Syllabus

(With effect from 2017-2018 Academic year)

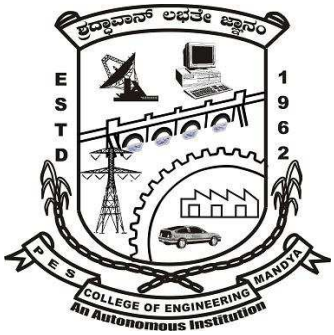
ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18)

I & II Semester

Master of Technology
in
Civil Engineering (CADS)

Out Come Based Education
with
Choice Based Credit System



P.E.S. College of Engineering, Mandya - 571 401, Karnataka

(An Autonomous Institution Affiliated to VTU, Belagavi)
Grant -in- Aid Institution
(Government of Karnataka)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight undergraduate and Eight Postgraduate programs. It consists of Six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit& Interactionare included in all undergraduate programs.

Sri. B.DineshPrabhu
Associate Professor
Deputy Dean (Academic)
Dept. of Automobile Engg

Dr.P S Puttaswamy
Dean (Academic)
HoD & Professor
Dept. of Electrical & Electronics Engg

P.E.S.COLLEGE OF ENGINEERING, MANDYA-571401, (KARNATAKA) (An Autonomous Institution under VTU, Belagavi)

Vision

"PESCE shall be leading institution imparting quality engineering and management and education developing creative and socially responsible professionals"

Mission

Institute mission in pursuance of its vision is:

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching learning practices*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

DEPARTMENT OF CIVIL ENGINEERING
About the Department
Department of Civil Engineering

The Civil Engineering Department was started in the year 1962 as one of the first branches inP.E.S College of Engineering, Mandya with an intake of 40. The department has carved a niche for itself by offering the most competent instructional programme to the students. The department is running an undergraduate programme with an intake of 120 and it has started PG in CAD structures with an intake of 18 in the year 2004. The department has been recognized as research center under VTU, Belgaum. The department is accredited by NBA, New Delhi for five years (2004-2009). The department is well equipped with laboratories, computing facilities, independent library and other facilities. The department has well qualified and experienced teaching faculties. The department also takes up consultancy work pertaining to civil engineering. Planning, structural design of buildings, testing of materials and soil investigation is part of the department activities.

Vision

- *To attain Excellence in imparting quality civil engineering education to meet the societal needs.*

Mission

- *Impart civil engineering and managerial skills with state of art infrastructure, competent and committed faculty using outcome based educational curriculum.*
- *Promote research, project management and consultancy*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*

The Program Educational Objectives (PEOs)

Graduates will be able to

- Apply technical competence in the field of Civil Engineering with a strong background in basic science and mathematics.
- Analyse and interpret data to design or evaluate civil engineering systems to satisfy societal needs with the use of modern tools including higher education.
- Function effectively as an individual and or to work in a team on multispecialized civil engineering projects with professional ethics and effective communication skills inculcating the habit of life-long learning.

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduate will be able to:

1. PSO1: Apply knowledge of basic science to analyze and solve problems in the core area of Civil Engineering such as Structural, Geotechnical, Transportation, Environmental, Hydraulics and Water resources engineering.
2. PSO2: Analyze, Plan, design, quality assessment and cost estimate of Civil Engineering structures with professional ethics.
3. PSO3: work in a consulting organization or can be an entrepreneur to investigate and execute Civil Engineering structures using modern tools and technology to provide sustainable solutions to meet the societal needs.

Scheme of Teaching and Examination

First semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCAD11	Computational structural mechanics	CV	4:0:0:4	04	50	50	100
2.	P17MCAD12	Structural dynamics – theory & computation	CV	4:0:0:4	04	50	50	100
3.	P17MCAD13	Continuum mechanics-classical & FE approach	CV	4:0:0:4	04	50	50	100
4.	P17MCAD14	Advanced design of RC structural elements	CV	4:0:0:4	04	50	50	100
5.	P17MCAD15*	Elective – I	CV	4:0:0:4	04	50	50	100
6.	P17MCAD16*	Elective – II	CV	4:0:0:4	04	50	50	100
7	P17MCADL17	CAD Laboratory -I	CV	0:0:4:4	02	50	50	100
Total					**26**	**400**	**300**	**700**

Sl. No.	*Sub. code*	*Subject Name*	Hrs./Week L:T:P:H		*Sl. No.*	*Sub. code*	*Subject Name*	Hrs./Week L:T:P:H
Elective – I					Elective – II			
1	P17MCAD151	Construction Project Management And Structural Optimization	4:0:0:4		3	P17MCAD161	Ground improvement techniques	4:0:0:4
2	P17MCAD152	Application of AI & expert Systems in structural engineering	4:0:0:4		4	P17MCAD162	Advanced mechanics of materials	4:0:0:4

Second semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCAD21	ANALYSIS OF PLATES	CV	4:0:0:4	04	50	50	100
2.	P17MCAD22	Seismic resistant design of structural systems	CV	4:0:0:4	04	50	50	100
3.	P17MCAD23	Structural stability analysis-classical and FE approach	CV	4:0:0:4	04	50	50	100
4.	P17MCAD24*	Elective – III	CV	4:0:0:4	04	50	50	100
5.	P17MCAD25*	Elective – IV	CV	4:0:0:4	04	50	50	100
6.	P17MCAD26*	Elective – V	CV	4:0:4:4	04	50	50	100
7	P17MCAD27	CAD Laboratory-II	CV	0:0:4:4	02	50	50	100
Total					**26**	**400**	**300**	**700**

