNIT – I

Principles of Experimental Approach: Merits of experimental analysis – Introduction – Uses of experimental stress analysis – Advantages of experimental stress analysis – Different methods – Simplification of problems.

UNIT – II

Strain Measurement Using Strain Gauges: Definition of strain and its relation of experimental determinations – Properties of strain-gauge systems – Types of strain gauges – Mechanical, acoustic and optical strain gauges. Introduction to electrical strain gauges – Inductance strain gauges – LVDT – Resistance strain gauges – Various types – Gauge factor – Materials of adhesion base.

UNIT – III

Strain Rosettes and Non – Destructive Testing of Concrete: Introduction – The three elements rectangular rosette – The delta rosette corrections for transverse strain gauge. Ultrasonic pulse velocity method – Application to concrete. Hammer test – Application to concrete.

UNIT – IV

Theory of Photoelasticity: Introduction – Temporary double refraction – The stress optic law – Effects of stressed model in a polariscope for various arrangements – Fringe sharpening. Brewster's stress optic law.

UNIT – V

Two Dimensional Photoelasticity: Introduction – Isochromatic fringe patterns – Isoclinic fringe patterns passage of light through plane polariscope and circular polariscope isoclinic fringe patterns – Compensation techniques – Calibration methods – Separation methods – Scaling model to prototype stresses – Materials for photoelasticity – Properties of photoelastic materials.

Text Books :

1. J.W. Dally and W.F. Riley, *Experimental Stress Analysis*, College House Enterprises.

2. Sadhu Singh, *Experimental Stress Analysis*, Khanna Publishers.

3. Abdul Mubeen, *Experimental Stress Analysis*, Dhanpat Rai and Sons.

Reference Books :

1. U.C. Jindal, *Experimental Stress Analysis*, Pearson Publications.
2. L.S. Srinath, *Experimental Stress Analysis*, McGraw Hill Company Publishers.
3. P S Theocaris, *Moire Fringes in Strain Analysis,* Pergammon Press.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

PRECAST AND PREFABRICATED STRUCTURES (PPFS)
(Professional Elective – II)

M.Tech- I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 814	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Analyze the prefabricated load carrying members.

CO2: Understand the production technology of prefabrication.

CO3: Design and detailing of precast UNIT for factories.

CO4: Acquire the knowledge of use of different types of prefabricated structures.

CO5: Design and detailing of precast UNIT for single storied buildings, slabs, beams and columns

UNIT – I

Need for prefabrication – General principles of prefabrication – Comparison with monolithic construction – Types of prefabrication – Site and plant prefabrication – Economy of prefabrication – Modular coordination – Standardization – Materials – Modular coordination – Systems – Production – Transportation – Erection.

UNIT – II

Prefabricated load carrying members – Planning for components of prefabricated structures – Disuniting of structures – Design of simple rectangular beams and I-beams – Handling and erection stresses – Elimination of erection stresses, beams, columns, symmetric frames. Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs, wall panels, columns, shear walls.

UNIT – III

Joints – Joints for different structural connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings – Expansion joints in precast construction.

UNIT – IV

Production Technology – Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. Hoisting Technology – Equipment for hoisting and erection – Techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

UNIT – V

Applications – Designing and detailing of precast Unit for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns. Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones etc. – Importance of avoidance of progressive collapse.

Text Books :

1. CBRI, *Building Materials and Components*, India, 1990.

2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., *Knowledge Based Process Planning for Construction and Manufacturing*, Academic Press Inc., 1994.

3. Koncz T., *Manual of Precast Concrete Construction*, Vol. I, II and III, Bauverlag, GMBH, 1971.

Reference Books :

1. *Structural Design Manual, Precast Concrete Connection Details*, Society for the Studies in the Use of Precast Concrete, Netherland Betor Verlag, 1978.

2. Bairagi, *K., A Text Book of Shell Analysis*, Khanna Publisher, New Delhi.

3. Mokk. L, *Pre-fabricated Concrete for Industrial and Public Structures*, Publishing House of the Hungarian Academy of Sciences, Budapest.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

PROFESSIONAL ELECTIVE COURSES

Professional Elective-III (PE-III) (in II sem.)	1. Finite Element Methods for Structural Engineering (FEMSE)
	2. Advanced Steel Structures Design (ASSD)
	3. Theory of Plates and Shells (TPS)
Professional Elective-IV (PE-IV) (in II sem.)	1. Design of Pre-stressed Concrete (DPSC)
	2. Design of Bridges (DB)
	3. Structural Health Monitoring (SHM)

FINITE ELEMENT METHODS for STRUCTURAL ENGINEERING (FEMSE)
(Professional Elective – III)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 815	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the concepts, advantages, and limitations of FEM along with energy principles and discretization techniques.

CO2: Formulate and solve 1D FEM problems for beams and bars including static condensation and temperature/strain effects.

CO3: Generate stiffness and load matrices for 2D FEM problems and apply shape functions for plane stress, plane strain, and axi-symmetric problems.

CO4: Apply isoparametric formulations for 2D elements and perform axi-symmetric FEM analysis for bodies of revolution.

CO5: Formulate and analyze 3D FEM models using hexahedral and isoparametric solid elements for complex structural problems.

UNIT – I

Introduction: Concepts of FEM – Steps involved – Merits & Demerits – Energy principles – Discretization – Rayleigh – Ritz method of functional approximation.
Elastic Formulations: Stress equations – Strain displacement relationships in matrix form – Plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT – II

One Dimensional FEM: Stiffness matrix for beam and bar elements shape functions for 1D elements – Static condensation of global stiffness matrix-solution – Initial strain and temperature effects.

UNIT – III

Two Dimensional FEM: Different types of elements for plane stress and plane strain analysis – Displacement models – Generalized coordinates – Shape functions – Convergent and compatibility requirements – Geometric invariance – Natural coordinate system – Area and volume coordinates – Generation of element stiffness and nodal load matrices – Static condensation.

UNIT – IV

Isoparametric Formulation: Concept, different isoparametric elements for 2D analysis – Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements – Serendipity elements.
Axi-Symmetric Analysis: Bodies of revolution-axi symmetric modelling – Strain displacement relationship – Formulation of axi-symmetric elements.

UNIT – V

Three Dimensional FEM: Different 3-D elements, 3D strain – Displacement relationship – Formulation of hexahedral and isoparametric solid element.

Text Books :

1. Tirupati. R. Chandrnpatla and Ashok D. Belegundu, *Finite Elements Methods in Engineering,* Pearson Education Publications.

2. C.S. Krishna Murthy, *Finite Element Analysis–Theory & Programming*, Tata McGraw Hill Publishers.

3. Tirupati. R. Chandrnpatla, *Finite Elements Methods in Engineering*, Universities Press India Ltd.

Reference Books :

1. Desai, *Finite Element Method and Its Application*, Pearson Publications.
2. Darrel W. Pepper, *Finite Element Methods*, Vikas Publishers.
3. H.V. Lakshminaryana, *Finite Element Analysis and Procedures in Engineering*, 3rd Edition, Universities Press.
4. S. Rajasekharan, *Finite Element Analysis in Engineering Design*, S. Chand Publications.
5. S.S. Bhavakatti, *Finite Element Analysis*, New Age International Publishers.
6. P Seshu, *Finite Element Analysis*, PHI Learning Publications.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED STEEL STRUCTURES DESIGN (ASSD)
(Professional Elective – III)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 816	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Design self-supporting steel stacks/chimneys considering wind, dead, and accidental loads.

CO2: Apply approximate methods and substitute frame methods for analysis of multi- storey steel frames.

CO3: Design gantry girders for electrically operated cranes, evaluating maximum moments and shears.

CO4: Apply theorems of plastic analysis and optimization principles to simple portal frames for minimum weight design.

CO5: Use general plastic design methods and plastic moment redistribution techniques for two-storey portal frames, including deflection assessment.

UNIT – I

Design of self-supporting steel stacks/chimneys – Considerations for preliminary design (Industrial requirements – Thermal requirement – Mechanical force requirement – Wind load and dead load estimation) – Detailed estimation of wind, dead, and other accidental – loads; analysis; detailed design including provision of stakes /spoilers – Design of super structure only.

UNIT – II

Analysis of multi-storey frames using approximate methods and substitute frame method; cantilever method &portal method

UNIT – III

Design of gantry girder – Introduction – Loads acting on the gantry girder – Permissible stresses – Types of gantry girders and crane sails – Crane data – Maximum moments and shears – Design procedure (restricted to electrically operated cranes)

UNIT – IV

Theorems of plastic analysis, applications to the cases of rectangular portal frames – Principles of optimization in structural design – Application to simple–rectangular portal frame – Minimum weight design.

UNIT – V

General Methods of Plastic Design: Combining mechanics methods, plastic moment redistribution method; Application to few cases of simple two storied rectangular portal frames including estimation of deflection.

Text Books :

1. B.G. Neal, *Plastic Analysis of Structures*.
2. Baker, *Steel Skeleton Vol. I and II*.
3. Vazarani and Ratwani, *Design of Steel Structures*.

Reference Books :

1. Timoshenko, *Strength of Materials (Vol-II))*.
2. Manohar, *Analysis of Steel Structure*.
3. Pinfold, *Analysis of Steel Structure*.
4. Arya & Azmani, *Analysis of Steel Structure.*
5. Relevant IS Codes, *Analysis of Steel Structure.*
6. Punmia, B.C., *Analysis of Steel Structure*.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

THEORY OF PLATES AND SHELLS (TPS)
(Professional Elective – III)

M.Tech- II Semester : SE						Scheme : 2025	
Course Code	Hours/Week			Credits	Maximum Marks		
CE 817	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain shell theory, displacement field approximations, stress resultants, and boundary conditions.

CO2: Analyze thin rectangular plates under different loadings using Navier and Levy methods.

