



**SDM College of Engineering & Technology, Dharwad**

It is certified that the scheme and syllabus for I&II semester M.Tech. Computer Aided Design of Structures is recommended by the Board of Studies of Civil Engineering and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal

Chairman BoS&HoD

**SDM College of Engineering & Technology, Dharwad**

**VISION AND MISSION**

**VISION:**

To develop competent professionals with human values

**MISSION:**

- To have contextually relevant curricula.
- To promote effective teaching learning practices supported by modern educational tools and techniques.
- To enhance research culture.
- To involve industrial expertise for connecting classroom content to real life situations.
- To inculcate ethics and impart soft skills leading to overall personality development.

**SDM College of Engineering & Technology, Dharwad**

**Civil Engineering Department**

**DEPARTMENT VISION AND MISSION**

**Vision:**

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving modern society.

**Mission:**

The stated vision can be achieved through:

- The development of robust curricula to meet the industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research
- Industry-Institute interaction.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

1. To provide proficiency in the basic principles and advanced courses of technology in Computer Aided Design of Structures so that students are able to formulate, analyze and solve the societal problems for sustainable development related to Structural Engineering.
2. To expose students to the latest innovations and trends with a view to inculcate strong research orientation in Computer Aided Design of Structures as well as in multidisciplinary streams.
3. To create a congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups in professional, industry and research organizations.
4. To produce Structural Engineers who integrate and build on the program's core curricular concepts in the pursuit of professional leadership, teamwork, life-long learning, and successful career advancement.

**PROGRAMME OUTCOMES (PO):**

PO1: An ability to independently carry out design /research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over design of structures using software tools as per the specialization of the program.

**Scheme of Teaching and Examination**

**I Semester M. Tech.**

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs./Wk.)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PRMIC100	Research Methodology and IPR	2-0-0	2	50	50	2		
20PCDSC101	Computational Structural Mechanics – Classical and FE Approach	4-0-0	4	50	100	3		
20PCDSC102	Continuum Mechanics – Classical and FE Approach	4-0-0	4	50	100	3		
20PCDSC103	Structural Dynamics -Theory & Computations	4-0-0	4	50	100	3		
20PCDSExxx	Elective-1	4-0-0	4	50	100	3		
20PCDSL104	Cad Lab –Structural Analysis	0-0-3	2	50	-	-	50	3
20PCDSL105	**Seminar	0-0-2	1	50	-	-	-	-
<b>Total</b>		<b>18-0-5</b>	<b>21</b>	<b>350</b>	<b>450</b>		<b>50</b>	

**CIE:** Continuous Internal Evaluation

**SEE:** Semester End Examination

**L:** Lecture      **T:** Tutorials      **P:** Practical

\*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

\*\*Seminars are to be conducted every week and 2-3 students/week will present a topic from emerging areas in Computer Aided Structural Engineering preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in Structural Engineering and allied areas.

**List of Electives**

<b>Course Code</b>	<b>Elective Courses</b>
20PCDSE125	Structural Optimization - Theory & Computations
20PCDSE126	AI and Expert Systems in Structural Engineering
20PCDSE127	Action and Response of Structural Systems
20PCDSE128	Geotechnical Aspects of Foundations and Earth Retaining Structures
20PCDSE129	Numerical Methods and Programming
20PCDSE130	Composite and Smart Materials

**Scheme of Teaching and Examination**

**II Semester M.Tech.**

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hours/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PCDSC201	Structural Stability Analysis - Classical and FE Approach	4-0-0	4	50	100	3		
20PCDSC202	Advanced Design of Reinforced Concrete Structural Elements	4-0-0	4	50	100	3		
20PCDSExxx	Elective-2	4-0-0	4	50	100	3		
20PCDSExxx	Elective-3	4-0-0	4	50	100	3		
20PCDSExxx	Elective-4	4-0-0	4	50	100	3		
20PCDSL204	Cad Lab - FE Analysis	0-0-3	2	50	-	-	50	3
20PCDSL205	**Seminar	0-0-2	1	50	-	-	-	-
<b>Total</b>		<b>20-0-5</b>	<b>23</b>	<b>350</b>	<b>500</b>		<b>50</b>	

**CIE:** Continuous Internal Evaluation

**SEE:** Semester End Examination

**L:** Lecture

**T:** Tutorials

**P:** Practical

\*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

\*\*Seminars are to be conducted every week and 2-3 students/week will present a topic from emerging areas in Computer Aided Structural Engineering preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in Structural Engineering and allied areas.



**List of Electives**

<b>Course Code</b>	<b>Elective Courses</b>
20PCDSE225	Analysis of Plates - Classical and FE Approach
20PCDSE226	Reliability Analysis and Design of Structural Elements
20PCDSE227	Advanced Design of Steel Structures
20PCDSE228	Design of Stack Tower and Water Storage Structural Systems
20PCDSE229	Seismic Resistant Design of Structural Systems
20PCDSE230	Advanced Structural Dynamics
20PCDSE231	Design of Tall Structures

**20PRMIC100                      Research Methodology and IPR                      (2-0-0) 2**

**Contact Hours: 26**

**Course Learning Objectives (CLOs):** The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Further, the students shall know about the intellectual property rights, copyrights, trademarks, patents, patents filing procedure, infringement & remedies and information technology act etc.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
<b>CO-1</b>	<b>Formulate</b> the research problem, carry out literature survey and decide the methodology.		1	
<b>CO-2</b>	<b>Use</b> measurement and scaling and <b>carryout</b> data collection.		1	
<b>CO-3</b>	<b>Test</b> the hypothesis, <b>interpret, analyze</b> the results and <b>write</b> the report.	2	3	
<b>CO-4</b>	<b>Explain</b> the need of IPR, copyright, patents, trademarks & the filing procedure and know about infringement, remedies and regulatory framework.		2	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2	2.5	2

**Prerequisites:**

- 1) Branch specific course on problem analysis (Preferred)

**Contents:**

- 1) **Research Methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research

and scientific method, importance of knowing how research is done, research process, criteria of good research and problems encountered by researchers in India. **2 Hours**

**Defining the Research Problem:** Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **1 Hour**

**2) Reviewing the literature:** Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed. **2 Hours**

**Research Design:** Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs, important experimental designs. **3 Hours**

**3) Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques **2 Hours**

**Data Collection:** Collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, collection of secondary data. **2 Hours**

**4) Testing of Hypotheses:** What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses. **2 Hours**

**5) Interpretation and Report Writing:** Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. **3 Hours**

**6) Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. **1 Hour**

**Copyright:** Historical evolution of the law on copyright, meaning, content, substance, ownership, primary, special rights, obligations, period, assignment and relinquishment of copyrights. License and application for registration of copyright.

**Industrial design:** Significance & registration

**2 Hours**

**Trademarks:** Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known and well-known trademarks, application for registration and procedure for registration, procedure and certification of Trademarks.

**1 Hour**

**Patents:** Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions, publications and public use, priority date and its purpose, procedure for obtaining patent. Stages of procedure, refusal to grant patent - consequence, protection period, drafting of claims, grant of patent and significance of date of patent and date of expiry. Services available with patent office, jurisdiction, appellate authorities, powers and obligations of central government, patent agent and controller – not a civil court.

**3 Hours**

**Infringement and Remedies:** Meaning of infringement, acts of infringement, suit against infringement and defence against infringement, reliefs and certificate of validity.

**1 Hour**

**The information Technology Act:** Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation, damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying.

**1 Hour**

**Reference Books:**

- 1) C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4<sup>th</sup> Edition, 2018.
- 2) Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3<sup>rd</sup> Edition, 2011.
- 3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
- 4) N. K. Acharya, Textbook on Intellectual Property Rights, 4<sup>th</sup> Edition, Asia Law House, Hyderabad.

**Course Learning Objectives (CLOs):** Calculation of distribution of forces within the structure and the displaced state of the system forms the crux of design process. The objective of this course is to make students learn computer aided methods of analysis adopted in industry for such purposes.