Sl. No.	***Sub. code***	**Sub. Name**	***Sl. No.***	***Sub. code***	***Sub. Name***	***Sl. No.***	***Sub. code***	***Sub. Name***
Elective – III			Elective – IV			Elective – V		
1	P17MCAD241	Reliability analysis and design of structural elements	3	P17MCAD251	Advanced design of steel structures	5	P17 MCAD 261	Advanced design of substructures
2	P17MCAD242	Advanced structural dynamics	4	P17MCAD252	Design of structural systems in bridges	6	P17 MCAD 262	Design of tall structures

Third semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17 MCAD31	Self study course	CV	4:0:0:4	04	50	50	100
2.	P17 MHSM32	Pedagogy/ Research Methodology	HS&M	0:2:2:4	02	100	--	100
3.	P17MCAD3 3	Seminar	CV	--	02	100	--	100
4.	P17 MCAD34	Project –Phase – I	CV	--	04	100	--	100
5.	P17MCAD35	Project –Phase-II	CV	--	04	100	--	100
6.	P17MCAD36	Industrial Training	CV	--	06	100	--	100
Total					**22**	**550**	**50**	**600**

Fourth semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCAD41	Project –Phase-III	CV	--	04	100	--	100
2.	P1MCAD42	Project –Phase-IV(Thesis Evaluation)	CV	--	10	100	--	100
3.	P17MCAD43	Project –Phase-V(Viva-Voce)	CV	--	08	--	100	100
4.	P17MCAD44	Term Paper	CV	-	04	--	100	100
Total					**26**	**200**	**200**	**400**

Note:

1 Eight weeks of compulsory Industrial Training to be undergone by the students during their third semester. A report on Industrial Training is to be submitted by the student. The report has to be evaluated by Industrial guide and Institute guide for CIE of 50 marks (industry and supervisor evaluation average marks for 50 each). The student must give seminar based on Industrial Training before a committee constituted by the department for remaining CIE of 50 marks.

2 The Laboratories are CIE with report submission and seminar presentation /Viva Voce of 50 marks each.

3 Pedagogy/Research methodology is CIE with objective type of question for evaluation

4 The seminar (III Semester) on current topics shall be presented along with a report for evaluation each of 50 marks.

5 Project work Phase-1, 2 & 3 to be awarded by the Department committee constituted for the purpose

a) The Project Phase-I evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Title, Introduction, Literature Survey, Summary of Literature Survey, Objectives and Methodology (50 Marks) and Presentation (50 marks) each.

b) The Project Phase-II evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Experimentation, Theoretical analysis approach and results (if completed as a stage work) and Presentation for 50 marks each.

c) The Project Phase-III evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Experimentation, Theoretical analysis approach and results and discussion (if completed) and Presentation for 50 marks each.
d) The Project Phase-IV evaluation shall be of 100 marks CIE. It is based on Thesis manuscript and Presentation for 50 marks each (work completion report).
e) The Project Phase-V evaluation shall be of 100 marks SEE. It is based on Thesis manuscript preparation and Presentation for 50 marks each

6 The project thesis evaluation has to be done separately by internal and external examiners for 100 marks each and the average marks of the two examiners shall be the final.

7 The Project viva voce has to be conducted jointly by internal and external examiner for a total of 100 marks SEE.

8 The term paper is purely based on the project work he/she chooses.

9 Term paper has to be evaluated by the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate.

10 The term paper evaluation is based on the publication of an article in peer reviewed conference/ journal (national/ international) and quality of the journal. If the term paper is not published by the candidate or the same is communicated for publication at the end of his/ her tenure, then the committee form by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate.

11 The self study course shall consists of five units with lab component and he/ she must be able to demonstrate the knowledge gained by the candidates. The course content must be tailor made by the department to suit their requirements.

12 The self study course shall be of 100 marks. The course evaluation is based on the lab report submission/ assignment/ viva -voce as CIE 50 marks and SEE for 50 marks.

Course Title : Computational Structural Mechanics			
Course Code: P17MCAD11	**Semester : I**	**L-T-P-H: 4 – 0 – 0- 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

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 to learn computer aided Methods of analysis adopted in industry for such purposes.

Course Content

UNIT – I

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, elastic (spring) supports, support settlement. **12Hrs**

Self-study: analysis of indeterminate trusses for roller &slider.

UNIT – II

Direct Stiffness Method: Continuous beam, 2d frames: analysis of continuous beams for different types of boundary conditions such as fixed, hinged, roller, slider support settlement. Analysis of simple 2d frames with and without sway, element stiffness matrix for 3d frames and grids. **10Hrs**

Self-study: Analysis of continuous beams for elastic (spring) supports.

UNIT – III

Basic Concept of Finite Element Method: Concept of FEM, formulation using principle of virtual work, principles minimum potential energy, method of weighted residuals (Galerkin's), choice of displacement function, degree of continuity. **10 Hrs**

Self-study: Generalized and natural coordinates.

UNIT – IV

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 nodded 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. **10 Hrs**

Self-study: Iso parametric formulation.

UNIT – V

FE Analysis using Beam Element: Derivation of shape function for two noded beam element, Hermitian interpolation, element stiffness matrix, consistent nodal loads.

Examples: cantilever and simply supported beams. **10 Hrs**

Self-study: concept of reduced or lumped loads.

TEXT BOOKS:

1. Rajasekaran.S, "Computational Structural Mechanics", PHI, New Delhi 2001.

2. Reddy.C.S, "Basic Structural Analysis," TMH, New Delhi 2001.
3. Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, JohnWiley and Sons, New York.