CO3: Solve circular plate problems with uniform, central, and concentric loading using differential equations.

CO4: Determine stress resultants and equilibrium equations for cylindrical shells and classify shell structures.

CO5: Apply membrane theory to double-curvature and axi-symmetrical shells, and perform basic design of structures such as cooling towers.

UNIT – I

Introduction: Space curves, Surfaces, Shell co-ordinates, Strain displacement relations, Assumptions in shell theory, Displacement field approximations, Stress resultants, Equation of equilibrium using principle of virtual work, Boundary conditions.

UNIT – II

***Small Deflection Theory of Thin Rectangular Plates*:** Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – Simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure.

UNIT – III

Circular Plates: Differential equation for symmetrical bending of laterally loaded circular plates – Uniformly loaded circular plates – Circular plate concentrically loaded – Circular plate loaded at center.

UNIT – IV

Shells – Functional behaviour – Examples – Structural behavior of shells – Classification of shells – Definitions – Various methods of analysis of shells – Merits and demerits of each method – 2D Membrane equation.

Equations of Equilibrium: Derivation of stress resultants – Cylindrical shells – Flugges simulations equations.

UNIT – V

Introduction to the Shells of Double Curvatures: Geometry, Analysis and design of elliptic paraboloid, Conoid and hyperbolic parabolic shapes, Inverted umbrella type. Axi-symmetrical shells: General equation – Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers.

Text Books :
1. Stephen, P.Timoshenko, S. Woinowsky-Krieger, *Theory of Plates & Shells*, Tata McGraw Hill Edition.
2. G.S. Ramaswami, *Analysis and Design of Concrete Shell Roofs*, CBS Publications.
3. Billington, *Design of Concrete Shell Roofs*, Tata McGraw Hill.
Reference Books :
1. N.K. Bairagi, *Shell Analysis*, Khanna Publishers, New Delhi.
2. P.C. Varghese, *Design of Shells and Folded Plates*, PHI Learning Pvt. Ltd.
3. Chaterjee, *Design of Concrete Shell Roofs*, Oxford and IBH Publications.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

DESIGN OF PRESTRESSED CONCRETE (DPSC)
(Professional Elective – IV)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 818	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the principles, advantages, and materials used in prestressed concrete, including pre-tensioning and post-tensioning methods.

CO2: Estimate prestress losses due to elastic shortening, creep, shrinkage, relaxation, friction, and anchorage slip.

CO3: Analyze and design PSC beams for flexure and deflection using elastic theory and IS code provisions.

CO4: Design for shear, bond, bearing, and anchorage stresses, including end block detailing in PSC members.

CO5: Analyze and design statically indeterminate prestressed concrete beams, including continuous beam layouts and moment distribution.

UNIT – I

Introduction: Development of prestressed concrete – Advantages and disadvantages of PSC over RCC – General principles of pre-stressing, Pre-tensioning and Post tensioning – Materials used in PSC – High strength concrete – High tension steel – Different types/ Methods/ Systems of prestressing.

UNIT – II

Losses of Prestress: Estimation of the loss of prestress due to various causes like elastic shortening of concrete, Creep of concrete, Shrinkage of concrete, Relaxation of steel, Slip in anchorage and friction.

UNIT – III

Flexure & Deflections: Analysis of sections for flexure in accordance with elastic theory – Allowable stresses – Design criteria as per I.S. code of practice – Elastic design of beams (rectangular, I and T sections) for flexure – Introduction to partial prestressing. Introduction – Factors influencing deflections – Short term and long term deflections of un-cracked and cracked members.

UNIT – IV

Shear, Bond, Bearing and Anchorage: Shear in PSC beams – Principal stresses – Conventional elastic design for shear – Transfer of prestress in pre-tensioned members – Transmission length – Bond stresses – Bearing at anchorage – Anchorage zone stresses in post-tensioned members – Analysis and design of end blocks by Guyon, Magnel and approximate methods – Anchorage zone reinforcements.

UNIT – V

Statistically Indeterminate Structures: Introduction – Advantages and disadvantages of continuity – Layouts for continuous beams – Primary and secondary moments – Elastic analysis of continuous beams – Linear transformation – Concordant cable profile – Design of continuous beams.

Text Books :
1. N. Krishna Raju, *Prestressed Concrete*, TMH Publishers.
2. K.U. Muthu, *Prestressed Concrete*, I.K. International Publishing House.
3. Praveen Nagarajan, *Prestressed Concrete Design*, Pearson Publications.
Reference Books :
1. T.Y. Lin, *Design of Prestressed Concrete Structures*, Asian Publishing House.
2. Y. Guyon, *Prestressed Concrete, Vol. I & II*, Wiley and Sons.
3. F. Leohhardt, *Prestressed Concrete Design and Construction*, Wilhelm Ernst and Shon, Berlin.
4. C.E. Reynolds and J.C. Steedman, *Reinforced Concrete Designers Hand Book*, A view point publication.
5. Edward P. Nawy, *Prestressed Concrete*, Prentice Hall.
6. Raj Gopal, *Prestressed Concrete*, Narsoa Publications.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

DESIGN OF BRIDGES (DB)
(Professional Elective – IV)

M.Tech- II Semester : SE						Scheme : 2025	
Course Code	Hours/Week			Credits	Maximum Marks		
CE 819	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the classification, planning, and design considerations of bridges in accordance with IRC specifications.

CO2: Design box culverts and slab bridges considering load distribution, moments, and detailing requirements.

CO3: Apply Pigeaud's and Courbon's theories to analyze and design reinforced concrete T-beam bridges.

CO4: Design prestressed concrete slab bridges, and select and design suitable bridge bearings.

CO5: Analyze and design piers and abutments, ensuring safety and stability under various loading conditions.

UNIT – I

Introduction: Classification, Investigations and planning, Choice of type – Economic span length – IRC Specifications for road bridges, Standard live loads, Other forces acting on bridges, General design considerations.

UNIT – II

***Design of Box Culverts*:** General aspects – Design loads – Design moments, shears and thrusts – Design of critical section.

Design of Slab Bridges: Effective width of analysis – Workings stress design and detailing of slab bridges for IRC loading.

UNIT – III

T-Beam Bridges: Introduction – Wheel load analysis – B.M. in slab – Pigaud's theory – Analysis of longitudinal girders by Courbon's theory – Working stress design and detailing of reinforced concrete T-beam bridges for IRC loading.

UNIT – IV

Prestressed Concrete Bridges: General features – Advantages of prestressed concrete bridges – Pre-tensioned prestressed concrete bridges – Post tensioned prestressed concrete bridge decks. Design of post tensioned prestressed concrete slab bridge deck. Bridge bearings – General features – Types of bearings – Forces on bearings basis for selection of bearings – Design principles of steel rocker and roller bearings and its design – Design of elastomeric pad bearing detailing of elastomeric pot bearings.

UNIT – V

Piers and Abutments: General features – Bed block – Materials for piers and abutments – Types of piers – Forces acting on piers – Design of pier – Stability analysis of piers – General features of abutments – Forces acting on abutments – Stability analysis of abutments.

Text Books :
1. D. Hohnson Victor, *Essentials of Bridges Engineering*, Oxford & IBH Publishers Co. Private Ltd.
2. M C Aswanin, V N Vazrani, and M M Ratwani, *Design of Concrete Bridges*, Khanna Publishers.
3. S. Ponnuswamy, *Bridge Engineering*.
Reference Books :
1. Browe R.E., *Concrete Bridge Design*, C.R. Books Ltd., London.
2. Taylor F.W., Thomson, S.E., and Smulski E., *Reinforced Concrete Bridges*, John Wiley and Sons, New York.
3. Derrick Beckett, *An Introduction to Structural Design of Concrete Bridges*, Surrey University Press, Henlely –Thomes, Oxford Shire.
4. Bakht. B. and Jaegar, L.G., *Bridge Analysis Simplified*, McGraw Hill.
5. N. Krishna Raju, *Design of Bridges*, Oxford & IBH.
6. F R Jagadeesh, M.A. Jaya Ram, *Design of Bridge Structures*, Eastern Economy Edition.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

STRUCTURAL HEALTH MONITORING (SHM)
(Professional Elective – IV)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 820	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the causes of distress and the importance of maintenance in structural health.

CO2: Apply SHM concepts, procedures, and auditing techniques to assess the safety of structures.

CO3: Select appropriate static and dynamic field testing methods for evaluating structural performance.

CO4: Utilize modern sensor systems, hardware, and remote monitoring technologies for structural health assessment.

CO5: Demonstrate knowledge of rehabilitation techniques, smart materials, and EMI-based approaches through case studies.

UNIT – I

Structural Health: Factors affecting health of structures – Causes of distress – Regular maintenance.

UNIT – II

Structural Health Monitoring: Concepts – Various measures – Structural safety in alteration. ***Structural Audit:*** Assessment of health of structure – Collapse and investigation – Investigation management – SHM procedures.

UNIT – III

Static Field Testing: Types of static tests – Simulation and loading methods – Sensor systems and hardware requirements – Static response measurement.

UNIT – IV

Dynamic Field Testing: Types of dynamic field test – Stress history data – Dynamic response methods – Hardware for remote data acquisition systems – Remote structural health monitoring.

UNIT – V

Structural Health Monitoring: Introduction – Piezo– electric materials and other smart materials – Electro–Mechanical Impedance (EMI) technique – Adaptations of EMI technique.

Text Books :

1. Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, *Structural Health Monitoring*, John Wiley and Sons.

2. Douglas E Adams, *Health Monitoring of Structural Materials and Components Methods with Applications,* John Wiley and Sons.

Reference Books :

1. J. P. Ou, H. Li and Z. D. Duan, *Structural Health Monitoring and Intelligent*

Infrastructure, Vol.1, Taylor and Francis Group, London, UK.