**Course Outcomes (COs):**

<b>Description of the Course Outcome: At the end of the course the student will be able to:</b>		<b>Mapping to POs (1 to 3)</b>		
		<b>Substantial Level (3)</b>	<b>Moderate Level (2)</b>	<b>Slight Level (1)</b>
CO-1	Apply Direct stiffness method and Analyze 2D-truss structures	<b>3</b>	<b>1</b>	
CO-2	Apply Direct stiffness method and Analyze continuous beams and 2D-frames	<b>3</b>	<b>1</b>	
CO-3	Formulate finite element method with respect to structures	<b>3</b>	<b>1</b>	
CO-4	Formulate and Apply finite element method for bar element	<b>3</b>	<b>1</b>	
CO-5	Formulate and Apply finite element method for beam element	<b>3</b>	<b>1</b>	
CO-6	Apply Knowledge of problem solving skills using computer aided methods	<b>3</b>	<b>1</b>	

<b>POs</b>	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

**Contents:**

**Module 1: Direct Stiffness Method — Trusses:** Degrees of Static and Kinematic indeterminacies, Concepts of Stiffness and Flexibility, Local and Global Coordinate System, Analysis of indeterminate Trusses, with and without initial strains for different types of boundary conditions such as Fixed, Hinged, Roller, supports, support settlement. **11 Hours**

**Module 2: Direct Stiffness Method - Continuous Beam, 2D Frames:** Analysis of Continuous beams, for different types of boundary conditions such as Fixed, Hinged, Roller, supports, support settlement. Analysis of Simple 2D Frames with and without sway, Element stiffness matrix for 3D frames and Grids **11 Hours**

**Module 3: Basic Concept of Finite Element Method:** Concept of FEM, principle of virtual work, Principles minimum potential energy, Method of Weighted Residuals (Galerkin's). **10 Hours**

**Module 4: FE Analysis using Bar Elements:** Derivation of Shape Function for Linear and Higher order elements using Inverse and Lagrange Interpolation formula, Element Stiffness matrix Two and Three noded elements. Examples with constant and varying cross-sectional area subjected to concentrated loads, distributed body force and surface traction and Initial strains due to temperature, Isoparametric formulation. **10 Hours**

**Module 5: FE Analysis using Beam Element:** Derivation of Shape Function for two noded beam element, Hermitian Interpolation, Element Stiffness matrix, Consistent Nodal loads, Concept of Reduced or Lumped Loads, Examples: Cantilever and Simply Supported beams. **10 Hours**

**Reference Books:**

- [1] Rajasekaran.S, "Computational Structural Mechanics", PHI, New Delhi.
- [2] Reddy.C.S, "Basic Structural Analysis," TMH, New Delhi.
- [3] Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, John Wiley and Sons, New York
- [4] Beaufait.F.W.et al., "Computer Methods of Structural Analysis", Prentice Hall.
- [5] Weaver.W and Gere.J.H., Matrix, "Analysis of Framed Structures", Van Nostrand.
- [6] Rubinstein M.F, Matrix Computer Methods of Structural Analysis Prentice-Hall.
- [7] Bathe.K.J, "Finite element procedures in Engineering Analysis" .PHI New Delhi.

**Course Learning Objectives (CLOs):** To introduce students to the fundamental concepts of the mechanics of deformable bodies along with state-of-the-art computational methods in civil engineering. The range of material behavior considered includes: Finite Deformation Elasticity The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Apply knowledge of mathematics, science, and engineering by developing the Equilibrium equations		1,2,3	
CO-2	Formulate, analyze and solve two-dimensional elasticity rectangular and polar coordinate problems using classical approach.		1,2,3	
CO-3	Formulate, analyze and solve three-dimensional stress-strain problems using classical approach.		1,2,3	
CO-4	Formulation and implementation of Isoparametric finite element models for two and three-dimensional deforming bodies	1,2,3		
CO-5	Use FEM for solving continuum mechanics problems.	1,2,3		

## SDMCET: Syllabus

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2.4	2.4	2.4

### Prerequisites:

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

### Contents:

**Module 1: Basic Concepts:** Definition of stress and strain at a point, components of stress and strain at a point, strain displacement relations in cartesian coordinates, constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases, plane stress, plane strain — Definition. **10 Hours**

**Module 2: Two-dimensional problems in Rectangular Coordinates:** Airy's stress function approach to 2-D problems of elasticity. Solution by Polynomials— End Effects, Saint — Venant's Principle — solution of some simple beam problems, including working out of displacement components. **11 Hours**

**Module 3: Two - dimensional problems in Polar coordinates:** General equation in Polar coordinates — Strain and displacement relations, equilibrium equations - Stress distribution symmetrical about an axis — Pure bending of curved bars — Displacements for symmetrical stress distributions — Bending of a curved bar by a force at the end — The effect of a small circular hole on stress distribution in a large plate subjected to uniaxial tension and pure shear. **11 Hours**

**Module 4: Analysis of Stress and Strain in Three Dimensions:** Introduction — Principal stresses — Determination of the principal stresses and principal planes. — Stress invariants — Determination of the maximum shearing stress- Octahedral stress components, Principal strains — strain invariants. **10 Hours**

**Module 5: FE approach:** 2D and 3D Elements - CST, LST, Rectangular family, Tetrahedra and Hexahedra: Shape functions, Element Stiffness matrix, Equivalent Loads, Isoparametric formulation of Triangular and General quadrilateral elements, Axisymmetric elements, Gauss Quadrature. **10 Hours**

### Reference Books:

- [1] Timoshenko and Goodier, "Theory of Elasticity" McGrawHill Book Company, III Edition, 1983.
- [2] Valliappan.S, "Continuum Mechanics fundamentals ", Oxford And IBH.
- [3] Robert D Cook etl, "Concepts and Applications of Finite Element



## SDMCET: Syllabus

- Analysis”, 3<sup>rd</sup> Edition, John Wiley and Sons, New York
- [4] Srinath.L.S.,” Advanced Mechanics of Solids”, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
- [5] Bathe.K.J, “Finite element procedures in Engineering Analysis”. PHI. New Delhi.
- [6] Zienkiewicz.O.C, “The Finite Element Method”, Tata-McGraw-Hill Publishing Company
- [7] Krishnamoorthy C.S, “Finite Element Analysis”, Tata-McGraw-Hill Publishing Company

### 20PCDSC103    Structural Dynamics -Theory & Computations    (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** This course focuses on how to model single degree, multi degree of freedom systems and continuous vibratory systems for un-damped, damped forced and free vibrations. Quantification of responses of these systems is also discussed.

#### Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Evaluation of effect of structural vibrations on safety and reliability of structural systems		<b>1,3</b>	
CO-2	Develop the equations of motion for vibratory systems and solve for the free and forced response required for modeling structures for dynamic analyses.	<b>1,3</b>		
CO-3	Analyze and modify a vibratory structure order to achieve specified requirements by developing a model.		<b>3</b>	
CO-4	Emphasize the role of	<b>3</b>		

## SDMCET: Syllabus

	damping and its influence upon structural response to limit the possibility of their structures being influenced by resonance that may affect the structural safety and reliability of engineering systems.			
CO-5	Apply modal methods to calculate the forced response of SDOF and MDOF systems.	<b>3</b>		
CO-6	Analyze vibrations of the structures using finite element methods.		<b>3</b>	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2.5		2.5

### Prerequisites:

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

### Contents:

**Module1:SingleDegreeof Freedom System:** Degrees of freedom, undamped system, springs in parallel, in series. Newton's laws of motion, free body diagrams. D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system — viscous damping, equation of motion, critically damped system, over damped system, under damped system, and logarithmic decrement. Response of single degree of freedom system to harmonic loading — undamped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismic instruments.

**11 Hours**

**Module 2; Response to General Dynamic Loading:** Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, undamped system, numerical evaluation of Duhamel's integral, damped system. Fourier analysis and response in frequency domain — Fourier analysis,

## SDMCET: Syllabus

Fourier coefficient for piecewise linear functions, exponential form of Fourier series, discrete Fourier analysis, fast Fourier transform.