REFERENCES:

1. Beaufait.F.W. et al., "Computer Methods of Structural Analysis", Prentice Hall, 1970.
2. Weaver.W and Gere.J.H.,"Matrix Analysis of Framed Structures", Van Nastran, 1980.
3. Rubinstein M.F, "Matrix Computer Methods of Structural Analysis" Prentice-Hall.
4. Bathe.K.J, "Finite element procedures in Engineering Analysis". PHI. New Delhi.

Course Outcome (CO)

After learning all the units of the course, the student is able to

1. Idealize the actual structural systems, for the purpose of analysis, in the form of an acceptable simple frame work consisting of one dimensional elements being connected at joint locations.
2. Achieve knowledge of problem solving skills using computer aided methods.
3. Understand implementation procedures of such methods in computer programs.

Course Title : STRUCTURAL DYNAMICS - THEORY & COMPUTATIONS			
Course Code:P17MCAD12	**Semester : I**	**L-T-P-H: 4 – 0 – 0–4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

The objectives of this course is to make students to learn principles of Structural Dynamics, To implement these principles through different methods and to apply the same for free and forced vibration of discrete single-degree and multiple-degree vibratory systems and continuous vibratory systems and quantification of response of these systems . To evaluate the dynamic characteristics of the structures.

Course Content

UNIT – I

Single Degree of Freedom System: concept of degrees of freedom, undamped system, springs in parallel or in series, free body diagram, D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Mathematical models of Single-degree-of-freedom systems system. Free vibration response of damped and undamped systems. **10 Hrs**

Self Study: Methods of evaluation of damping.

UNIT – II

Response to General Dynamic Loading: Response of Single-degree-of-freedom systems to harmonic loading (rotation unbalance, reciprocating unbalance) including support motion, vibration isolation, transmissibility, Numerical methods applied to Single-degree-of-freedom systems -Duhamel integral. **10 Hrs**

Self Study: principle of vibration measuring instruments – seismometer and accelerometer.

UNIT – III

Dynamics of Multi-degree freedom systems: Multistory 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. **12Hrs**

Self Study: Conditions for uncoupling.

UNIT – IV

Discretization of Continuous Systems: Longitudinal Vibration of a uniform rod. Free transverse vibration of uniform beams– The effect of axial loading. **10Hrs**

Self study: Orthogonality of normal modes. Undamped forced vibration of beams by mode superposition.

UNIT – V

Dynamic Analysis of Beams: Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretised beam in matrix form. 1**0Hrs**

Self study: Examples

TEXT BOOKS:

1. Mario Paz, "Structural Dynamics, Theory and Computation", 2nd Edition, CBS Publisher and Distributors, New Delhi.
2. Mukhopadyaya, "Vibration, Dynamics and Structural Problems," Oxford IBH Publishers

REFERENCES:

1. Clough, Ray W and Penzien J, "Dynamics of Structures", 2nd Edition, McGraw-Hill, New Delhi.
2. Roy R. Craig, Andrew J. Kurdila, "Fundamentals of Structural Dynamics", John Wiley & Sons

Course Outcomes

On completion of this course, students are able to

1. Identify and specify various types of dynamic loads for structural analysis
2. Demonstrate an understanding of fundamental concepts of structural dynamics
3. Apply knowledge of mathematics, science, and engineering to develop the model for free and forced vibrations of discrete single-degree and multiple-degree vibratory systems and continuous vibratory systems.
4. Determine the natural frequency, the dynamic response and other important parameters for
   structural design of these systems.

Course Title : CONTINUUM MECHANICS - CLASSICAL AND FE APPROACH			
Course Code: P17MCAD13	**Semester : I**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

To introduce students to the fundamental concepts of the mechanics of deformable bodies alongwith state-of-the-art computational methods in civil engineering. The range of material behaviorconsidered includes: Finite Deformation Elasticity.

Course Content

UNIT – I

Analysis of Stress: Introduction, Definition of stress at a point, Rectangular and Polar coordinates in 2D and 3D, Components of stresses, Equilibrium equations, Principal stresses and stress invariants, Maximum shear stresses, Stress transformation, Octahedral Stresses, Stress boundary Conditions. (All Topics to be discussed in both rectangular and polar co-ordinate systems in 2D and 3D treatments). **12Hrs**

Self Study: Mohr's Circle for stresses

UNIT – II

Analysis of Strain: Definition of a Strain at a point and Strain components in rectangular and polar coordinates (2D and 3D), Strain displacement relationships, strain compatibility, Principal strain, Maximum shear strain & octahedral strains.(All Topics to be discussed in both rectangular and polar co-ordinate systems in 2D and 3D treatments). **10Hrs**

Self Study: Strain Rossette

UNIT – III

Stress-Strain Relationship: Hook's law, General Constitutive Relationship, Definition of Plane stress and Plane strain idealizations, Constitutive relation for plane stress and plane strain cases, Compatibility equations.

Airy's Stress Function: Airy's stress function approach to 2D problems of elasticity. Solution by Polynomials – End Effects, Saint – Venant's Principle. **10Hrs**

Self Study: Stress –strain relationship in polar co-ordinates.

UNIT – IV

Applications: Solution of some simple beam problems, including working out of displacement components. Applications in polar coordinates: Axi- symmetric stress distribution, Analysis of Thick cylinders, Hallow and solid Rotating discs.