2. Victor Giurglutiu, *Structural Health Monitoring with Wafer Active Sensors*, Academic Press Inc.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

PROFESSIONAL ELECTIVE COURSES

Professional Elective-V (PE-V) (in III sem.)	1. Earthquake Resistant Design of Structures (ERDS)
	2. Rehabilitation and Retrofitting of Structures (RRS)
	3. Design of Tall Buildings (DTB)

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (ERDS)
(Professional Elective – V)

M.Tech- III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 821	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain earthquake mechanisms, seismic waves, and seismic zones, including measuring techniques and instruments.

CO2: Analyze vibratory systems, single-degree-of-freedom (SDOF) models, damping effects, and earthquake-induced dynamic forces.

CO3: Evaluate conceptual design strategies, ductility factors, and seismic design methods for ensuring structural resilience.

CO4: Apply IS code provisions and lateral force methods for seismic design of reinforced concrete and masonry buildings.

CO5: Assess the significance of structural walls, non-structural elements, and ductile detailing in enhancing earthquake resistance.

UNIT – I

***Engineering Seismology**:* Earthquake phenomenon – Cause of earthquakes – Faults – Plate tectonics – Seismic waves – Terms associated with earthquakes – Magnitude/intensity of an earthquake – Scales – Energy released – Earthquake measuring instruments seismogram, seismoscope, seismograph – Strong ground motions – Seismic zones of India.

***Theory of Vibrations**:* Elements of a vibratory system – Degrees of freedom – Continuous system – Lumped mass idealization – Oscillatory motion – Simple harmonic motion – Free vibration of single degree of freedom (SDOF) system – Undamped and damped – Critical damping – Logarithmic decrement – Forced vibrations – Harmonic excitation – Dynamic magnification factor – Excitation by rigid based translation for SDOF system – Earthquake ground motion.

UNIT – II

Conceptual Design: Introduction – Functional planning – Continuous load path – Overall form – Simplicity and symmetry – Elongated shapes – Stiffness and strength – Horizontal and vertical members – Twisting of buildings – Ductility – Definition – Ductility relationships – Flexible buildings – Framing systems – Choice of construction materials – Unconfined concrete – Confined concrete – Masonry – Reinforcing steel.

Introduction to Earthquake Resistant Design: Seismic design requirements – Regular and irregular configurations – Basic assumptions – Design earthquake loads – Basic load combinations – Permissible stresses – Seismic methods of analysis – Factors in seismic analysis – Equivalent lateral force method.

UNIT – III

Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members – Structural models for frame buildings – Seismic methods of analysis – IS Code based methods for seismic design – Vertical irregularities – Plan configuration problems – Lateral

load resisting systems – Determination of design lateral forces as per IS 1893 (Part-1):2016 – Equivalent lateral force procedure – Lateral distribution of base shear.

UNIT – IV

Masonry Buildings: Introduction – Elastic properties of masonry assemblage – Categories of masonry buildings – Behaviour of unreinforced and reinforced masonry walls – Behaviour of walls – Box action and bands – Behaviour of infill walls – Improving seismic behaviour of masonry buildings – Load combinations and permissible stresses – Seismic design requirements – Lateral load analysis of masonry buildings.

UNIT – V

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls – Sectional shapes – Variations in elevation – Cantilever walls without openings – Failure mechanism of non-structures – Effects of non-structural elements on structural system – Analysis of non-structural elements – Prevention of non-structural damage ductility considerations in earthquake resistant design of RC buildings: introduction – Impact of ductility – Requirements for ductility – Assessment of ductility – Factors affecting ductility – Ductile detailing considerations as per IS 13920-2016 – Behaviour of beams, columns and joints in RC buildings during earthquakes.

Text Books :

1. S. K. Duggal, *Earthquake Resistant Design of structures*, Oxford University Press.
2. Pankaj Agarwal and Manish Shrikhande, *Earthquake Resistant Design of structures*, Prentice Hall of India Pvt. Ltd.

Reference Books :

1. T. Paulay and M.J.N. Priestly, *Seismic Design of Reinforced Concrete and Masonry Building,* John Wiley & Sons.
2. Vinod Hosur, *Earthquake Resistant Design of Building structures*, Wiley India Pvt. Ltd.
3. R.N. Iyengar, *Elements of Mechanical Vibration,* I. K. International Publishing House Pvt. Ltd.
4. Anand S. Arya, *Masonry and Timber structures including earthquake Resistant Design,* Nem Chand & Bros.
5. C.V.R. Murthy, *Earthquake Tips – Learning Earthquake Design and Construction*.
6. BIS Codes: (1) IS 1893(Part-1):2016 or latest codes; (2) IS 13920:2016; (3) IS 4326. (4) IS 456:2000 or latest.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

REHABILITATION AND RETROFITTING OF STRUCTURES (RRS)
(Professional Elective – V)

M.Tech- III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
CE 822	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand corrosion effects.

CO2: Understand the deterioration in structures.

CO3: Understand nondestructive tests.

CO4: Understand the surface repair of structures.

CO5: Understand the concepts of Strengthening and stabilization of structural elements.

UNIT – I

Introduction, significance of corrosion, and corrosion mechanisms – Embedded metal corrosion.

UNIT – II

Deterioration of cementations systems – Sulphate and acid attack – Alkali Silica Reaction (ASR), Shrinkage and others.

UNIT – III

Concrete assessment using non-destructive tests (NDT) – Concrete assessment and load effects.

UNIT – IV

Surface repair – Condition assessment – Analysis, strategy and design – Material requirement, surface preparation, placement of repair material.

UNIT – V

Strengthening and stabilization – Strengthening of Structural elements – Repair of structures distressed due to corrosion, fire, leakage, earthquake – Transportation of Structures from one place to other – Structural Health Monitoring – Demolition techniques – Engineered demolition methods – Case studies – Study of structural conditions of heritage buildings.

Text Books :

1. Peter H. Emmons, *Concrete Repair and Maintenance,* R.S. Means Company, Kingston, MA, USA.

2. P.C. Varghese, *Maintenance Repair & Rehabilitation & Minor Works of Buildings*, PHI Learning Pvt. Ltd., New Delhi.

Reference Books :

1. Michael Raupach and Till Buttner, *Concrete Repair to EN1504 – Diagnosis, Design, Principles and Practice*, CRC Press.

2. R. Dodge Woodson, Butterworth-Heinemann, *Concrete Structures – Protection, Repair and Rehabilitation*, Elsevier, UK.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

DESIGN OF TALL BUILDINGS (DTB)
(Professional Elective – V)

M.Tech- III Semester : SE				Scheme : 2025			
Course Code	Hours/Week			Credits	Maximum Marks		
CE 823	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs				End Exam Duration: 3 Hrs			

Course Outcomes : At the end of the course the student will be able to

CO1: Understand structural systems of tall buildings.

CO2: Implement latest construction practices and processes for structural systems.

CO3: Analyze and design high rise structures.

CO4: Design fire protection systems in tall buildings.

CO5:

UNIT – I

Evolution of Tall Buildings: Introduction – Design criteria for structural design of tall building – Concept of premium for height – Development of high rise architecture.

Assembly of Building: Building performance – Cost, quality and time – Environmental requirements – Industrialization & robotics in construction – Introduction to safety and health management system.

UNIT – II

Site Investigation: Stages of site investigation – Site reconnaissance & ground investigation – Field tests & laboratory tests.

Foundation Systems: Foundation systems – Material handling and mechanization: Material handling considerations – Earthmoving equipment's – Horizontal and vertical movements – Selection & utility of cranes (Tower cranes & climbing cranes).

UNIT – III

Wind Effects on Behaviour of Tall Structures: Outlook of design considerations and characteristics of wind, codal wind loads and cladding pressures on behavior of tall buildings.

UNIT – IV

Seismic Effects on Behaviour of Tall Structures: Introduction to tall building behavior during earthquakes and seismic design philosophy – Building behaviour – Seismic design concept – Dynamic response concept – Dynamic analysis theory – Design techniques.

UNIT – V

Structural Forms & Flooring Systems: Introduction of various structural forms and their importance to high rise architecture – Introduction to various flooring systems in concrete & steel.

Modeling for Analysis: Approaches for analysis – Assumptions involved in modelling – Reduction techniques – Application using structural engineering software.

Text Books :

1. Taranath, B, *Steel, Concrete and Composite Design of Tall Buildings*, 2nd Edition,

McGraw Hill.

2. White And Salmon, *Building Structural Design Handbook*, John Wiley & Sons.

3. Bryan S, Smith and Alex Coull, *Tall Buildings Structures Analysis and Design,* Wiley India Pvt. Ltd.

Reference Books :

1. Wolfgang Schueller, *The Design of Building Structures,* Prentice Hall India.
2. S. Taranath. B, *Reinforced Concrete Design of Tall Buildings,* CRC Press.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

LIST OF AUDIT COURSES

Audit Course – I (AC – I)	English for Research Paper Writing (ERPW)
	Disaster Management (DM)
	Essence of Indian Traditional Knowledge (EITK)
Audit Course – II (AC – II)	Pedagogy Studies (PS)
	Personality Development Through Life Enlightenment Skills (PDTLES)
	Yoga for Stress Management (YSM)

ENGLISH FOR RESEARCH PAPER WRITING (ERPW)
(Audit Course – I)

M.Tech- I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
AC101	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	-	-	-	-
Sessional Exam Duration : --					End Exam Duration: --		

Course Outcomes : At the end of the course the student will be able to

CO1: Recall the key language aspects and structural elements of academic writing in research papers.

CO2: Explain the importance of clarity, precision, and objectivity in research writing.

CO3: Apply critical reading strategies and advanced grammar skills to analyze and write research papers.

CO4: Analyze research articles and identify the strengths and limitations of different methodologies.

CO5: Evaluate research papers to check for plagiarism, structure, clarity, and language accuracy.