**11 Hours**

**Module 3: Generalized Coordinates and Rayleigh's method:** Principle of virtual work, generalized single degree of freedom system (rigid body and distributed elasticity), Rayleigh's method. Hamilton's principle. Multistorey Shear Building. Free vibration — natural frequencies and normal modes. Forced motion — modal superposition method — response of a shear building to base motion. Damped motion of shear building — equations of motions — uncoupled damped equation — conditions for uncoupling. Damping.

**10 Hours**

**Module 4: Discretization of Continuous Systems:** Longitudinal Vibration of a uniform rod. Transverse vibration of a pretensioned cable. Free transverse vibration of uniform beams — Rotary inertia and shear effects — The effect of axial loading. Orthogonality of normal modes. Undamped forced vibration of beams by mode superposition.

**10 Hours**

**Module 5: Dynamic Analysis of Beams:** Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretized beam in matrix form and its solutions.

**10 Hours**

### Reference Books:

- [1] Mario Paz, "Structural Dynamics, Theory and Computation", 2<sup>nd</sup> Edition, CBS Publisher
- [2] Mukhopadhyaya, "Vibration, Dynamics And Structural Problems," Oxford IBH Publishers
- [3] Clough, Ray W and Penzien J, "Dynamics of Structures", 2<sup>nd</sup> Edition, McGraw-Hill,
- [4] Roy R. Craig, Andrew J. Kurdila, "Fundamentals of Structural Dynamics", John Wiley & Sons

**20PCDSE125 Structural Optimization - Theory & Computations (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** In this course, topics on Classical Optimization Techniques, Linear Programming, Nonlinear Programming, Stochastic Programming and Genetic Algorithms are dealt.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Classify the Optimization problems and techniques.	3	1	
CO-2	Solve the Optimization problems by Linear programming method and sketch them graphically.	3	1	
CO-3	Solve the Optimization problems by Non - Linear programming method.	3	1	
CO-4	Solve the Optimization problems by Stochastic programming method.	3	1	

POs	PO-1	PO-2	PO-3
Mapping Level	2		3

**Contents:**

**Module1: Classical Optimization Techniques:** Engineering applications, Statement of optimization problem, Classification of optimization problems, Optimization techniques. Single variable optimization, Multivariable optimization with no constrains, with equality constraints-Lagrange multiplier-method, constrained variation method- and with inequality constraints Kuhn-Tucker conditions.

**11 Hours**

**Module2:LinearProgramming:** Standard form of Linear programming problem, simplex method, revised simplex Method. **11 Hours**

**Module 3: Nonlinear Programming:** One dimensional minimization methods, Elimination and Interpolation methods, unconstrained Optimization Techniques, Direct Search methods, Descent Methods, Constrained Optimization Techniques, Direct methods, indirect methods. **10 Hours**

**Module4:StochasticProgramming:**For optimization of design of structural elements with random variables. Application Problems: Optimum Design RC, PSC, Steel structural elements. Algorithms for optimum designs. **10 Hours**

**Module5: Genetic Algorithms:** Introduction fitness functions including the effect of constraints crossover,mutation.**10 Hours**

**Reference Books:**

- [1]Rao.S.S- Optimization Theory and Applications,Wiley Eastern Limited,1978.
- [2] Fox.R.L. - Optimization Methods for Engineering Design”, Addison Wesley,
- [3] Stark.R.M.Nicholls.R.L., Mathematical Foundations for Design”, McGraw Hill Book Company.
- [4] Narsing k Deo— System simulation with digital computer”, Prentice- Hall of India Pvt ,Ltd. New Delhi—

**20PCDSE126 AI and Expert Systems in Structural Engineering (4-0-0) 4**  
**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Expert systems are the most mature and widely used commercial application coming out of artificial intelligence. In an expert system, the computer applies heuristics and rules in a knowledge-specific domain to render advice or make recommendations, much like a human expert would.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Use expert systems to achieve fairly high levels of performance in task areas which require a good deal of specialized knowledge and training.	3	1	
CO-2	Develop expert systems to perform tasks which are physically difficult, tedious, or expensive to have a human perform	3	1	

## SDMCET: Syllabus

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

### Contents:

#### Module 1: Artificial Intelligence:

Introduction: AI - Applications fields, defining the problems - state space representation - problem characteristics - production system - production system characteristics. Knowledge Representation: Formal logic - predicate logic - logic programming - forward v/s backward reasoning - matching control knowledge. **11 Hours**

#### Module 2: Search and Control:

Concepts - uninformed / blind search: depth first search - breadth first search - bi-directional search - informed search - heuristic graph search - generate and test - hill climbing – best-first search - AND OR graph search. Non-formal Knowledge Representation - semantic networks - frames— scripts— production systems, Programming in LISP. **11 Hours**

#### Module 3: Expert Systems:

Their superiority over conventional software — components of an expert system — expert system life cycle-expert system development process- nature of expert knowledge —techniques of soliciting and encoding expert knowledge. Inference: Forward chaining - backward chaining - rule value approach. **10 Hours**

#### Module 4: Uncertainty

Symbolic reasoning under uncertainty: logic for non-monotonic reasoning. Statistical reasoning: Probability and Bayes' theorem - certainty factor and rule-based systems - Bayesian network –Dempster - Shafer theory. **10 Hours**

#### Module 5; Fuzzy reasoning and Neural Networks:

Features of rule-based, network- based and frame -based expert systems — examples of expert systems in Construction Management and Structural Engineering. Expert system shells. Neural Networks: An introduction — their possible applications in Civil Engineering. **10 Hours**

### Reference Books:

- [1] Adeli,H., “Expert Systems in Construction and Structural Engg”,Chapman & Hall,NewYork
- [2] PattersonD W,“Artificial Intelligence and Expert Systems”,Prentice-Hall,NewJersey.

[3] Rich, E. and Knight K. "Artificial Intelligence", TMH, New Delhi.

[4] Rolston, D.W., "Artificial Intelligence and Expert Systems" McGraw Hill, New York.

[5] Nilsson, N.J., "Principles of Artificial Intelligence", Narosa, New Delhi.

**20PCDSE127      Action and Response of Structural Systems      (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** A structural system may be subjected to several combinations of actions when deployed into service. Certain important decisions such as, proper identification of structural systems, design actions on them and the recourse to the type of analysis have to be made during the design process. The focus of this course is on how to calculate the various design loads, known as actions, which are required to determine the design forces, known as 'Response' or effects of actions.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Understand the importance of appropriate code provisions	<b>1</b>	<b>3</b>	
CO-2	Familiarize with procedures for calculating action effects for different types of structures frequently encountered in practice	<b>1</b>	<b>3</b>	
CO-3	Assess the basic need, concepts and procedures of different types of analysis		<b>3</b>	
CO-4	Characterize the response of different types of structural systems for Tall buildings		<b>3</b>	

## SDMCET: Syllabus

POs	PO-1	PO-2	PO-3
Mapping Level	3		2

### Contents:

**Module 1: IS 875 PART 1, 2, 4, 5:** Sources, Nature and Magnitude, Probabilistic assessment, Characteristic and Design values. IS875 PART 1 and 2 code provisions. Load combination rules for design. Estimation of DL and LL on structural elements such as Slab, Beams, Columns, in different types of structural systems, Joint Loads on Trusses, Distributed load on Purlins- Numerical examples. Accidental loads Impact and collisions, Explosions and Fire – Numerical examples. **11 Hours**

**Module 2: Wind Load- IS875 PART 3: Buildings:** Nature and Magnitude, Factors influencing wind loads, Internal and External pressure distribution, Design Wind Speeds and Pressure, Numerical Examples to calculate external and internal pressure for different types of buildings and regions— Flat roof, Pitched Roof, mono slope roof, Hipped roof, Signboard, Water tank on braced and shaft staging, Multistory Frames. **11 Hours**

**Module 3: Seismic Loads IS1893 Buildings-** Nature and Magnitude, Centre of mass and rigidity, Calculation of Design Seismic Force by Static Analysis Method, Dynamic Analysis Method Location of Centre of Mass, Location of Centre of Stiffness, and Lateral Force Distributions as per code provisions. **10 Hours**