The effect of a small circular hole on stress distribution in large plates subjected to uni-axial tension and pure shear. **10Hrs**

Self Study: Application of theory of elasticity to obtain solutions for problems - Pure bending of curved bars, Bending of a curved bar by a force at the end.

UNIT – V

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. **10Hrs**

Self Study: Axisymmetric elements & Gauss quadrature.

TEXT BOOKS:

1. Timoshenko and Goodier, "Theory of elasticity", McGraw Hill Book Company, III Edition, 1983.
2. Valliappan. S, "Continuum Mechanics fundamentals", Oxford and IBH.

REFERENCES

1. Srinath. L.S., Advanced Mechanics of Solids", Tata McGraw-Hill Publishing Co ltd., New Delhi
2. Bathe. K.J, "Finite element procedures in Engineering Analysis".PHI. New Delhi
3. Krishnamoorthy C.S, "Finite Element Analysis", Tata-McGraw-Hill Publishing Company

Course Outcome (Co)

On successful completion of this course, students are able to

1. Understand the concept of stresses and analyse the various mathematical operations involved in analysing stresses in 2D and 3D problems in Cartesian and polar co-ordinates.
2. Apply the concept of stain at a point and to get acquaint with the various mathematical operations involved in analysis strains in 2D and 3D problems in Cartesian and polar co-ordinates.
3. Develop general stress strain relations and to understand its application in various cases.
4. Apply the basic principles of theory of elasticity to obtain classical solutions to some of the problems in structural engineering.
5. Apply the principles of FEA to solve problems in continuum mechanics.

Course Title : Advanced Design of RC Structural Elements			
Course Code: P17MCAD14	**Semester : I**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course learning objectives (CLO)

To provide a detailed study of fundamental concepts for the design of RC structural elements, and to present different methods for the design of 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 Contents

UNIT I

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 barsin beams (for limiting crack width) with redistribution – Moment – curvature Relations of Reinforced Concrete sections. Curtailment of tension Reinforcement - code procedure – Numerical examples. **14Hrs**

Self-Study: Analysis and design of Corbels.

UNIT II

Design of Flat slab and Circular slab: proportioning of slab thickness, drop panel and column head, transfer of shear from slab to column, direct design method, equivalent frame method. **12hrs**

Self Study: Design of circular slabs.

UNIT III

Behavior and analysis of compression members and design of PORTAL FRAME: effective length ratios of columns in frames, code charts - modes of failure in eccentric compression, axial load - moment interaction equation, and interaction surface for a biaxially loaded column. Simple portal frames with fixed base- (single bay, single storey). **14Hrs**

Self-Study: Slender columns.

UNIT IV

Design of storage structure (Silos and Bunkers): Introduction, Design of Rectangular & Circular Bunkers, Design of Silos by Janssen's & Airy's theory. **12Hrs**

Self-Study: Design of Rectangular Bunkers.

TEXT BOOKS

1. S. Pillai, DevdasMenon- "Reinforced Concrete Design", 3/ED 3rd Edition
2. Varghese. P.C., "Advanced Reinforced Concrete design", prentice, Hall of India, Neevpeth.

REFERENCES:

1. Krishna Raju – "Advanced R.C. Design", CBSRD, 1986,
2. Park R. and Paulay, T., "Reinforced Concrete Structures", John Wiley and Sons.
3. Karve. S.R. and Shah V.L., "Limit State theory and design of Reinforced Concrete", Pune Vidyarthi GrihaPrakashan, Pune.

Course Learning Outcome

On completion of this course, students are able to

1. Use the concept of redistribution of moments in design
2. Develop equations for the design of compression members of arbitrary sections subjected to general loading.
3. Compute effective length of columns based on structural framing, instead of simplified values. Select proper method for Design of Flat slab systems.

Course Title : Construction Project Management and Structural Optimization			
Course Code: P17MCAD151	**Semester : I**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives

This course aims to

To study the elements of construction project management consisting of Bar charts, Miles stone charts and Network diagrams and also Economics studies, cost models cost optimization techniques, construction procedure, and resource utilization.

To provide an engineering view of optimization as a tool for design. The course will also concentrate on the mathematical and numerical techniques of optimization as applied to structural engineering problems.

Course Contents

UNIT-I

Management: Definition, concept of management, objectives, advantages, limitations and stages of planning. Preparation of construction schedules, uses, advantages, classification of scheduling. Methods of scheduling: Bar chart and miles stone chart, development of bar chart, short comings of bar charts and remedial measures. Milestone charts, Job layout, work breakdown structures. Line of balance technique, elements of quality, quality assurance techniques. **12Hrs**

Self-Study: objectives of management, Principles, objectives and advantages of planning.

UNIT-II

Project management through networks: Definition. Terms and definitions, dummy activities, illustrative examples. Program evaluation and review techniques (PERT): introduction, t_m to t_p time estimates, earliest expected time(T_E), latest allowable occurrence time(T_L), combined T_E and T_L , slacks , critical path , probability of completion time for a project, illustrative examples. CPM: Earliest event time, latest event time, activity time, float, critical activity, illustrative examples. **10Hrs**

Self-Study: objectives of network techniques, types of network.

UNIT-III

Economics of project management: Economics studies, break-even analysis. CPM: Cost model-, slope of direct cost curve, total project cost and optimum duration, controlling the network for cost optimization. CPM Updating: Updating process. Data required for updating, steps in process of updating. Resource allocation: resource usage profiles: histograms, resources smoothing, resource leveling and problems. **10Hrs**

Self-Study: Project cost, indirect project cost, direct project cost, steps in time-cost optimization and problems, when to update-problems.