CO6: Evaluate the effectiveness of different language and technology tools in research writing, including AI-assisted tools and plagiarism detection software.

CO7: Develop a well-structured research paper that effectively communicates complex ideas.

UNIT – I

Fundamentals of Academic English: Academic English – MAP (Message-Audience Purpose) – Language Proficiency for Writing – Key Language Aspects – Clarity and Precision – Objectivity – Formal Tone – Integrating References – 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.

UNIT – II

Reading Skills for Researchers: Reading Academic Texts – Critical Reading Strategies – Skimming and Scanning – Primary Research Article vs. Review Article – Reading an Abstract – Analyzing Research Articles – Identifying Arguments – Classifying Methodologies – Evaluating Findings – Making Notes.

UNIT – III

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.

UNIT – IV

Mastery in Refining Written Content/Editing Skills: 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 – Critical and Creative Phases of Writing.

UNIT – V

Technology and Language for Research: Digital Literacy and Critical Evaluation of Online Content – Technology and Role of AI in Research Writing – Assistance in Generating Citations and References – Plagiarism and Ethical Considerations – Tools and Awareness – Fair Practices.
Text Books :
1. Bailey. S., A*cademic Writing: A Handbook for International Students.* London and New York, Routledge, 2015.
2. Adrian Wallwork, *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, 2011.
Reference Books :
1. Craswell G., *Writing for Academic Success,* Sage Publications, 2004.
2. Peter Elbow, *Writing with Power, E-book*, Oxford University Press, 2007.
3. Oshima A. & Hogue A., *Writing Academic English*, Addison-Wesley, New York, 2005.
4. Swales J. & C. Feak, *Academic Writing for Graduate Students: Essential Skills and Tasks,* Michigan University Press, 2012.
5. Goldbort R., *Writing for Science*, Yale University Press (available on Google Books), 2006.
6. Day R, *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006.

DISASTER MANAGEMENT (DM)
(Audit Course – I)

M.Tech- I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
AC102	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	-	-	-	-
Sessional Exam Duration : --					End Exam Duration: --		

Course Outcomes : At the end of the course the student will be able to

CO1: Define and distinguish between hazards and disasters, and explain their types, nature, and impacts.

CO2: Identify and map disaster-prone areas in India and understand the epidemiological consequences of disasters.

CO3: Assess the economic, social, and ecological repercussions of major natural and man-made disasters.

CO4: Demonstrate knowledge of disaster preparedness tools such as remote sensing, meteorological data, risk evaluation, and community awareness.

CO5: Apply risk assessment methods and propose disaster risk reduction strategies at local, national, and global levels.

CO6: Formulate and evaluate structural and non-structural disaster mitigation strategies, with emphasis on Indian programs and emerging trends.

UNIT – I

Introduction: Disaster – Definition, factors and significance – Difference between hazard and disaster – Natural and man-made disasters – Difference, nature, types and magnitude – 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.

UNIT – II

Repercussions of Disasters and Hazards: Economic damage – Loss of human and animal life – Destruction of ecosystem – Natural disasters – Earthquakes, volcanism, cyclones, tsunamis, floods, droughts and famines, landslides and avalanches, man-made disaster – Nuclear reactor meltdown – Industrial accidents – Oil slick sand spills – Outbreaks of disease and epidemics war and conflicts.

UNIT – III

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.

UNIT – IV

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.

UNIT – V

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.
Text Books :
1. Gupta H. K., *Disaster Management*, Universities Press, 2003.
2. Singh R. B., *Natural Hazards and Disaster Management*, Rawat Publications, 2006.
Reference Books :
1. Coppola D. P., *Introduction to International Disaster Management,* (4th ed.), Elsevier, 2020.
2. Shaw R. & Izumi. T., *Science and Technology in Disaster Risk Reduction in Asia,* Springer, 2022.
3. Wisner B., Gaillard, J. C., & Kelman I., *Handbook of Hazards and Disaster Risk Reduction and Management* (2nd ed.), Routledge, 2021.
4. Saini V. K., *Disaster Management in India: Policy, Issues and Perspectives*, Sage India, 2021.
5. Kelman I., *Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes,* Oxford University Press, 2022.
6. Sahni P. & Dhameja A., *Disaster Mitigation: Experiences and Reflections,* Prentice Hall of India, 2004.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (EITK)
(Audit Course – I)

M.Tech- I Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
AC103	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	-	-	-	-
Sessional Exam Duration : --					End Exam Duration: --		

Course Outcomes : At the end of the course the student will be able to

CO1: Define and explain the concept of traditional knowledge, its nature, characteristics, and scope.

CO2: Understand the need for protecting traditional knowledge and its significance in the global economy.

CO3: Explain the legal framework and policies related to traditional knowledge protection.

CO4: Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology.

CO5: Analyze the importance of traditional knowledge in various contexts, including its historical impact and social change.

CO6: Analyze the relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms.

UNIT – I

Introduction to traditional knowledge – Definition, Nature and characteristics, scope and importance – Kinds of traditional knowledge – Physical and social contexts in which traditional knowledge develop – Historical impact of social change on traditional knowledge systems – Indigenous Knowledge (IK) – Characteristics – Traditional knowledge vis-à-vis indigenous knowledge – Traditional knowledge vs. western knowledge, traditional knowledge vis-à-vis formal knowledge.

UNIT – II

Protection of traditional knowledge – Need for protecting traditional knowledge – Significance of TK Protection – Value of TK in global economy – Role of Government to harness TK.

UNIT – III

Legal frame work and TK - A) The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 – Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act) – B) The Biological Diversity Act 2002 and Rules 2004 – The protection of traditional knowledge bill, 2016 – Geographical Indicators Act 2003.

UNIT – IV

Traditional knowledge and Intellectual property – Systems of traditional knowledge protection – Legal concepts for the protection of traditional knowledge – Certain non-IPR mechanisms of traditional knowledge protection – Patents and traditional knowledge – Strategies to increase protection of traditional knowledge – Global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT – V

Traditional knowledge in different sectors – Traditional knowledge and Engineering – Traditional medicine system – TK and Biotechnology – TK in Agriculture – Traditional

societies depend on it for their food and healthcare needs – Importance of conservation and sustainable development of environment – Management of biodiversity, Food security of the country and protection of TK.
Text Books :
1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. *Introduction to Indian Knowledge System: Concepts and Applications*, PHI Learning Pvt. Ltd. Delhi, 2022.
2. Basanta Kumar Mohanta and Vipin Kumar Singh, *Traditional Knowledge System and Technology in India,* Pratibha Prakashan, 2012.
Reference Books :
1. *Pride of India: A Glimpse into India's Scientific Heritage*, Samskrita Bharati, New Delhi.
2. Kak, S.C., *On Astronomy in Ancient India*, Indian Journal of History of Science, 22(3), 1987.
3. Subbarayappa, B.V. and Sarma, K.V. *Indian Astronomy: A Source Book*, Nehru Centre, Mumbai, 1985.
4. Bag, A.K. *History of Technology in India -Vol. I*, Indian National Science Academy, New Delhi, 1997.
5. Acarya P.K., *Indian Architecture*, Munshiram Manoharlal Publishers, New Delhi, 1996.
6. Banerjea P, *Public Administration in Ancient India,* Macmillan, London, 1961.
7. Kapoor Kapil, Singh Avadhesh, *Indian Knowledge Systems Vol. – I & II,* Indian Institute of Advanced Study, Shimla, H.P., 2022.

PEDAGOGY STUDIES (PS)
(Audit Course – II)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
AC104	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	-	-	-	-
Sessional Exam Duration : --					End Exam Duration: --		

Course Outcomes : At the end of the course the student will be able to

CO1: Define and explain key concepts, frameworks, and methodologies in pedagogy and teacher education research.

CO2: Critically analyze pedagogical practices used in diverse classroom settings, with reference to teacher education and curriculum design.

CO3: Evaluate the effectiveness of pedagogical approaches using quality assessment tools and theory of change models.

CO4: Apply evidence-based strategies to improve classroom practices, curriculum alignment, and teacher professional development.

CO5: Identify and address barriers to learning through innovative pedagogical strategies.

CO6: Design and propose research studies that contribute to filling gaps in pedagogy, curriculum, and teacher education, with focus on dissemination and impact.

UNIT – I

Foundations of Pedagogy: Introduction to pedagogy and its importance in education – Historical and philosophical foundations of pedagogy – Theories of learning and teaching (behaviorist, cognitive, constructivist) – Role of pedagogy in shaping educational practices – Role of technology in modern pedagogy (ICT, e-learning, blended learning).

UNIT – II

Teaching-Learning Processes: Understanding the teaching-learning process – Lesson planning and curriculum design – Strategies for effective teaching and learning (expository, collaborative, experiential) – Use of technology to enhance teaching-learning processes (multimedia, simulations, gamification).

UNIT – III

Technology Integration in Education: Educational technology and system design – Instructional design models (ADDIE, ASSURE, Dick and Carey Model) – Emerging trends in e-learning (social learning, MOOCs, mobile learning) – ICT tools for teaching and learning (Learning Management Systems, online resources).

UNIT – IV

Pedagogy and Assessment: Pedagogy, pedagogical analysis, and assessment – Types of assessment (placement, formative, diagnostic, summative) – Technology-based assessment tools (online quizzes, polls, discussions) – Rubrics for self and peer evaluation – Reflective Practices.

UNIT – V

Contemporary Issues and Trends: Inclusive education and technology (assistive technology, accessibility) – Change management and innovation in education – Quality assurance and evaluation in education (TQM, Six Sigma) – Future trends in pedagogy and technology (AI, AR, VR in education) – Personalized learning and adaptive teaching.