**Module 4: Vehicles Loads as per IRC 6-2010 on Road Bridges—** Class 70R, Class AA, Class A, Class B, Tracked Vehicle, Wheeled Vehicle, Load Combinations, Impact, Wind, Water Currents, Longitudinal Forces: acceleration, braking and frictional resistance, Centrifugal forces, temperature, Seismic forces, Snow Load, Collision Loads. Load Combinations- Simple Numerical examples **10 Hours**

**Module 5: Types of Analysis and Behavior of Tall Buildings:** Linear, Nonlinear behavior, Material nonlinearity, Geometric nonlinearity, Rigid and Elastic Supports, First Order Elastic Analysis, Second Order Elastic Analysis, First order Inelastic Analysis, Second order Inelastic Analysis— Concepts and Brief descriptions Behavior of Structural forms in Tall buildings— Rigid frame, Braced Frames, Shear Walls, Core walls, Tubular, Belt Truss, Outrigger. **10 Hours**

### Reference Books:

[1] IS Codes IS875 Parts (1 to 5), IS1893, IRC6,



- [2] An explanatory Handbook on IS875 (PART3);Wind Load on Building and Structures,
- [3] Document No:IITK-GSDMAWind07V1.0-IITK-GSDMAProject on Building Codes
- [4] Explanatory Examples on Indian Seismic Code IS1893 (Part I): Document No: IITK- GSDMA-EQ21-V2.O-IITK-GSDMAProject on Building Codes

**20PCDSE128      Geotechnical Aspects of Foundations and      (4-0-0) 4**  
**Earth Retaining Structures**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**This course focuses on how to Plan a site investigation, classify and characterize soils for foundation design to estimate the capacity of foundations, and the settlement of the soil under the foundation load as well as computation of earth pressure and stability of different types of retaining structures.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Plan a subsurface exploration	<b>3</b>	<b>1</b>	
CO-2	Evaluate appropriate bearing capacity correction factors to use in design	<b>3</b>	<b>1</b>	
CO-3	Identify strategies to mitigate the effects of expansive soils on foundations	<b>3</b>	<b>1</b>	
CO-4	Select the appropriate deep foundation type for different soil profiles	<b>3</b>	<b>1</b>	
CO-5	Compute earth pressure and implement the design procedure for block foundation	<b>3</b>	<b>1</b>	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

**Contents:**

**Module 1: Bearing Capacity of Soils:** Generalized Bearing Capacity Equation; Field tests for Bearing Capacity and settlement estimation; Settlement of shallow foundations - Elastic and consolidation settlements; Settlement estimates from penetration tests; Settlement tolerance; Allowable bearing pressure. **11 Hours**

**Module 2: Design Parameters for Substructures:** Factors influencing selection of depth of Foundation, Subgrade Reaction, Winkler hypothesis and Beams on Elastic Foundation Approach; Soil Line Method; Foundations on expansive soils. Geotechnical failure of foundations during earthquake — Earthquake Resistant design of Shallow foundation —Liquefaction and Remedial measures. **11 Hours**

**Module 3: Pile Foundations;** Classification of pile foundations and general considerations of design; Ultimate load capacity of piles; Pile settlement; Analysis of single pile and pile group; laterally loaded piles and ultimate lateral resistance. Uplift resistance of piles and anchored foundations; under reamed Pile; Pile load tests; Design examples. **10 Hours**

**Module 4: Retaining structures:** Earth pressure theories, Fill Walls, Concrete/Gravity walls, Mechanically Stabilized Earth (MSE) walls- Analysis and Design, Sheet pile walls, internally braced excavations (struts), externally braced excavations (tieback excavations), Soil Nailing. **10 Hours**

**Module 5: Elements of Soil Dynamics and Design of Machine Foundations:** IS 2974 Parts I to IV Machine- Foundation System , Block Foundations, Frame Foundations, Design Criteria, Tuning of Foundation, DOF of a Rigid Block Foundation, Linear Elastic Spring, Elastic Half Space Analog, Parameters influencing Dynamic Soil Parameters, Soil Mass Participation, Effect of Embedment, Soil Damping, Machine Parameters, Vibration Isolation System. **10 Hours**

**Reference Books:**

- [1] Bowles J.E “Foundation Analysis and Design”, McGraw Hill.
- [2] Swami, S. (1999). “Soil Dynamics and Machine Foundation”, Galgotia Publications Pvt Ltd, New Delhi
- [3] Dr. B C Punmia, Soil Mechanics and Foundation Engineering

## SDMCET: Syllabus

- [4] Leonards. G.A, "Foundation Engineering", McGraw Hill.  
 [5] Varghese P C, "Foundation Engineering", PHI Learning Pvt. Ltd  
 [6] Srinivasulu. P. and Vaidyanathan, V. (1980). "Handbook of Machine Foundations", Tata McGraw- Hill Publishing Company, New Delhi

**20PCDSE129 Numerical Methods and Programming (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** An overlying goal of the course is the realization of the necessity of numerical methods and programming techniques in order to simulate technological and scientific processes.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify various mathematical problems and reformulate these in a way suitable for numerical treatment	<b>1,3</b>		
CO-2	Select a suitable numerical method for the treatment of the given problem	<b>1,3</b>		
CO-3	Motivate the choice of a method by describing its advantages and limitations	<b>1,3</b>		
CO-4	Select an algorithm leading to efficient computation, and implement this in a suitable programming language, e.g. Matlab	<b>1,3</b>		
CO-5	Write well-structured programs in the programming language.	<b>1,3</b>		

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	3		3

**Prerequisites**

Students taking this course shall have the knowledge of following:

1. Engineering Mathematics
2. Computer Programming

**Contents:**

**Module 1: Solutions of linear equations:** Direct method – Cramer’s rule, Gauss – Elimination method- Gauss –Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Seidel iteration, Successive over –relaxation method. Eigenvalues and Eigenvectors: Jacobi Method for symmetric matrices- Given’s method for symmetric matrices-Householder’s method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method. **11 Hours**

**Module 2: Interpolation: Linear Interpolation -** Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences-Hermite Interpolation -piecewise and spline Interpolation. **11 Hours**

**Module 3: Finite Difference and their Applications:** Introduction-Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series-Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson’s extrapolation- Use of unevenly spaced pivotal points-Integration formulae by interpolating parabolas-Numerical solution to spatial differential equations. **10 Hours**

**Module 4: Numerical Differentiation:** Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation. Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radau integration method- composite integration method – Double integration using Trapezoidal and Simpson’s method. **10 Hours**

**Module 5: Ordinary Differential Equation:** Euler’s method – Backward Euler method – Midpoint method – single step method, Taylor’s series method-Boundary value problems. **10 Hours**

**Note**

1. Emphasis is on developing algorithms / flow charts and converting them into working programs.
2. Programs can be written in C / C++ / Matlab or any other programming language that the student finds it suitable. In the class, C++ and/or Matlab will be used.
3. Pre-requisites: Working knowledge of C / C++ / Matlab. This shall be done during I& II Semesters through value addition courses.

**Reference Books:**

- [1] Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, 6ed. Pearson Education, 1999.
- [2] Chapra, S.C. and Canale, R.P., Numerical Methods for Engineers with Programming and Software Applications, 3ed., Tata McGraw Hill, New Delhi, 1998.
- [3] Schilling, R.J. and Harries, S.L., Applied Numerical Methods for Engineers using Matlab and C, Thomson Brooks/Cole, 2000.