UNIT-IV

Transportation problems: Formulation of transportation problem as LPP. North-West corner rule, column minima method, Vogel's approximation method, u-v method, stepping stone method, optimality test, degeneracy in transportation problem, unbalanced transportation problem. **10Hrs**

Self Study: General mathematical formulation.

UNIT-V

Linear programming: Formulation of linear programming models, Standard form of linear programming problem, Computational details of the Simplex algorithm, simplex method, M – Technique and Two phase method, revised simplex method. **10Hrs**

Self-Study: Graphical solution of two variables problems.

TEXT BOOKS:

1. Dr. B C Punmia and Khandelwal, "Project Planning and Control with PERT and CPM" Laxmi publications Pvt.Ltd.
2. S Seethraman "Construction Engineering and Management" 2nd edition, Umesh Publications, Delhi.
3. Hamdy A Taha "Operations Research an introduction", Micro print Pvt.Ltd.

REFERENCES:

1. Peurifoy R L "Construction Planning, Equipment and Methods", McGraw Hill publications.
2. Srisanth L S "Pert and CPM", East West Press Pvt, Ltd. New Delhi.

Course Outcome (CO)

Student will be able to:

1. Apply the knowledge and understanding the construction project management
2. Explain PERT and CPM method.
3. Define engineering economics and resource allocation.
4. Analyze transportation problems through various methods.
5. Analyze standard, simplex and revised simplex method problems.

Course Title : Application of AI and Expert Systems in Structural Engineering			
Course Code: P17MCAD152	**Semester: I**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

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 acknowledge-specific domain to render advice or make recommendations, much like a human expert would.

Course Content

UNIT I

Artificial Intelligence: Introduction: AI – Applications fields, defines 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. **10 Hrs**

Self-study: matching control knowledge.

UNIT II

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. **10 Hrs**

Self-study: Programming in LISP.

UNIT III

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. **10 Hrs**

Self-study: Rule value approach.

UNIT IV

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. **12 Hrs**

Self-study: Shafer theory.

UNIT V

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 Engg. Expert system shells. **10 Hrs**

Self-study: Neural Networks: An introduction– their possible applications in Civil Engineering.

TEXT BOOKS:

1. Adeli, H., "Expert Systems in Constructions and Structural Engg", Chapman &Hall, New York
2. Patterson D W, "Artificial Intelligence and Expert Systems", Prentice-Hall, New Jersy.

REFERENCES:

1. Rich, E. and Knight K. "Artificial Intelligence", TMH, New Delhi.
2. Rolston, D.W., "Artificial Intelligence and Expert Systems" McGraw Hill, NewYork.
3. Nilsson, N.J., "Principals of Artificial Intelligence", Narosa., New Delhi.

Course Learning Outcome (CLO)

On completion of this course, students are able to

1. Use expert systems to achieve fairly high levels of performance in task areas which require a good deal of specialized knowledge and training.
2. Develop expert systems to perform tasks which are physically difficult, tedious, or expensive to have a human perform.

Course Title : GROUND IMPROVEMNET TECHNIQUES			
Course Code: P17MCAD161	**Semester : I**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This Course aims to

1. Study and understand the concepts of ground improvement techniques, mechanical modification and chemical modification for different types of soil.
2. Study the concepts of grouting and geosynthetic.

Course Contents

UNIT-I

Ground Improvement: Definition, Objectives of soil improvement, classification of ground improvement techniques, Factors to be considered in selection of best soil improvement

technique, mechanical modification, compaction, principle of densification, field compaction, shallow and deep compaction. **10Hrs**
Self-Study: effect of compaction on engineering properties of soil,

UNIT-II

Hydraulicmodification: Definition,aim,principle,techniques,lowering of water table, design of dewatering system, preloading, vertical drain, sand drains. **10Hrs**
Self-Study: electro-kinetic dewatering.

UNIT-III

Chemical modification-Definition, aim and methods, cement stabilization, stabilization using flyash, lime stabilization bitumen, tar, asphalt in stabilization**.**
Grouting-Introduction, Chemicals and materials uses, types of grouting, grouting procedure, applications of grouting, anchors, rock bolt. **10Hrs**
Self-Study: soil nailing.

UNIT-IV

Reinforced earth-Introduction, basic mechanics of reinforced earth of soil reinforcement, reinforced earth retaining wall, wall with reinforced backfill, reinforced earth slab. **10Hrs**
Self-Study: sheet piles.

UNIT-V

Geosynthetics- Introduction, Geo-synthetic types, properties of geo-synthetics. **10Hrs**
Self-Study: application of geo-synthetics.

TEXT BOOKS:

1. Ground Improvement Techniques- Purushotham Raj P (1999),Laxmi Publications, New Delhi.
2. Engineering principles of ground modification-Manfred Hausmann (1990) -McGrawHill Pub.co., NewYork.

REFERENCES:

1.Constrution and geotechnical method in Foundation engineering-Koernar.R.M(1985), Mac Graw Hill Pub.co., NewYork.
2. Methods of treatment of unstable ground-Bell,F.G(1975),Butterworths, London
3. Soil Stablisation: Principles and practice-Ingles.c.g and Metcalf J.B.(1972),Butterworths, London

Course Outcome

After learning all the units of the course, the student is able to

1. Select the best soil improvement technique based on soil condition.
2. Explain different techniques of hydraulic modification.
3. Explain different techniques of chemical modification and grouting.
4. Explain reinforced earth technique and its applications.
5. Understand the properties of geosynthetic material and fibre properties.