Text Books :
1. Alexander, R. J., *Essays on Pedagogy*, Routledge, 2008.
2. Shulman, L. S., *The Wisdom of Practice: Essays on Teaching, Learning, and Learning to Teach*. Jossey-Bass, 2004.
Reference Books :
1. *Teaching for the Future: Effective Teacher Education and Pedagogical Practices*, OECD Publishing, 2021.
2. Fullan M. & Edwards M. *System Change in Education: Sustainability and Impact*, Routledge, 2022.
3. Coe R., Rauch C., Kime S., & Singleton D., *Great Teaching Toolkit: Evidence Review*, Evidence Based Education, 2020.
4. Zeichner K. M., *The Struggle for the Soul of Teacher Education*, Routledge, 2024.
5. UNESCO. *Global Education Monitoring Report: Pedagogy, Teachers and Learning*, UNESCO Publishing, 2024.
6. Hattie, J. *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*, Routledge, 2009.
7. Darling-Hammond, L. *Teacher Education Around the World: What Can We Learn from International Practice?* Routledge, 2007.
Online Resources :
1. UNESCO Education Resources – https://www.unesco.org/education
2. OECD Education and Skills – https://www.oecd.org/education
3. ERIC (Education Resources Information Center) – https://eric.ed.gov (peer-reviewed papers, reports).
4. World Bank Education – https://www.worldbank.org/en/topic/education (research reports on teacher development in developing countries).
5. NPTEL/SWAYAM MOOCs – Teacher education and pedagogy-focused courses.
6. Google Scholar Alerts – set alerts for "pedagogical practices", "teacher education", "curriculum research" for the latest academic papers.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (PDTLES)

(Audit Course – II)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
AC105	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	-	-	-	-
Sessional Exam Duration : --					End Exam Duration: --		

Course Outcomes : At the end of the course the student will be able to

CO1: Define and explain key concepts of self-awareness, personality, and personal growth.

CO2: Identify and apply strategies of emotional intelligence to regulate emotions and build effective interpersonal relationships.

CO3: Demonstrate positive thinking, gratitude, and resilience to overcome personal and professional challenges.

CO4: Analyze barriers to effective communication and apply verbal and non-verbal communication techniques in diverse contexts.

CO5: Prepare, deliver, and evaluate effective presentations and public speeches with confidence.

CO6: Develop leadership and teamwork skills to collaborate, negotiate, and solve problems in group settings.

UNIT – I

Self-Awareness and Personal Growth: Understanding personality and its development- Identifying strengths, weaknesses, opportunities, and challenges (SWOC analysis) – Setting personal and professional goals – Practicing self-reflection and journaling.

(Activities: Personality assessments, self-reflection exercises, group discussions, SWOC analysis worksheet, Action plan, SMART goal activities, Reflective journaling, Self-care Planning)

UNIT – II

Emotional Intelligence and Interpersonal Skills: Understanding emotional intelligence and its importance – Developing self-awareness, self-regulation, and motivation – Building effective communication and interpersonal skills – Conflict resolution and negotiation strategies.

(Activities: Emotional Intelligence Quiz, Self-Reflection exercises, Feedback sessions, Mindfulness exercises, Positive self-talk, Active Listening exercises, Conflict-resolution, Role-play, Case studies & Group activities)

UNIT – III

Positive Thinking and Attitude: Understanding the power of positive thinking – Developing a growth mindset and resilience – Practicing gratitude and mindfulness – Overcoming negative thoughts and behaviors.

(Activities on positive thinking, growth mindset, mindfulness and self-care plan for overcoming negative thoughts)

UNIT – IV

Effective Communication and Presentation Skills: Understanding the importance of

effective communication – Developing verbal and non-verbal communication skills – Preparing and delivering effective presentations – Building confidence and public speaking skills. (Activities: Group discussions, Case studies, Role-Play, Non-verbal communication exercises, Practice presentations, Peer feedback, Public speaking exercises, Storytelling, Debates)
UNIT – V
Leadership and Teamwork: Understanding leadership styles and qualities – Developing leadership skills and qualities – Building effective teams and teamwork strategies – Practicing collaboration and problem-solving. (Activities: Case studies, Group discussions, Debates, Leadership role-playing, Team building activities, Group projects, Collaborative problem-solving exercises, Feedback sessions)
Text Books :
1. Daniel Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ*, Bantam Books, 2017.
2. Stephen R. Covey, *The 7 Habits of Highly Effective People*, Simon & Schuster, 2020.
Reference Books :
1. Dale Carnegie, *How to Win Friends and Influence People*, Simon & Schuster, 2020.
2. Brian Tracy, *Goals!: How to Get Everything You Want Faster Than You Ever Thought Possible*, Berrett-Koehler Publishers, 2021.
3. Robin Sharma, *The 5 AM Club: Own Your Morning, Elevate Your Life*, Harper Collins, 2020.
4. Carol S. Dweck, *Mindset: The New Psychology of Success*, Random House, 2016.
5. Daniel H. Pink, *Drive: The Surprising Truth About What Motivates Us*, Riverhead Books, 2018.
6. John C. Maxwell, *Leadershift: 11 Essential Changes Every Leader Must Embrace*, Harper Collins, 2019.
Online Resources:
1. Coursera – *Personal Development Specialization* (https://www.coursera.org)
2. edX – *Leadership and Emotional Intelligence Courses* (https://www.edx.org)
3. FutureLearn – *Mindfulness and Resilience Training* (https://www.futurelearn.com)
4. MindTools – Practical resources on leadership, communication, and emotional intelligence (https://www.mindtools.com)
5. Positive Psychology – Articles and tools on resilience, gratitude, and well-being (https://positivepsychology.com)
6. TED Talks – Inspirational talks on leadership, communication, and self-growth (https://www.ted.com)
7. Harvard Business Review (HBR) – Leadership, negotiation, and workplace communication (https://hbr.org)

YOGA FOR STRESS MANAGEMENT (YSM)
(Audit Course – II)

M.Tech- II Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
AC106	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	2	-	-	-	-	-	-
Sessional Exam Duration : --					End Exam Duration: --		

Course Outcomes : At the end of the course the student will be able to

CO1: Explain the eight limbs of Yoga (Ashtanga) and their interrelationship in holistic development.

CO2: Demonstrate understanding of Yama and Niyama as ethical guidelines and apply them in personal and professional life.

CO3: Differentiate between do's and don'ts in daily life with reference to Yogic principles like ahimsa, satya, and swadhyaya.

CO4: Perform selected asanas and pranayama techniques with correct posture, breathing, and awareness.

CO5: Evaluate the physical, mental, and emotional benefits of yoga practices in stress reduction, concentration, and self-discipline.

CO6: Integrate yoga philosophy and practices into a personal routine for sustainable health and inner growth.

UNIT – I

Definitions of Eight parts of yoga. (Ashtanga)

UNIT – II

Yam and Niyam.

UNIT – III

Do's and Don'ts in life
(i) Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha
(ii) Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan

UNIT – IV

Asan and Pranayam

UNIT – V

(i) Various yoga poses and their benefits for mind and body
(ii) Regularization of breathing techniques and its effects – Types of pranayam

Text Books :

1. Swami Prabhavananda and Christopher Isherwood (Translation & commentary), *Patanjali Yoga Sutras,* Sri Ramakrishna Math, 1953.
2. B.K.S. Iyengar, *Light on Yoga,* Thorsons, 2003.

Reference Books :

1. T.K.V. Desikachar, *The Heart of Yoga: Developing a Personal Practice,* Inner Traditions 2nd Edition, 1999.

2. Acharya Yatendra, *Yoga & Stress Management*, Fingerprint Publishers, 2019.
3. Yamini Muthanna, *The Power of Yoga,* Om Books International, 2015.
4. Nayaswami Devarshi, *Kriya Yoga: Spiritual Awakening for the New Age,* Ananda Sangha Publications, 2023.
Online Resources :
1. NPTEL / SWAYAM Online Courses – Yoga and Physical Education modules.
2. AYUSH Ministry Website: https://yoga.ayush.gov.in – official yoga resources, protocols, and research.
3. Yoga Journal: https://www.yogajournal.com – practical guides, research updates, asana tutorials.
4. Art of Living Foundation: https://www.artofliving.org – pranayama, meditation, and wellness practices.
5. YouTube Channels (Scholarly & Practice-based): (i) *Sivananda Yoga Vedanta Centre* (ii) *Yoga with Adriene* (for practical asana guidance)

LIST OF OPEN ELECTIVES

S. No.	Course Code	Course name	Offered by the Department
1	OE-301	Green Buildings	CE
2	OE-302	Road Safety Engineering	
3	OE-303	IoT and its Applications	ECE
4	OE-304	Photovoltaic Systems	EEE
5	OE-305	Integrated Product Design and Development	ME
6	OE-306	Advanced Numerical Methods and Computational Mathematics	H&BS
7	OE-307	Mathematics for Machine Learning and Data Science	
8	OE-308	Statistical Learning Theory and Mathematical Foundations of AI	
9	OE-309	Chemistry of Nano materials and Applications in Engineering	
10	OE-310	Photonics for Engineers	

GREEN BUILDINGS (GB)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE301	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the importance of green buildings, their necessity, and sustainable features.

CO2: Analyze various green building practices, rating systems, and their impact on environmental sustainability.

CO3: Apply principles of green building design to enhance energy efficiency and incorporate renewable energy sources.

CO4: Evaluate HVAC systems, energy efficient air conditioning techniques, and their role in sustainable building designs.

CO5: Assess material conservation techniques, waste reduction strategies, and indoor air quality management in green buildings.

UNIT – I

Introduction to Green Building: Necessity of green buildings – Benefits of green buildings – Green building materials and equipment in India – Key requisites for constructing a green building – Important sustainable features for green buildings.

UNIT – II

Green Building Concepts and Practices: Indian green building council – Green building movement in India – Benefits experienced in green buildings – Launch of green building rating systems, residential sector, market.