**20PCDSE130                      Composite and Smart materials                      (4-0-0) 4**  
**Contact Hours: 52**

**Course Learning Objectives (CLOs):** A great deal of fundamental and developmental research has been made to bring composite materials in various applications such as automobile, space, medical, automotive, building construction, etc. The advent of composite materials has introduced a new dimension in application of energetic, smart and reactive materials. The objective of this course is to know the processing and application of composite and smart materials.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify and understand the basic properties and manufacturing process along with their application for different types of composites.	3	1	
CO-2	Compose and Analyze Laminated Composites	3	1	
CO-3	Failure theories of composites and Analyze Cross-ply and Angle-ply Laminates	3	1	
CO-4	Familiarize with different classes of ceramic and polymeric smart materials; development of actuators and sensors and their integration into a smart structure	3	1	
CO-5	Generate controllable force	3	1	

## SDMCET: Syllabus

	and response of a system. Monitor the response of the system.			
--	------------------------------------------------------------------	--	--	--

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Matrix Method of Analysis

**Contents:**

**Module1:Introduction to Composite materials** Classifications and applications. Of fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices, coupling  
**10 Hours**

**Module2: Anisotropic elasticity** Unidirectional and anisotropic lamina, thermo-mechanical properties, micro- mechanical analysis, classical composite lamination theory, Cross and angle—ply laminates, symmetric, antisymmetric and general symmetric laminates, mechanical coupling, and laminate stacking  
**11 Hours**

**Module3: Analysis of simple laminated structural elements** Ply-stress and strain, lamina failure theories-first Ply failure, environmental effects, manufacturing of composites.  
**11 Hours**

**Module4:Smart materials** Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted, piezoelectric coefficients, phase transition, piezoelectric constitutive relation.  
**10 Hours**

**Module5:** Beam modeling with strain actuator, bending extension relation  
**10 Hours**

**Reference Books:**

- [1]Robert M Jones, “Mechanics of Composite Materials”, McGraw Hill Publishing Co.
- [2]Bhagwan D Aggarwal, and Lawrence J Brutman, “Analysis and Performance of Fiber Composites”, John Willy and Sons.
- [3]Madhujit Mukhopadhyay, “Mechanics of Composite Materials and

Structures”, Universities Press (2004)

- [4]Lecture notes on “Smart Structures”, by Inderjith Chopra, Department of Aerospace Engg., University of Maryland.
- [5]Crawley, E and DeLuis, J.,“Use of piezoelectric actuators as elements of intelligent structures”, AIAA Journal,Vol.25No10, Oct 1987, PP1373-1385.
- [6]Crawley, E and Anderson,E., “Detailed models of Piezoceramic actuation of beams”, Proc. Of the 30th AIAA/ASME/ASCE/AHS/ASC- Structural dynamics and material conference, AIAA WashingtonDC, April1989.

**20PCDSL104      Cad lab —Structural Analysis      (0-0-3) 2**  
**Contact Hours: 35**

**Course Learning Objectives (CLOs):**In a professional design scenario, it is very important to use industry standard software in a Proficient manner besides knowing the theoretical concepts of structural analysis. The programming exercises help in understanding the implementation of algorithms into a program.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Use industry standard software in a professional set up.	<b>2</b>	<b>3</b>	
CO-2	Apply finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design	<b>2</b>	<b>3</b>	
CO-3	Develop customized design automation tools	<b>2</b>	<b>3</b>	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>		3	2

**Contents:**

1. Structural Analysis of 2D and 3D Trusses
2. Structural Analysis of Continuous Beams using for different types of loadings and support conditions
3. Structural Analysis of 2D and 3D Rigid and Braced Frames for different types of loadings , support conditions, section orientations and stiffness variation between columns and beams, Member offsets, End release, Tension only members, Active and Inactive member specifications, Soil - Structure Interaction Problems using Winkler Springs
4. Program Development for Matrix operations- Multiplication, Transpose, Inverse, Gauss elimination and Gauss-Seidel, Cholesky methods for solution of linear system of equations using VBA / MATLAB / C++
5. Program Development for Analysis of Trusses, Beams and Frames using VBA / MATLAB / C++

*\* Exercises 1to 3 on Structural Analysis using Industry Standard Software's*

<b>20PCDSL105</b>	<b>Seminar</b>	<b>(0-0-2) 1</b>
-------------------	----------------	------------------

**Course Learning Objectives (CLOs):** Develop skills in searching technical literature, analyzing and evaluating it to compare the various approaches and prepare a written report and presenting it orally.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Prepare reports and compile data.		<b>2</b>	
CO-2	Prepare presentations and communicate findings to the audience.		<b>2</b>	



## SDMCET: Syllabus

POs	PO-1	PO-2	PO-3
Mapping Level		2	

The student must prepare, submit a seminar report and make a presentation on the Seminar topic allotted. The seminar shall be evaluated as internal assessment by a committee constituted by the HOD.

<b>20PCDSC201</b>	<b>Structural Stability Analysis - Classical and FE Approach</b>	<b>(4-0-0) 4</b>
-------------------	----------------------------------------------------------------------	------------------

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The objective of this course is to learn buckling characteristics of various structural elements and plates by energy and FE approach. Solution to practical problems will be emphasized including integration with finite element analysis. The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Illustrate detailed treatment of buckling characteristics of various structural elements	<b>1</b>	<b>3</b>	
CO-2	Calculate critical load by elastic energy method	<b>1</b>	<b>3</b>	
CO-3	To assess different methods to solve stability problems including integration with finite element procedures	<b>1</b>	<b>3</b>	
CO-4	Calculate and analyze buckling of simply supported rectangular plate	<b>1</b>	<b>3</b>	
CO-5	Calculate and analyze buckling of simply supported rectangular plate under combined bending and compression	<b>1</b>	<b>3</b>	

## SDMCET: Syllabus

POs	PO-1	PO-2	PO-3
Mapping Level	3		2

### Prerequisites:

1. Strength of Materials
2. Structural Analysis I & II

### Contents:

**Module 1: Beam column:** Differential equation. Beam column subjected to (i) lateral concentrated load, (ii) several concentrated loads, (iii) continuous lateral load. Application of trigonometric series. Euler's formulation using fourth order differential equation for pinned-pinned, fixed-fixed, fixed-free and fixed- pinned columns.

**11 Hours**

**Module 2: Buckling of frames and continuous beams:** Elastic Energy method: Approximate calculation of critical loads for a cantilever. Exact critical load for hinged-hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever columns under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Columns subjected to non-conservative follower and pulsating forces.

**11 Hours**

**Module 3: Stability analysis by finite element approach:** Derivation of shape functions for a two noded Bernoulli-Euler beam element (lateral and translational DOF) —element stiffness and Element geometric stiffness matrices — Assembled stiffness and geometric stiffness matrices for a discretized column with different boundary conditions — Evaluation of critical loads for a discretized (two elements) column (both ends built-in). Algorithm to generate geometric stiffness matrix for four noded and eight noded isoparametric plate elements. Buckling of pin jointed frames (maximum of two active DOF)-symmetrical single bay Portal frame.

**10 Hours**

**Module 4: Buckling of simply supported rectangular plate:** Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides- Buckling of a Rectangular Plate Simply Supported along Two opposite sides and uniformly compressed in the Direction Parallel to Those sides.

**10 Hours**

**Module 5: Buckling of simply supported rectangular plate —combined effects:** Buckling of a Simply Supported Rectangular Plate under Combined Bending and Compression — Buckling of Rectangular Plates under the Action of Shearing Stresses — Other Cases of Buckling of Rectangular Plates.

**10 Hours**

**Reference Books:**

- [1] Stephen P. Timoshenko, James M. Gere, “Theory of Elastic Stability”, 2nd Edition, McGraw-Hill, New Delhi.
- [2] Zeiglar.H,” Principles of Structural Stability”, Blasdel Publication
- [3] Robert D Cook et al, “Concepts and Applications of Finite Element Analysis”, 3rd Edition, John Wiley and Sons, New York
- [4] Rajashekar. S, “Computational Structural Mechanics”, Prentice-Hall, India.
- [5] Ray W Clough and J Penzien, “Dynamics of Structures”, 2<sup>nd</sup> Edition, McGraw-Hill, New Delhi.