Course Title : Advanced Mechanics Of Materials			
Course Code: P17MCAD162	**Semester : I**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

The primary objective of this course is to learn classical methods in advanced mechanics of materials. Focus will be given to the use of general relationships in the solution of mechanics problems.

Course Contents

UNIT– I

Torsion: Torsion of straight bars of elliptic cross section – St.Venant's semi-inverse method and Prandtl's function approach – membrane analogy – torsion of a bar of narrow rectangular cross section torsion of thin walled open cross sections. **10Hrs**

Self-Study: torsion of thin walled tubes.

UNIT – II

Curved beams: Introduction, circumferential stress in a curved beam, radial stresses in curved beams, correction for circumferential stresses in curved beams having I, T, or similar cross sections, deflections of curved beams, statically indeterminate curved beams. **10Hrs**

Self-Study: Closed ring subjected to a concentrated load.

UNIT – III

Shear center for thin-wall beam cross sections: Definition of shear center in bending approximations employed for shear in thin-wall beam cross sections, shear flow in thin-walled beam cross sections, shear center for singly symmetric and unsymmetrical sections. Nonsymmetrical bending of straight beams: symmetrical and nonsymmetrical bending, bending stresses in beams subjected to nonsymmetrical bending. **12Hrs**

Self-Study: deflections of straight beams subjected to nonsymmetrical bending.

UNIT – IV

Beams on elastic foundations: General theory, infinite beam subjected to concentrated load, boundary conditions, infinite beam subjected to a distributed load segment, semi-infinite beam with different end conditions subjected to concentrated load. **10Hrs**

Self-Study: semi-infinite beam with moment at its end - short beams.

UNIT-V

Structures subjected to out of plane loading: Analysis of simple bents, frames, grids and beams circular in plan – cantilever beams, semicircular continuous beams with three equally spaced supports. **10Hrs**

Self-Study: circular beams with different number of equally spaced supports.

TEXTBOOKS:

1. Arthur P. Boresi and Omar M. Sidebottom: "Advanced Mechanics of Materials", Fourth Edition,John Wiley & Sons, 1985

2. James M. Gere and S. P. Thimoshenko: "Advanced Mechanics of Materials", Second Edition,
CBS Publishers, New Delhi, 2000.

REFERENCES:

1. Ugural.A.C. and Fenster.S.K, "Advanced Strength of material and Applied Elasticity", Arnold Publishers, 1981.
2. Junnarkar.S.B., "Mechanics of Structures", Volume - III, Charotar Publications, Anand.

Course Outcome (CO)

On completion of this course, students are able to

1. Apply knowledge of mathematics, science, and engineering related to shell theory.
2. Use finite element methods in shell analysis and design, ability to design special and long span roofs.

Course Title : CAD LAB- I			
Course Code: P17MCADL17	**Semester : I**	**L-T-P-H: 0 – 0 –3 -3**	**Credits:02**
Contact Period : Lecture :39Hr		**Weightage :CIE:50% SEE:50%**	

Course learning objectives (CLO)

In professional design scenario, it is very important to use industry standard software's in a proficient manner besides knowing the theoretical concepts of structural analysis. The programming exercises helps in understanding the implementation of algorithms in to a program.

Course Contents

Introduction to Stad Pro.: Modeling –Property-Load case –Supports-Analyse the model - analysis output-Design Applications using Stad Pro.:

1. Structural Analysis of 2D and 3D Trusses
2. Structural Analysis of Continuous Beams for different types of loadings and support conditions
3. Structural Analysis and Design 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.

Course Learning Outcome

On successful completion of this course, students are able to

1. Use industry standard software in a professional set up.
2. Understand the elements of finite element modelling, specification of loads and boundary condition, performing analysis and interpretation of results for final design
3. Develop customized design automation tools

TEXT BOOKS:

1. .Bathe. K.J, "Finite element procedures in Engineering Analysis".PHI. New Delhi
2. .Krishnamoorthy C.S, "Finite Element Analysis", Tata-McGraw-Hill Publishing Company

REFERENCES:

1. STAD-PRO Manual and instructions

Course Title : Analysis of Plates			
Course Code: P17MCAD21	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

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. Use finite Difference methods in plate analysis.

Course Content

UNIT – I

Bending of plates: Introduction - Slope and curvature of slightly bent plates – relations between bending moments and curvature in pure bending of plates – Differential equation for cylindrical bending of long rectangular 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). **12Hrs**

Self-study: Strain energy in pure bending & centrally loaded clamped circular plate.

UNIT – II

Simply supported rectangular plates: Differential equation of the deflection surface – boundary conditions. Simply supported rectangular plates subjected to harmonic loading. Navier's solution for simply supported plate subjected to udl, patch load and point load.

10 Hrs

Self-study: hydrostatic pressure

UNIT – III

Rectangular plates with different Edge conditions: Bending of simply supported rectangular plates subjected to udl, Bending of rectangular simply supported plate subjected to a distributed moments at a pair of opposite edges, Bending of rectangular plates 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 **10 Hrs**

Self-study: Bending of rectangular plates subjected to udl with all edges built-in

UNIT – IV

Large Deflections of Plates: Approximate formulae for uniformly loaded circular plate, exact solution for circular plate with clamped edge. **10 Hrs**

Self-study: Exact solution for rectangular plates with simply supported edges.

UNIT – V

Finite Difference approach: Application of finite difference technique for the analysis of isotropic rectangular plates subjected to uniformly distributed lateral loads. **10Hrs**

Self-study: Use of standard computer packages for the analysis of Plates.