Transformation; Green Building Opportunities and Benefits: Opportunities of green buildings – Green building features – Material and resources – Water efficiency – Optimum energy efficiency – Typical energy-saving approaches in buildings – LEED India rating system, and Energy efficiency.

UNIT – III

Green Building Design: Introduction – Reduction in energy demand – Onsite sources and sinks – Maximizing system efficiency – Steps to reduce energy demand and use on sit sources and sinks – Use of renewable energy sources – Eco-friendly captive power generation for factories – Building requirements.

UNIT – IV

Air Conditioning: Introduction – CII Godrej green business centre – Design philosophy – Design interventions – Energy modeling – HVAC system design – Chiller selection – Pump selection – Selection of cooling towers – Selection of air handling units – Pre-cooling of fresh air – Interior lighting systems – Key features of the building – Eco-friendly captive power generation for factories – Building requirements.

UNIT – V

Material Conservation: Handling of non-process waste – Waste reduction during

construction – Materials with recycled content – Local materials – Material reuse – Certified wood – Rapidly renewable building materials and furniture – Indoor environment quality and occupational health – air conditioning – Indoor air quality – Sick building syndrome – Tobacco smoke.
Text Books:
1. Indian Society of Heating Refrigerating and Air conditioning Engineers, *Handbook on Green Practices,* 2009.
2. Tomwoolley and Samkimings, *Green Building Hand Book*, 2009.
Reference Books:
1. Trishriley, *Complete Guide to Green Buildings*.
2. Kent Peterson, *Standard for the design for High Performance Green Buildings.*
3. *Energy Conservation Building Code – ECBC-2020*, published by BE
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ROAD SAFETY ENGINEERING (RSE)
(Open Elective)

M.Tech - III Semester : SE						Scheme : 2025	
Course Code	Hours/Week			Credits	Maximum Marks		
OE302	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the basic causes of road accidents.

CO2: Conduct accident investigations and identify black spots.

CO3: Design & plan road geometrics incorporating road safety.

CO4: Understand the importance of road signs and markings.

CO5: Conduct road safety audit.

UNIT – I

Accident investigations and risk management – Collection of accident data – Assessment of road safety – Methods to identify and prioritize hazardous locations and elements – Determine possible causes of crashes – Crash reduction capabilities and countermeasures – Effectiveness of safety design features – Accident reconstruction – Condition and collision diagram.

unit – ii

Traffic Engineering Studies: Statistical methods in traffic safety analysis – Regression methods – Poisson distribution – Chi- squared distribution – Statistical comparisons – Traffic management measures and their influence on accident prevention.

UNIT – III

Road Safety in Transport Planning and Geometric Design: Vehicle and human characteristics – Road design and safety elements – Redesigning junctions – Cross section improvements – Traffic control – Traffic calming measures – Road safety furniture.

UNIT – IV

Role of Signs and Markings in Safety: Types of signs – Design specifications – Guidelines for installation – Role of signs in safety –Types of road markings – Design specifications – Role of road markings in safety.

UNIT – V

Traffic management systems for safety – Road safety audits and tools for safety management systems – Road safety audit process – Road safety improvement strategies – ITS and safety.

Text Books:

1. L.R. Kadiyali, *Traffic Engineering and Transportation Planning*, Khanna Publishers.
2. C.S. Papacostas, *Fundamentals of Transportation Engineering*, Prentice Hall India.
3. *Road Safety* by NCHRP

Reference Books:

1. C. Jotin Khisty, B. Kent Lall, *Transportation Engineering–An Introduction*.
2. Richardo G Sigua, *Fundamentals of Traffic Engineering*.
3. Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson, *Hand Book of Road Safety*

Measures, Second Edition.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

IOT AND ITS APPLICATIONS (IOT)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE303	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Apply the Knowledge in IOT technologies and data management.

CO2: Determine the values chains Perspective of M2M to IOT.

CO3: Implement the state of the architecture of an IOT.

CO4: Compare IOT applications in Industrial & real world.

CO5: Demonstrate knowledge and understand the security and ethical issues of an IOT.

UNIT – I

***Fundamentals of IoT*:** Evolution of Internet of Things – Enabling technologies – IoT architectures – oneM2M – IoT World Forum (IoTWF) and alternative IoT models – Simplified IoT architecture and core IoT functional stack, fog, edge and cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, actuators, smart objects and connecting smart objects. IoT Platform overview: Overview of IoT supported hardware platforms such as: Raspberry pi, ARM cortex processors, Arduino and Intel Galileo boards.

UNIT – II

IoT Protocols: IT access technologies: Physical and MAC layers – Topology and security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN – Network layer: IP versions – Constrained nodes and constrained networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo – Routing over low power and lossy networks – Application transport methods: Supervisory control and data acquisition – Application layer protocols: Co AP and MQTT.

UNIT – III

Design and Development: Design methodology – Embedded computing logic – Microcontroller – System on chips – IoT system building blocks – Arduino, Board details – IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python programming.

UNIT – IV

Data Analytics and Supporting Services: Photovoltaic systems – Types – General design considerations – System sizing, Battery sizing, Inverter sizing, Design examples – Balance of PV systems. Structured Vs. Unstructured data and Data in Motion Vs. Data in Rest – Role of machine learning – No SQL Databases – Hadoop ecosystem – Apache Kafka, Apache Spark – Edge streaming analytics and network analytics – Xively cloud for IoT – Python web application framework – Django, AWS for IoT – System management with NETCONF-YANG.

UNIT – V

***Case Studies/Industrial Applications*:** Maximum power point trackers – Perturb and observe – Incremental conductance method – Hill climbing method – Hybrid and complex methods – Data based and other approximate methods – Instrument design – Other MPP techniques – Grid interactive PV system. IoT applications in home, infrastructures, buildings, security,

industries, home appliances, other IoT electronic equipment. Use of Big Data and visualization in IoT – Industry 4.0 concepts. Sensors and sensor node and interfacing using any embedded target boards (Raspberry Pi/Intel Galileo/ARM Cortex/Arduino).
Text Books:
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*, Cisco Press, 2017.
2. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A Hands-on Approach*, Universities Press, 2015
Reference Books:
1. Olivier Hersent, David Boswarthick, Omar Elloumiand, *The Internet of Things – Key applications and Protocols,* Wiley, 2012 (for Unit 2).
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyleand, *From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence,* Elsevier, 2014.
3. Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), *Architecting the Internet of Things,* Springer, 2011.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

PHOTOVOLTAIC SYSTEMS (PVS)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE304	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Identify photovoltaic system components and system types.

CO2: Calculate electrical energy and power.

CO3: Correctly size system components, design considerations of solar equipment.

CO4: Design a basic grid-tie photovoltaic system.

CO5:

UNIT – I

Solar Energy: Sun and Earth – Solar spectrum – Solar geometry – Solar radiation on horizontal and inclined planes – Instruments for measurement of solar radiation – Solar cell – Equivalent circuit – V-I characteristics – Performance improvement.

UNIT – II

Solar Cells: Manufacture of solar cells-technologies – Design of solar cells – Photovoltaic modules – Design requirements – Encapsulation systems – Manufacture – Power rating – Hotspot effect – Design qualifications.

UNIT – III

Protection and Measurements: Flat plate arrays – Support structures – Module interconnection and cabling – Lightning protection – Performance measurement using natural sunlight and simulator – Determination of temperature coefficients – Internal series resistance – Curve correction factor.

UNIT – IV

Photovoltaic Systems: Photovoltaic systems – Types – General design considerations – System sizing – Battery sizing – Inverter sizing – Design examples – Balance of photovoltaic systems.

UNIT – V

Maximum Power Point Trackers: Maximum power point trackers – Perturb and observe – Incremental conductance method – Hill climbing method – Hybrid and complex methods – Databased and other approximate methods – Instrument design – Other MPP techniques – Grid interactive photovoltaic system.

Text Books:

1. F.C. Treble, *Generating Electricity from Sun,* Pergamon Press.
2. A.K. Mukherjee, Nivedita Thakur, *Photovoltaic Systems: Analysis and Design,* PHI.

Reference Books:

1. C.S. Solanki, *Solar Photovoltaic's: Fundamentals, Technologies and Application,* PHI.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

INTEGRATED PRODUCT DESIGN AND DEVELOPMENT (IPDD)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE305	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Understand to know the design concepts, product development planning and customer requirements.

CO2: Generate the concept using creative problem-solving methods, concept generation and testing.

CO3: Realize product teardown, specifications, portfolios and architecture, configurations and prototyping.

CO4: Demonstrate and classify the design aspects for risk, reliability and safety and environments.

CO5: Do industrial design, understand intellectual property, robust design and product development Economics.

UNIT – I

Design Concepts: Design process – Considerations of a good design – Description of good design process – Design codes and standards. Product Development and Planning Process: Characteristics and challenges of product development – Concept development – Generic product development – Product development process flows –Tyco product development – Product development organizations – Organizational structure and design – Product and process cycles – Technological innovation – Structure of opportunity – Opportunity identification – Product planning process – Types of product development projects.

Identifying Customer Needs: Process of identifying customer needs – Customer requirements.

UNIT – II

Concept Selection, Generation and Testing

Concept Generation: Activity – Concept generation process – Creativity and problem solving – Creative thinking methods and design – Functional decomposition and synthesis – Morphological methods – Axiomatic design.

Concept Selection and Testing: Development process – Choosing a concept – Concept screening and scoring – Decision making and evaluation – Methods for testing product concepts.

UNIT – III

Embodiment and Detail Design

Product Teardown, Specifications, Portfolios and Architecture: Teardown process – Methods and applications – Post teardown report – Benchmarking approach and support tools for benchmarking process – Product portfolios architecture – Architecture type – Platform architecture – Target Specifications – Setting the final specifications – Modularity – Implications of the architecture – Establishing the architecture – Delayed differentiation – Platform planning – Related system-level design.