**20PCDSC202                      Advanced Design of Reinforced Concrete Structural Elements                      (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** To provide a detailed treatment of fundamental concepts for the design of RC structural elements, and to present different methods for the design of RC beams subjected to shear and torsion, Deep beams, flat slab systems including integration with finite element procedures. The course also aims at explaining the underlying theory for the provisions in IS standards.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Discuss the behavior of Reinforced Concrete Beams in Shear and Torsion.		1,3	
CO-2	Apply redistribution of moments in design of Reinforced Concrete beam.	1,3		

## SDMCET: Syllabus

CO-3	Design of Reinforced Concrete Deep Beams	1,3		
CO-4	Analysis and design of compression members	1,3		
CO-5	Design of flat slabs		1,3	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2.6		2.6

### Prerequisites:

1. Strength of Materials
2. Structural Analysis I & II
3. Design of RC elements

### Contents:

**Module 1: Behavior of RC Beams in Shear and Torsion:** Modes of Cracking , Shear Transfer Mechanisms , Shear Failure Modes, Critical Sections for Shear Design , Influence of Axial Force on Design Shear Strength, Shear Resistance of Web Reinforcement, Compression Field Theory, Strut-and- Tie Model. Equilibrium Torsion and Compatibility Torsion, Design Strength in Torsion, Design Torsional Strength with Torsional Reinforcement. **11 Hours**

**Module 2: Redistribution of Moments in RC Beams:** Conditions for Moment Redistribution — Final shape of redistributed bending moment diagram — Moment redistribution for a two-span continuous beam— Advantages and disadvantages of Moment redistribution — Modification of clear distance between bars in beams ( for limiting crack width) with redistribution — Moment — curvature Relations of Reinforced Concrete sections . Curtailment of tension Reinforcement - code procedure — Numerical Example. **11 Hours**

**Module 3: Design of Reinforced Concrete Deep Beams:** Introduction — Minimum thickness -Steps of Designing Deep beams — design by IS 456 - Detailing of Deep beams. **10 Hours**

**Module 4: Behavior and Analysis of Compression Members:** Effective Length Ratios of Columns in Frames, Code Charts — Numerical Examples, Short Columns - Modes of Failure in Eccentric Compression, Axial Load - Moment Interaction equation, Interaction Surface for a Biaxial Loaded Column,

## SDMCET: Syllabus

Concept of Equilibrium approach and application to Non rectangular columns. Slender Column: Braced and Unbraced, Design Methods as per IS 456 — Strength Reduction and Additional Moment Method. **10 Hours**

**Module 5: Flat Slab Design:** Behavior of Slab supported on Stiff, Flexible and no beams, Equivalent Frame Concept, Proportioning of Slab Thickness, Drop Panel and Column Head, Transfer of Shear from Slab to column, Direct Design Method, Equivalent Frame Method — Design Examples. FE analysis and design of Slab Panels based on Wood-Armer equations. **10 Hours**

### Reference Books:

- [1] S. Pillai, Devdas Menon- Reinforced concrete design 3/ED 3rd Edition
- [2] Varghese. P.C., Advanced Reinforced Concrete design, Prentice, Hall of India,
- [3] Krishna Raju — “Advanced R.C. Design”, CBSRD, 1986,
- [4] Park R. and Paulay, T., Reinforced Concrete Structures, John Wiley and sons.
- [5] Karve.S.R. and Shah V.L., Limit State theory and design of Reinforced Concrete, Pune Vidyarthi Griha Prakashan, Pune.

### 20PCDSE225 Analysis of Plates - Classical and FE Approach (4-0-0) 4

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The primary objective of this course is to learn classical methods in theory of plates pertaining to the analysis of solids. Focus will be given to the use of general relationships in the solution of plate bending problems. Solution to practical problems will be emphasized including integration with finite element analysis. The delivery of topics will be made through lecture classes.

### Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Apply knowledge of mathematics, science, and	1	3	

**SDMCET: Syllabus**

	engineering by developing the Equilibrium equations for plate element			
CO-2	Formulate, analyze and solve two dimensional plate elements using strain energy approaches.	<b>1</b>	<b>3</b>	
CO-3	Formulate, analyze and solve simply supported rectangular plate element	<b>1</b>	<b>3</b>	
CO-4	Formulate Rectangular plates with different edge conditions	<b>1</b>	<b>3</b>	
CO-5	Formulate, analyze and solve circular plate	<b>1</b>	<b>3</b>	

<b>POs</b>	PO-1	PO-2	PO-3
<b>Mapping Level</b>	3		2

**Prerequisites**

1. Strength of Materials
2. Structural Analysis I & II

**Contents:**

**Module 1: Pure Bending of plates:** Introduction - Slope and curvature of slightly bent plates — Displacement strain relations, Strains in terms of displacements, strain-stress relations, expressions for moments. Small deflections of laterally loaded plates- stress resultants on a typical plate element, equations of equilibrium, expressions for vertical shears and boundary conditions. Strain energy in pure bending- Expression for total energy, Analysis of plates subjected to uniformly distributed load by energy method.  
**11 Hours**

**Module 2: Simply supported rectangular plates –** Double Fourier series expressions for loads, Navier’s solution for simply supported plates subjected to udl, patch udl, point load and hydrostatic pressure. Bending of rectangular simply supported plates subjected to a distributed moment at a pair of opposite edges.  
**11 Hours**

**Module 3: Rectangular plates with different Edge conditions:** Levy’s solution

for rectangular plates – Analysis of rectangular plate subjected to UDL (i) two opposite edges simply supported and the other two edges clamped, (ii) three edges simply supported and one edge built-in and (iii) all edges built-in

**10 Hours**

**Module 4: Circular Plates:** Differential equation for symmetrical bending of laterally loaded circular plates — uniformly loaded circular plates with and without central cutouts, with two different boundary conditions (simply supported and clamped). Centrally loaded clamped circular plate.

**10 Hours**

**Module 5: FE approach:** Finite Element Analysis of Thin Plate: Triangular Plate Bending Element, Rectangular Plate Bending Element, Finite Element Analysis of Thick Plate.

**10 Hours**

**Reference Books:**

- [1]Timoshenko and Krieger, “Theory of Plates and Shells”, McGraw-Hill International Book Company
- [2]Chandrashekara K, “Theory of Plates”, University Press
- [3]S. S. Bhavikatti, “Theory of Plates and Shells”, New Age International Publishers
- [4]Robert D Cook et al, “Concepts and Applications of Finite Element Analysis”, 3rd Edition, John Wiley and Sons, New York
- [5]Szilard. R, “Theory and analysis of plates-classical and numerical Methods”
- [6]Ugural A C, “Stress in Plates and shells”, McGraw-Hill International Book Company

**20PCDSE226 Reliability Analysis and Design of Structural Elements (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** Assessment of safety of structures is a very important task of structural engineers. The action and response are subjected to statistical variations and are probabilistic. The primary objective of this course is to learn different methods of evaluation of safety taking into account the variation of design parameters.



**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Summarize concepts and techniques of reliability and probability distributions	1,3		
CO-2	Define safety format or failure surface for a given action and response along with their statistics.	1,3		
CO-3	Compute reliability index, for the given design details	1,3		
CO-4	Arrive at mean value of a dominant design parameter for the target reliability index	1,3		
CO-5	Use simulation techniques to arrive at the statistics of design variables	1,3		

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	3		3

**Prerequisites:**

1. Engineering Mathematics

**Contents:**

**Module 1: Concept of variability:** Applications of Statistical principles to deal with randomness in basic variables, statistical parameters and their significance, curve fitting, correlation and regression. **10 Hours**

**Module 2: Description of various probability distribution:** Probability theory, binomial, Poisson, Normal, Log-normal, External distributions, Testing of Goodness of fit of distribution to the actual data using Chi-square method. **11 Hours**

## SDMCET: Syllabus

**Module 3: Basic structural reliability:** Random variables, continuous variables, discrete variable and computation of structural reliability. **11 Hours**

**Module 4: Reliability methods:** Introduction, Basic variables and Failure surface, FOSM, Hasofer and Lind Method (AFOSM), determination of ' $\beta$ ' for present designs. **10 Hours**

**Module 5: Simulation techniques and reliability-based design:** Monte Carlo method, Applications, Reliability based design. Determination of partial safety factors, Safety checking formats. **10 Hours**

### Reference Books:

- [1] Ang A.H.S and W.H. Tang, Probability concepts in Engineering planning and Design, John Wiley and sons, New York, Vol.I and II.
- [2] Ranganthan R, Reliability Analysis and Design of Structures, Tata McGraw Hillpublishing Co. Ltd., New Delhi.
- [3] John B. Kennedy and Adam Neville, Basic Statistical Methods for Engineers and Scientists,
- [4] Harper and Row Publishers, New York. Robert E. Melchers, Structural Reliability Analysis and Prediction, Wiley

**20PCDSE227      Advanced Design of Steel Structures      (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** This course covers the advanced principles of the design of hot-rolled and cold-formed steel structural members. Reference is made to the IS 800 and 811 standards, explaining the underlying theory for the provisions in these standards. The objectives are to provide students with advanced knowledge of steel structural design and confidence to apply the underlying principles to solve a wide range of structural steel problems. The delivery of topics will be made through lecture classes.

### Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze and Design of	1,3		

## SDMCET: Syllabus

	Laterally unrestrained beams			
CO-2	Analyze and Design of beams subjected to torsion and bending	<b>1,3</b>		
CO-3	Analyze and Design of Beam-column in frames	<b>1,3</b>		
CO-4	Analyze and Design of Beams with web opening	<b>1,3</b>		
CO-5	Analyze and Design of cold formed steel sections	<b>1,3</b>		
CO-6	Discuss, Analyze and Design of fire resistance steel structures	<b>1,3</b>		

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	<b>3</b>		<b>3</b>

### Prerequisites:

1. Strength of Materials
2. Design of steel structures

### Contents:

**Module 1: Laterally Unrestrained Beams:** Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams — Design Examples

**11 Hours**

**Module 2: Beams subjected to Torsion and Bending:** Shear Center and Warping, Uniform and Non-Uniform torsion, Concepts, Methods of evaluating the torsional effects, IS 800 Code provisions, Design examples: Rolled and Hollow Sections.

**11 Hours**

**Module 3: Beam- Columns in Frames:** Behavior of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 – Examples

**10 Hours**

**Module 4: Steel Beams with Web Openings:** Shape of the web openings, practical guidelines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of castellated beams, Vierendeel girders

**10 Hours**

**Module 5: Cold formed steel sections and Fire resistance:** Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 811 code provisions-numerical examples, beam design, column design. Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Fire resistance ratings-Numerical Examples.

**10 Hours**

**Reference Books:**

- [1] N. Subramanian, Design of Steel Structures, Oxford, IBH.
- [2] Duggal. S.K., Limit State Design of Steel structures. Tata McGraw-Hill.
- [3] S.S. Bhavikatti Design of Steel Structures, by limit state method as per IS 800-2007, IK publication.

**20PCDSE228      Design of Stack Tower and Water Storage      (4-0-0) 4**  
**Structural Systems**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** To illustrate the quintessential differences in the design of stack, tower and water storage structural systems with reference to other structural systems The delivery of topics will be made through lecture classes.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze and Design of Steel Chimneys	<b>3</b>	<b>1</b>	
CO-2	Analyze and Design of Transmission line towers	<b>3</b>	<b>1</b>	
CO-3	Analyze and Design of	<b>3</b>	<b>1</b>	

**SDMCET: Syllabus**

	Trestles			
CO-4	Analyze and Design of water storage structures	<b>3</b>	<b>1</b>	
CO-5	Analyze and Design of over-head tanks	<b>3</b>	<b>1</b>	
CO-6	Analyze and Design of Steel Chimneys	<b>3</b>	<b>1</b>	

<b>POs</b>	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

**Prerequisites:**

1. Strength of Materials
2. Design of steel structures

**Contents:**

**Module 1: Steel Chimneys:** Lining for chimneys — breach opening — Forces acting on steel chimneys including seismic forces — Analysis Design and Detailing of RC chimneys for different load combinations. Design of thickness of steel plate — Design of base plate — Design of anchor bolts — Design of foundation.

**11 Hours**

**Module 2: Transmission line towers of various shapes and member types:** Loads on towers — Analysis and Design of Steel transmission line towers. Design of Foundations

**11 Hours**

**Module 3: Trestles:** Analysis and design of Steel Trestles for vertical and horizontal loads

**10 Hours**

**Module 4: Water Storage structures:** Properties of un-cracked section — Calculation of thickness and reinforcement for Liquid retaining structure, Design and Detailing of underground, Ground Level

**10 Hours**

**Module 5: Overhead water tanks:** Circular, Rectangular on framed and Shaft type of Staging systems as per IS 3370 Parts 1 to 4

**10 Hours**

**Reference Books:**

- [1] Ramachandra, Design of Steel structures Vol.1 and Vol. 2. Standard Publication
- [2] S.K. Duggal, Design of Steel structures. Tata McGraw-Hill
- [3] Vazirani & Ratwani, Steel structures, Vo1.III
- [4] IS: 6533. Code of Practice for Design and Construction of steel chimneys.
- [5] IS 802: Use Of Structural Steel in Overhead Transmission Line Towers — Code of Practice - Part 1 Material, Loads and Permissible Stresses

**20PCDSE229 Seismic Resistant Design of Structural System (4-0-0) 4**

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** In this course, topics covered on Seismic hazard assessment, Earthquake effects on structures, Concepts of earthquake resistant design of earthen, masonry and RCC buildings are dealt with.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Interpret engineering seismology and Seismic hazard assessment.	3	1	
CO-2	Evaluate earthquake forces and effect of earthquake on different types of structures.	3	1	
CO-3	Differentiate the philosophy and principles of earthquake resistance design of structures.	3	1	
CO-4	Illustrate Earthquake Resistance design of masonry and RCC buildings	3	1	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

**Contents:**

**Module 1: Seismic Hazard Assessment-** Engineering Seismology, Definitions, Introduction to Seismic hazard, Earthquake phenomenon, Seismic tectonics and seismic zoning of India, Earthquake monitoring and seismic instrumentation, Characteristics of strong Earthquake motion, Estimation of Earthquake parameters, Micro zonation. **10 Hours**

**Module 2: Earthquake effects on structures:** Response to ground acceleration, response analysis by mode superposition, torsional response of buildings, response spectrum analysis, selection of design earthquake, earthquake response of base isolated buildings, earthquake response of inelastic structures, allowable ductility demand Response Spectra / Average response Spectra, Design Response Spectra, Evaluation of earthquake forces (IS 1893 – 2002). Effect of earthquake on different types of structures – Lesson learnt from past earthquakes. **11 Hours**

**Module 3: Concepts of earthquake resistant design-** Structural Systems / Types of buildings, Causes of damage, Planning consideration/Architectural Concept (IS 4326–1993) (Do's and Don'ts for protection of life and property), Philosophy and principle of earthquake resistance design, Guidelines for Earthquake Resistant design. **11 Hours**

**Module4: Earthquake Resistant Masonry Buildings** Earthquake Resistant low strength masonry buildings, Strength and Structural properties of masonry– Lateral load Design considerations. **10 Hours**

**Module5: Earthquake Resistant Design of RCC Buildings**–Material properties–lateral load analysis design and detailing. Basic concepts of seismic base isolation and Seismic Isolation systems. **10 Hours**

**Reference Books:**

- [1] Chopra, A.K.-“Dynamics of structures”, Prentice-Hall of India Pvt. Ltd. New Delhi.
- [2] Clough, R.W. and Penzien J. - “Dynamics of Structures”, McGraw Hill Book Co. New York
- [3] S.K.Duggal -”Earthquake Resistant Design of Structures” Oxford publications New Delhi.