TEXT BOOKS:

1. Timoshenko and Krieger, "Theory of Plates and Shells", McGraw-Hill International Book Company.
2. Chandrashekara K, "Theory of Plates", University Press
3. Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, John Wiley and Sons, New York

REFERENCES:

1. Szilard. R, "Theory and analysis of plates-classical and numerical methods" Prentice Hall.
2. Ugural A C, "Stress in Plates and shells", McGraw-Hill International Book Company.
3. Bathe.K.J, "Finite element procedures in Engineering Analysis". PHI. New Delhi

Course Outcomes

After learning all the units of the course, the student is able to

1. Apply knowledge of mathematics, science, and engineering related to plate theory.
2. Obtain the solution for thin rectangular plates subjected to different types of loadings under different boundary conditions using various method- small deflections.
3. Analyse circular plates subjected to various lateral loadings and also moments under different boundary conditions-small deflections.
4. Apply the principles of FDM to solve problems in continuum mechanics.
   Analyse thin plates with large deflections.

Course Title : SEISMIC RESISTANT DESIGN OF STRUCTURAL SYSTEMS			
Course Code: P17MCAD22	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

This course integrates information from various engineering and scientific disciplines in-order to provide a rational framework for the design of earthquake-resistant structures. The focus of the course is on building structures. The course emphasizes on understanding the fundamental factors that influence and control the response of such structures.

Course Content

UNIT – I

Seismic Hazard Assessment: Engineering Seismology – Definitions, Introduction to seismic hazard, earthquake phenomenon –seismotectonics and seismic zoning of India — Characteristics of strong Earthquake motion - Estimation of earthquake parameters – Microzonation. **12Hrs** ***Self***

Study: Lessons learnt from past earthquakes, Earthquake monitoring and seismic instrumentation

UNIT – II

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 – (IS1893 – 2002). – Effect of earthquake on different types of structures. **10 Hrs**

Self-Study: Liquefaction of soils, Pushover Analysis.

UNIT – III

Concepts of Earthquake Resistant Design: Structural systems / Types of buildings – causes of damage – planning consideration / architectural concept (IS 4326 – 1993) –philosophy and principle of earthquake resistant design – guidelines for earthquake resistant design.

10 Hrs

Self-Study: Do's and Don'ts for protection of life and property

UNIT – IV

Earthquake Resistant Earthen and Masonry Buildings: Earthquake resistant low strength masonry buildings, strength and structural properties of masonry –lateral load - design considerations. **10Hrs**

Self-Study: Tips for the earthquake resistant masonry structures.

UNIT – V

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

Self-Study: Worked examples.

TEXT BOOKS:

1. PankajAgarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2006.
2. S K Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 2007.

REFERENCES:

1. Chopra, A.K. "Dynamics of structures", Prentice-Hall of India Pvt. Ltd. New Delhi.
2. Ghose, S.K. "Earthquake Resistance Design of Concrete Structures", SDCPL –R&D Center –New Mumbai 73.
3. Jaikrishna et al. "Elements of Earthquake Engineering", South Asia Publishers, New Delhi

Course Learning Outcome

On completion of this course, students are able to

1. Establish a performance-based framework to assess seismic response
2. Select appropriate structural systems, configurations and proportions,
3. Use design procedures capable of reliably achieving specified performance goals.

Course Title : Structural Stability Analysis – Classical and FE Approach			
Course Code: P17MCAD23	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

To provide a detailed treatment of buckling characteristics of various structural elements, and to present different methods to solve stability problems including integration with finite element procedures.

Course Content

UNIT – I

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 **10Hrs**

***Self-Study*:** fixed pinned columns.

UNIT – II

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 column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load.

10Hrs

Self-Study: Columns subjected to non-conservative follower and pulsating forces.

UNIT – III

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 discretised column with different boundary conditions – Evaluation of critical loads for a discretised (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)- **10 Hrs**

Self-Study: Symmetrical single bay Portal frame.

UNIT – IV

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. **12 Hrs**

Self-Study:– Other cases of buckling of rectangular plates.

UNIT – V

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. **10 Hrs**

Self-Study: Uniformly compressed in the direction parallel to those sides.

TEXT 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", Blaisdall Publication
3. Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, John Wiley and Sons, New York

REFERENCES:

1. Rajashekaran. S, "Computational Structural Mechanics", Prentice-Hall, India.
2. Ray W Clough and J Penzien, "Dynamics of Structures", 2nd Edition, McGraw-Hill, New Delhi.

Course Outcome

On completion of this course, students are able to

1. Understand the concepts of stability; types of buckling
2. Compute buckling loads of columns; elastic buckling of frames and Plates

Course Title : RELIABILITY ANAYSIS AND DESIGN OF STRUCTURAL ELEMENTS			
Course Code: P17MCAD241	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course learning objectives:

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 Contents

UNIT – I

Concept of variability in design parameters, applications of statistical principles to deal with randomness in basic variables, statistical parameters and their significance. Characteristic strength and characteristic load, probability modeling of strength, geometrical dimensions, material properties and loading. Description of various probability distributions – Binomial, Poisson, Normal, Log-Normal, Beta, Gama, distributions. **10Hrs**

***Self-Study*:**Worked examples

UNIT –II

Testing of goodness – of – fit of distributions to the actual data using chi-square method and K.S Method. Statistical regression and correlation using least – square. Statistical Quality control in Civil Engineering, - Application problems. **12 Hrs**

***Self-Study*:** Worked examples on chi-square method.

UNIT –III

Mean value method and its applications in structural designs, statistical inference, comparison of various acceptance and rejection testing. **10 Hrs**

***Self-Study*:** Worked examples.

UNIT –IV

The Random variable, operation on one Random variable, expectation, multiple random variables, reliability distributions – basic formulation, the hazard function,. Introduction to safety assessment of structures – reliability analysis using mean value theorem – I, II and III order Reliability formats. **10Hrs**

***Self-Study*:** Weibull distribution.

UNIT – V

Simulation techniques, reliability index - reliability formulation in various limit states, reliability based design, application to design of RC, PSC and steel structural elements.