Configuration and Detail Design: Generating, analyzing and evaluating configuration design – Best practices for configuration design – Design for X – Design and manufacturing information – Final design review–Activities beyond detail design.
Prototyping: Principles, types and technologies – Understanding prototypes and planning.

UNIT – IV

Design for Environment, Manufacturing and Safety
Design for Manufacture and Environment: Cross-functional team – Overview of DFM process – Life cycles – Environmental impacts – Design for environment process.
Design for Risk, Reliability and Safety: Classification of societal hazards – Standards – Risk assessment – Design for reliability – Causes of unreliability – Minimizing failure – FMEA – Fault tree analysis – Defects and failure modes – Potential dangers – Guidelines for design for safety – Warning labels.

UNIT – V

Industrial Design and Product Development Economics
Industrial Design: Need – Impact – Industrial design process – Management of the industrial design process – Assessing the quality of industrial design.
Robust Design: Robust design process.
Intellectual Property: Disclosure – Process of pursuing a patent.
Product Development Economics: Elements of economic analysis and process.
Managing Projects: Understanding and representing tasks – Baseline project planning – Accelerating projects – Project execution – Postmortem project evaluation – Project Portfolio Management (PPM) – Earned Value Management (EVM) – Sustainability and ESG in project management.

Text Books:

1. Karl T Ulrich, Steven D Eppinger and Maria C. Yang, *Product Design and Development*, McGraw Hill Education Pvt. Ltd., Noida.
2. George E. Dieter and Linda C. Schmidt, *Engineering Design*, McGraw Hill Education Pvt. Ltd., Noida.

Reference Books:

1. Kevin Otto and Kristin Wood, *Product Design*, Pearson Education, India.
2. Anil Mital, Anoop Desai, Anand Subramanian and Aashi Mital, *Product Development*, Butterworth-Heinemann, Elsevier.
3. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and PeterA. Sandborn, *Integrated Product and Process Design and Development: The Product Realization Process* (Special Indian Edition), CRC Press, Taylor & Francis Group, LLC.
4. Devdas Shetty, *Product Design for Engineers,* Cengage Learning, India.
5. Ali Jamnia, *Introduction to Product Design and Development for Engineers*, CRC Press, Taylor& Francis Group, LLC.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

ADVANCED NUMERICAL METHODS AND COMPUTATIONAL MATHEMATICS (ANMC)
(Open Elective)

M.Tech - III Semester : SE						Scheme : 2025	
Course Code	Hours/Week			Credits	Maximum Marks		
OE306	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Analyze conditioning, stability, and error behavior of numerical linear algebra routines for dense and sparse problems.

CO2: Derive and apply finite difference for BVP for linear and nonlinear models.

CO3: Derive and apply finite differences for PDE models; assess consistency and stability with Lax equivalence and CFL ideas.

CO4: Optimize engineering models via unconstrained/constrained methods; justify algorithm selection and tuning using theory and diagnostics.

CO5: Integrate GPU/MPI paradigms and the Sci Py stack to build scalable, reproducible computational workflow's profile and validate results.

UNIT – I

Numerical Linear Algebra: Floating-point arithmetic, conditioning, stability, backward/forward error. Direct solvers: LU/Cholesky/QR; pivoting and orthogonality. SVD, low-rank approximations, pseudo inverses., Iterative solvers: Jacobi/Gauss – Seidel/CG/GMRES; basic preconditioning. Parse matrix formats and operations for large-scale systems.

UNIT – II

Discretization of Linear and Nonlinear ODEs: Numerical solutions of initial value problems:(single step and multi-step methods) Stability of the numerical methods for initial value problems., Boundary value problems; shooting method, Finite difference for BVP (second and higher order methods), for linear and nonlinear problems, Consistency–stability–convergence.

UNIT – III

Discretization of Linear and Nonlinear PDEs: Finite difference methods for parabolic problems explicit and implicit methods – Finite difference for hyperbolic explicit and implicit methods – Elliptic PDE. Consistency – Stability and convergence. Lax equivalence and CFL (Courant–Fried Richs – Lewy) ideas. Iterative solvers and multi grid overview for discretized systems.

UNIT – IV

Numerical Optimization and Inverse Problems: Unconstrained methods: gradient, Newton, quasi-Newton, trust-region – Constrained methods: KKT conditions – Interior-point – SQP principles. Nonlinear least squares – Gauss–Newton and Levenberg – Marquardt., Regularization (Tikhonov/L1) and model selection concepts, Scientific Python stack: scipy. Optimize.minimize, scipy. Optimize. Linprog, and scipy. optimize. Curve _fit; solver choice and diagnostics.

UNIT – V
High-Performance Scientific Computing: Parallel paradigms: Data/task parallelism – Domain decomposition fundamentals – GPU programming model: threads/warps/ memory hierarchy – CUDA libraries – MPI and PETSc for scalable sparse linear algebra and time-steppers – Performance engineering: profiling, locality, and roofline-style thinking. Python at scale: NumPy/SciPy sparse and vectorization; brief Numba /CuPy ecosystem. End-to-end case sketches in CFD/structures/machine learning numerics.
Text Books:
1. Trefethen, L. N., and D. BauIII, *Numerical Linear Algebra*, Twenty-Fifth Anniversary Edition, SIAM.
2. LeVeque, R.J., *Finite Difference Methods for Ordinary and Partial Differential Equations: Steady State and Time Dependent Problems,* SIAM.
3. Nocedal, J., and S.J. Wright, *Numerical Optimization*, Springer.
Reference Books:
1. Hwu, W.M.W., and D.B. Kirk, *Programming Massively Parallel Processors: A Hands-on Approach,* Elsevier.
2. B.N. Dutta, *Numerical Linera Algebra and Application*, Springer Publications.
3. SciPy Project, Optimization (scipy.optimize) —SciPy Manual and—Optimization and Root Finding—SciPy1.16.2 (stable) Reference.
4. Balay, S., et.al. PETSc/TAO *User's Manual*, Argonne National Laboratory, ANL-21/39 Rev3.18 release documentation.
5. Logg, A., K.A. Mardal, and G. N. Wells (eds.). *Automated Solution of Differential Equations by the Finite Element Method:* The FEniCS Book. Berlin: Springer.
6. David Kincaid Ward Chenery, *Numerical analysis Mathematics of Scientific Computing*, AMS Book publishers.
7. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Computational Methods for Partial Differential Equations*, New Age Publications.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

MATHEMATICS FOR MACHINE LEARNING AND DATASCIENCE (MML)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE307	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Analyze conditioning, stability, and error behavior of numerical linear algebra routines for dense and sparse problems.

CO2: Formulate and solve convex and constrained optimization problems; compare first and second-order methods.

CO3: Apply probabilistic modeling, Bayesian inference, and information-theoretic measures to estimation and generalization.

CO4: Prove convergence properties or error bounds for selected learning algorithms such as SGD and Regularized estimators.

CO5: Evaluate and integrate methods into applications such as PCA, SVMs, and neural networks with appropriate regularization.

UNIT – I

Linear Algebra Foundations: Vector spaces, norms, inner products, orthogonality, and projections – Eigen values/ Eigen vectors, spectral theorem, and invariant subspaces, – Singular value decomposition, low-rank approximations, and Eckart –Young Matrix calculus for ML: gradients/ Jacobians / Hessians in matrix form Numerical linear algebra: conditioning, stability, power/QR methods – Feature whitening and centering: PCA link to covariance Eigen structure.

UNIT – II

Optimization for Learning: Unconstrained methods: gradient descent, line search, Newton/quasi-Newton – Constrained optimization: Lagrange multipliers, projected and barrier methods – Convex sets/functions, KKT conditions for nonlinear programming problems – Regularization: l1/l2penalties, bias – variance trade-offs in risk minimization – Convergence rates and step-size strategies in deterministic models.

UNIT – III

Probability and Statistical Learning: Random variables, expectations, covariance; exponential family basics – Bayesian inference: conjugacy, MAP vs. MLE, posterior predictive analysis – Hypothesis testing and confidence intervals for model comparison – Information measures: entropy, KL divergence, mutual information in learning – Generalization, overfitting, and model selection criteria (e.g. AIC/BIC/VC-style capacity) – Concentration and uncertainty quantification for predictions.

UNIT – IV

Models and Algorithms: Linear and kernel methods: least squares, logistic regression, and SVMs – Dimensionality reduction: PCA, kernel PCA, and manifold intuition – Probabilistic models: Naïve Bayes, Gaussian mixtures, EM overview – Neural network mathematics: backpropagation, initialization, normalization – Regularization schemes: weight decay, early stopping, dropout perspectives.

UNIT – V
Integrative Applications and Worked Examples: End-to-end ML pipelines: preprocessing, scaling/whitening, and feature engineering – PCA- based exploration and anomaly detection in high-dimensional data – SVMs and convex models for fault diagnosis and predictive maintenance – Bayesian A/B testing and decision-making under uncertainty – Neural network design trade-offs: capacity, optimization, and generalization – Model evaluation: calibration, ROC/PR analysis, and uncertainty reporting.
Text Books:
1. Deisenroth M.P., Faisal A.A. & Ong C.S., *Mathematics for Machine Learning*, Cambridge University Press.
2. Murphy K.P., *Probabilistic Machine Learning: An Introduction,* MIT Press.
3. Boyd S. & Vandenberghe L., *Convex Optimization*, Cambridge University Press.
Reference Books:
1. Goodfellow I., Bengio Y. & Courville A., *Deep Learning*, MIT Press.
2. Shalev-Shwartz S. & Ben-David S., *Understanding Machine Learning: From Theory to Algorithms,* Cambridge University Press.
3. Jolliffe I.T. & Cadima J., *Principal Component Analysis: A Review and Recent Developments,* Phil. Trans. R. Soc. A., 2016.
4. Cover T.M. & Thomas J.A., *Elements of Information Theory,* 2nd ed, Wiley.
5. Murphy K.P., *Probabilistic Machine Learning: Advanced Topics*, MIT Press.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

STATISTICAL LEARNING THEORY AND MATHEMATICAL FOUNDATIONS OF AI (SLTMFAI)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE308	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Analyze probabilistic models, convergence theorems, and stochastic processes underlying learning algorithms.