**Contact Hours: 52**

**Course Learning Objectives (CLOs):** The primary objective of this course is to learn advanced methods for solving problems in vibrations. Focus will be given to the use of general relationships in the solution of linear and non-linear problems. The course also addresses other sources of vibrations such as blast and water waves.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze and solve dynamic response of MDOF system	<b>1,3</b>		
CO-2	Formulate, analyze and solve nonlinear structural dynamic	<b>1,3</b>		
CO-3	Define and describe random vibration	<b>1,3</b>		
CO-4	Formulate, analyze and solve blast loads on structures	<b>1,3</b>		
CO-5	Define and describe water waves and analyze response of structures to water waves	<b>1,3</b>		

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	3		3

**Prerequisites:**

1. Structural dynamics

**Contents:**

**Module 1: Analysis of Dynamic Response of MDOF Systems by Direct Integration:** Basic concept of direct integration methods — central difference methods - Wilson - D Method - Newmark Method — Stability and accuracy of direct integration method. **10 Hours**



**Module 2: Nonlinear Structural Response** — Classification of nonlinear analysis — Systems with nonlinear characteristics — formulation of incremental equations of equilibrium — numerical solution of nonlinear equilibrium equations for single degree freedom systems - linear acceleration step by step method, elastoplastic behavior, algorithm for the step by step solution for elastoplastic SDOF system. Newmark Method — Wilson - D - Method Response spectra — construction of a response spectrum, response spectrum for support disturbance, tripartite response spectra, response spectra for inelastic design. Non-linear Response of MDOF Systems — incremental equation of motion, Wilson-D method. **11 Hours**

**Module 3: Introduction to Random Vibration** — Random functions, normal and Rayleigh's distribution, correlation, Fourier transform, spectral analysis, spectral density function, response to random excitation. **10 Hours**

**Module 4: Blast Loads on Structure:** Sources of Blast Loads — shock waves — sound speed and Mach numbers. Shock pressure. Determination of blast loads — defining blast loads — structure loading. Strain rate effects — approximate solution technique for SDOF systems. **10 Hours**

**Module 5: Basic Concepts of Water Waves** — Linear wave theory — dispersion equations — wave particle velocities- wave energies. Nonlinear waves- Stokes wave theory — Conoidal Wave theory — stream function wave theory. Waves transformations — Shoaling - refraction — diffraction — dissipation —breaking. Wave statistics — significant wave — short term statistics — wave spectra — long term statistics. Wave information — wave measurements — Hind casts. **Response of Structures to Water Waves:** Morrison equation, force coefficient, linearized Morrison equation, inclined cylinders — transfer lift forces. Diffraction theory- scattering problem — wave forces on vertical walls — wave forces on a low vertical wall - wave forces on a rectangular structure. **11 Hours**

**Reference Books:**

- [1] Mario Paz, "Structural Dynamics, Theory and Computation", 2nd Edition, CBS Publisher and Distributors, New Delhi.
- [2] Mukopadyaya, "Vibration, Dynamics and Structural Problems," Oxford IBH Publishers
- [3] Ray W Clough and J Penzien, "Dynamics of Structures", 2nd Edition, McGraw-Hill, New Delhi. 1989.
- [4] Joseph W Tedesco, William G McDougal, D.Allen Ross, " Structural Dynamics Theory and Applications" Publishers Addison Wesley Longman, Inc. Menlo Park, California 94025.

**Course Learning Objectives (CLOs):** To summarize fundamental concepts for the design of tall structure and to present the influence of different loads on the tall structure. The course also aims at explaining the underlying theory for the provisions in IS standards.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Describe tall structures and the types of load acting on tall structures.		<b>1</b>	
CO-2	Explain dispersion of Lateral Forces, flooring system, wall panel system, and multi-story box system.	<b>3</b>	<b>1</b>	
CO-3	Discuss different framing system and their comparison – drift and dynamic response of building	<b>3</b>	<b>1</b>	
CO-4	Design of tall structure by approximate method	<b>3</b>	<b>1</b>	
CO-5	Describe other latest tall structure framing system	<b>3</b>	<b>1</b>	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2		3

**Prerequisites:**

1. Strength of Materials
2. Structural Analysis I & II
3. Design of RC elements

**Course Contents:**

**Module1:** Introduction to Tall Building in the Urban Context - The Tall Building and its Support Structure - Development of High Rise Building Structures - General Planning Considerations. Dead Loads – Live Loads-Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading – Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads.

**11 Hours**

**Module2:** The vertical structure plane Dispersion of Vertical Forces- Dispersion of Lateral Forces – Optimum Ground Level Space - Shear Wall Arrangement - Behavior of Shear Walls under Lateral Loading. The Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing- Composite Floor Systems the High - Rise Building as related to assemblage Kits Skeleton Frame Systems – Load Bearing Wall Panel Systems - Panel – Frame Systems –Multi-storey Box Systems.

**10 Hours**

**Module3:** Common high-rise building structures and their behavior under load The Bearing Wall Structure- The Shear Core Structure - Rigid Frame Systems-The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss – Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms – The Counteracting Force or Dynamic Response.

**11 Hours**

**Module4:** Approximate structural analysis and design of buildings Approximate Analysis of Bearing Wall Buildings the Cross Wall Structure - The Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading – Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings The Rigid Frame - Shear Wall Structure – The Vierendeel Structure-The Hollow Tube Structure.

**10 Hours**

**Module 5:** Other high-rise building structure Deep - Beam Systems -High-Rise Suspension Systems – Pneumatic High -Rise Buildings - Space Frame Applied to High - Rise Buildings - Capsule Architecture.

**10 Hours****Reference Books:**

[1] Wolfgang Schuller - "High - rise building Structures", John Wiley and Sons, New York

- [2] Bryan Stafford Smith and Alex Coull, "Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc., 1991.
- [3] Coull, A. and Smith, Stafford, B. " Tall Buildings ", Pergamon Press, London, 1997.
- [4] Lin T.Y. and Burry D. Stotes, " Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994.
- [5] Lynn S. Beedle, "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1996.
- [6] Taranath. B.S., "Structural Analysis and Design of Tall Buildings", McGraw Hill, 1998.

**20PCDSL204                      Cad Lab—FE Analysis                      (0-0-3)2**

**Contact Hours: 35**

**Course Learning Objectives (CLOs):** In a professional design scenario, it is very important to use industry standard software in a Proficient manner besides knowing the theoretical concepts of structural analysis. The programming exercises help in understanding the implementation of algorithms into a program.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Use industry standard software in a professional set up.	<b>2</b>	<b>1,3</b>	
CO-2	Apply finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design	<b>2</b>	<b>1,3</b>	
CO-3	Develop customized design automation tools	<b>2</b>	<b>1,3</b>	

POs	PO-1	PO-2	PO-3
<b>Mapping Level</b>	2	3	2

**Contents:**

1. FE Analysis of Framed structures due to Seismic forces using modal dynamics
  2. FE Analysis of Plane Stress and Plane Strain Problems
  3. Flexural Behavior of Slab Panels with different aspect ratio and boundary conditions
  4. FE Analysis of Slab panel resting on column supports- Drop Panels, Capitals
  5. FE Analysis of Slab on Grade(Raft), Underpass, Bridge Structures
  6. Programming exercises using C/VBA/VB/MATLAB for CST, LST and Rectangular Elements
- \*Exercises 1 to 5 on FE Analysis are aimed at using Industry Standard Software*

**References:**

- [1] Timoshenko and Krieger, “Theory of Plates and Shells”, McGraw-Hill International Book Company
- [2] Chopra, A.K.-“Dynamics of structures”, Prentice-Hall of India Pvt. Ltd. New Delhi.
- [3] Clough, R.W. and Penzien J. - “Dynamics of Structures”, McGraw Hill Book Co. New York
- [4] Bathe.K.J, “Finite element procedures in Engineering Analysis” .PHI New Delhi

<b>20PCDSL205</b>	<b>Seminar</b>	<b>(0-0-2) 1</b>
-------------------	----------------	------------------

**Course Learning Objectives (CLOs):** Develop skills in searching technical literature, analyzing and evaluating it to compare the various approaches and prepare a written report and presenting it orally.

**Course Outcomes (COs):**

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Prepare reports and compile data.		<b>2</b>	
CO-2	Prepare presentations and communicate findings to the audience.		<b>2</b>	

## SDMCET: Syllabus

POs	PO-1	PO-2	PO-3
Mapping Level		2	

The student has to prepare, submit a seminar report and make a presentation on the Seminar topic allotted. The seminar shall be evaluated as internal assessment by a committee constituted by the HOD.