CO2: Formulate and prove generalization bounds using VC dimension, Rademacher complexity, and stability.

CO3: Derive and optimize loss/regularization for linear, kernel and deep models; justify selections by convexity and smoothness properties.

CO4: Evaluate algorithms via bias–variance, PAC guarantees, and information-theoretic criteria such as KL and mutual information.

CO5: Integrate theory to design robust AI solutions for multi-domain engineering applications and communicate findings effectively.

UNIT – I

***Probability and Measure Foundations*:** Probability spaces, σ-algebras, random variables; expectation and conditional expectation – Inequalities and concentration: Markov, Chebyshev, Hoeffding; LLN and CLT – Modes of convergence and Borel–Cantelli; almost surevs in-probability convergence – Random processes and martingale basics; optional stopping; Doob's inequality (overview). Markovchains: ergodicity, mixing, stationary distributions for modeling sequences.

UNIT – II

Statistical Learning Theory: PAC learning model, realizable/agnostic cases; sample complexity and no- free- lunch – VC dimension, shattering, Sauer's lemma; uniform convergence guarantees – Empirical risk minimization and structural risk minimization; capacity control – Rademacher/ Gaussian complexities and symmetrization for data-dependent bounds – Algorithmic stability and generalization; regularization and early stopping as capacity control – PAC-Bayes bounds and posterior-based generalization certificates.

UNIT – III

Optimization for Learning: Convex analysis: Lip schitzness, smoothness, strong convexity; implications for rates – Gradient, stochastic, and variance-reduced methods; step-size and convergence trade-offs – Proximal methods and projected gradients; sparsity via$\ell 1$(Lasso) and shrinkage via$\ell 2$(ridge) – Duality and KKT conditions; constrained learning formulations – Nonconvexl and scapes in deep networks—saddle points, over-parameterization, and implicit regularization – Generalization–optimization inter play: implicit bias of optimizers.

UNIT – IV

***Kernel and Probabilistic Models*:** Reproducing kernel Hilbert spaces, kernel trick, representer theorem – Large-margin methods: SVMs, soft margins, hinge loss; primal–dual

views – Gaussian processes: kernelsaspriors; posterior prediction and uncertainty quantification – Graphical models—Bayesian networks and Markov/conditional random fields for structured prediction; exact inference (variable elimination, junction tree) and approximate methods (loopy belief propagation, variational) – Hidden Markov models; EM for latent-variable learning – Variational inference and message passing for scalable probabilistic AI.

UNIT – V

Deep Learning and Information Theory: Back propagation (chain rule), initialization, normalization, and activation design – Loss functions and calibration; cross-entropy, margin losses, and robust objectives – Generalization in deep nets: margins, flat minima, compression, and stability views – Information-theoretic tools: entropy, mutual information, KL divergence – Information bottleneck and representation learning, with links to PAC-Bayes – Worked examples: applying theory to vision, language, and control tasks in engineering.

Text Books:

1. Shalev-Shwartz S., Ben-David S., *Understanding Machine Learning: From Theory to Algorithms,* Cambridge University Press.
2. Goodfellow I., Bengio Y., Courville A., *Deep Learning*, MIT Press.
3. Bishop C.M., *Pattern Recognition and Machine Learning*, Springer.

Reference Books:

1. Vapnik V.N., *The Nature of Statistical Learning Theory,* Springer.
2. Cover T.M., Thomas J.A., *Elements of Information Theory,* 2nd ed., Wiley.
3. Mohri M., Rostamizadeh A., Talwalkar A., *Foundations of Machine Learning,* 2nd ed., MIT Press.
4. Schölkopf B., Smola A.J., *Learning with Kernels: Support Vector Machines, Regularization, Optimization and Beyond,* MIT Press.
5. Rasmussen C.E., Williams C.K.I., *Gaussian Processes for Machine Learning*, MIT Press.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions.

End Exam: The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

CHEMISTRY OF NANOMATERIALS AND APPLICATIONS IN ENGINEERING (CNAE)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE309	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the fundamental concepts of nanoscience and nanotechnology.

CO2: Understand the advantages and limitations of each synthesis method.

CO3: Analyze structural, optical, and morphological properties of nanomaterials.

CO4: Understand the synthesis, properties, and applications of important nano materials.

CO5: Analyze the impact of nanotechnology in civil, mechanical, chemical engineering, agriculture, and food science.

UNIT – I

Basics of Nano Materials: Introduction – Scope of nano science and nano technology – Nano science in nature – Classification of nano structured materials – Importance of nano materials.

UNIT – II

Synthesis of Nano Materials: Top-Down approach – Inert gas condensation – Arc discharge method – Aerosol synthesis – Plasma arc technique – Ion sputtering – Laser ablation – Laser pyrolysis, and chemical vapor deposition method – Electrode position method – High-energy ball milling method. Synthetic Methods: Bottom-up approach – Sol-gel synthesis – Micro emulsions or reverse micelles – Co precipitation method – Solvothermal synthesis – Hydro thermal synthesis – Microwave heating synthesis and sono chemical synthesis.

UNIT – III

Techniques for Characterization: Diffraction techniques – Spectroscopy techniques – Electron microscopy techniques for the characterization of nano materials – BET method for surface area analysis – Dynamic light scattering for particle size determination.

UNIT – IV

Studies of Nano-structured Materials: Synthesis, properties and applications of the following nano materials: fullerenes, carbon nanotubes, 2D- nano material (Graphene), core-shell, magnetic nano particles, thermoelectric materials, non-linear optical materials.

UNIT – V

Adv*anced Engineering Applications of Nano Materials*: Applications of nano particles, nanorods, nanowires in water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation.

Text Books:

1. T Pradeep, *NANO-The Essentials*, McGraw-Hill.
2. B S Murty, P Shankar, Baldev Rai, B B Rathand James Murday, *Text book of Nano Science and Nano Technology,* Univ. Press.

Reference Books:
1. Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, *Concepts of Nano chemistry,* Wiley, VCH.
2. Guozhong Cao, *Nanostructures & Nanomaterials: Synthesis, Properties & Applications*, Imperial College Press.
3. C.N.R. Rao, Achim Muller, K. Cheetham, *Nanomaterials Chemistry*, Wiley, VCH.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.

PHOTONICS FOR ENGINEERS (PE)
(Open Elective)

M.Tech - III Semester : SE					Scheme : 2025		
Course Code	Hours/Week			Credits	Maximum Marks		
OE310	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes: At the end of the course the student will be able to

CO1: Gain the ability to describe how light behaves and propagates in optical media.

CO2: Explain light–matter interaction mechanisms and analyze the working, characteristics, and applications of LEDs, laser diodes, quantum well lasers and various photo detectors.

CO3: Explain key nonlinear effects and analyze the operation of optical modulators and switches such as the Mach–Zehnder interferometer.

CO4: Analyze fiber parameters and explain the functioning of transmitters, receivers, WDM systems, couplers and resonator-based communication devices.

CO5: Describe the working of photonic sensors and emerging quantum and ultrafast photonic technologies used in sensing, computation and communication.

UNIT – I

Fundamentals of Photonics: Nature of light: wave-particle duality, polarization, coherence – Maxwell's equations and wave propagation in dielectric media – Reflection, refraction, (vector notation) interference, diffraction, dispersion and birefringence.

UNIT – II

***Photonic Devices and Components – I*:** Absorption, spontaneous and stimulate demission – Einstein coefficients, population inversion, optical gain – Semiconductor light sources: LEDs, laser diodes, quantum well lasers – Photo detectors: PIN, avalanche photodiodes, photomultiplier tubes.

UNIT – III

Photonic Devices and Components – II: Nonlinear optical effects – Second-harmonic generation, Kerr effect, four-wave mixing – Electro- optic Magneto optic and acousto-optic modulation principles – Optical modulators and switches (Mach-Zehnder Interferometer).

UNIT – IV

***Optical Wave Guides and Applications*:** Optical fibres – Numerical aperture, V-number, modes, attenuation, dispersion – Fibre-optic communication systems: transmitters, receivers, multiplexing (WDM), optical couplers, ring resonators.

UNIT – V

Photonic Systems and Applications: Photonic sensors – Interferometric, fiber Bragg gratings, bio-sensing – Optical signal processing and computing – Introduction to quantum photonics: single-photon sources, entanglement, and photonic qubits – Plasmonic and meta materials, ultrafast and terahertz photonics.

Text Books:

1. B.E.A. Saleh &M.C. Teic, *Fundamentals of Photonics*, Wiley.
2. J. Singh, *Semiconductor Optoelectronics: Physics and Technology.*

3. A. Yariv & P. Yeh, *Photonics: Optical Electronics in Modern Communications*.
4. G. Keiser, *Optical Fiber Communications*.
Reference Books:
1. J. Wilson & J.F.B. Hawkes, *Optoelectronics: An Introduction*.
2. R.W. Boyd, *Nonlinear Optics.*
3. E. Jordan, *Electromagnetic Waves and Radiating System*,
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 30 marks. The question paper shall consist of **Three** Questions (without choice) carrying 10 marks each and all questions are compulsory. Each question may contain sub-questions. **End Exam:** The question paper for End Examination shall be for 60 marks. The question paper consists of **Five** Questions (each question covering one unit of syllabus) carrying 12 marks each. Each question shall be EITHER/OR type and may contain sub-questions.