10Hrs

***Self-Study*:** Worked examples.

TEXT BOOKS:

1. R.Ranganthan, "Reliability Analysis and Design of Structures", Tata McGraw Hill publishing Co. Ltd., New Delhi.
2. L S Srinath , "Reliability Engineering", East West Press

REFERENCES:

1. John B.Kennedy and Adam M.Neville, "Basic Statistical Methods for Engineers and Scientists", Harper and Row Publishers, New York.
2. 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.

Course Outcomes:

On completion of this course, students are able to

- Understand the concepts and techniques of reliability and probability distributions
- Define safety format or failure surface for a given actions and response along with their Statistics.
- Compute reliability index, for the given design details
- Arrive at mean value of a dominant design parameter for the target reliability index.
- Use simulation techniques to arrive at the statistics of design variables

Course Title : ADVANCED STRUCTURAL DYNAMICS			
Course Code: P17MCAD242	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

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 Contents

UNIT-I

Analysis of Dynamic Response of MDOF Systems by Direct Integration: Basic concept of direct integration methods – central difference methods - Wilson Method –Newmark Method –Stability . **10Hrs**

***Self-Study*:**Accuracy of direct integration method.

UNIT-II

Non-liner Structural Response – Classification of non-linear analysis – Systems with nonlinear characteristics – formulation of incremental equations of equilibrium – numerical solution of nonlinear equilibrium equations for single degree freedom systems - liner acceleration step by step method, elastoplastic behaviour, algorithm for the step by step solution for elastoplastic SDOF system. Newmark Method – Wilson Method Response spectra – construction of a response spectrum, response spectrum for support disturbance, tripartite response spectra, response spectra for inelastic design. **10Hrs**

Self-Study:Non-liner Response of MDOF Systems – incremental equation of motion, Wilson method.

UNIT-III

Introduction to Random Vibration – Random functions, normal and Rayleigh's distribution, correlation, Fourier transform, spectral analysis, spectral density function. **10Hrs**

Self-Study:Response to random excitation

UNIT-IV

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 **10Hrs**

Self-Study:Strain rate effects – approximate solution technique for SDOF systems.

UNIT-V

Basic Concepts of Water Waves – Linear wave theory – dispersion equations – wave particle velocities- wave energies. Non-linear waves- Stokes wave theory – Cnoidal 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. **12Hrs**

Self-Study:Wave forces on vertical walls – wave forces on a low vertical wall - wave forces on a rectangular structure.

TEXT 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 New Delhi.

REFERENCES:

1. Ray W Clough and J Penzien, "Dynamics of Structures", 2nd Edition, McGraw-Hill, New Delhi. 1989.

2. 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 Outcome (CLO)

On completion of this course, students are able to

Apply knowledge of mathematics, science, and engineering related to vibration theory.

Course Title : ADVANCED DESIGN OF STEEL STRUCTURES			
Course Code: P17MCAD251	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

Understand 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**.**

Course Content

UNIT – I

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. **13Hrs**

Self-Study: Design Examples.

UNIT – II

Members Subjected to Combined Forces:

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, effective length of columns-, methods in IS: 800 – Examples. **13Hrs**

Self-Study: Design of Purlins.

UNIT – III

Steel Beams with Web Openings: Shape of the web openings, practical guide lines, and force distribution and failure patterns, analysis of beams with perforated thin and thick webs, design of castellated beams. **13Hrs**

Self-Study: Vierendeel girders.

UNIT – IV

Cold formed steel sections: Techniques and properties, advantages, typical profiles, Stiffened and un-stiffened elements, Local buckling effects, effective section properties, IS: 811 code provisions- numerical examples, beam design, column design. **13Hrs**

Self-Study

Tubular sections: Design principles of rounded tubular structures, permissible stresses, design of tension members, compression members and beams, connections.

NOTE: Two questions to be set from each unit of 25 marks, Answer one question from each unit is compulsory.

TEXT BOOKS:

1. N. Subramanian, "Design of Steel Structures", Oxford,IBH.
2. Duggal.S.K.,"Design of Steel structures". Tata McGraw-Hill Education, 2000.

REFERENCES:

1. IS 1641, 1642,1643
2. IS 800: 2007, IS 811

INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org

Course Outcome (Co)

On completion of this course, students are able to

1. Appreciate the behaviour of laterally unsupported beams and the factors affecting it behaviour so as to be able to relate them to the design concepts involved with laterally unsupported beams.
2. Apply the knowledge of structural members subjected to combined forces (axial and Bending moments) in analysing and designing such members.
3. Understand the influence of web openings on the structural behaviour of beams and to extend this concept for the design of castellated beams and Vierendeel girders.
4. Appreciate the behaviour and design concepts involved with light gauge steel structures and tubular structures.
5. Subramanian, "Design of Steel Structures", Oxford, IBH.l.S.K., "Design of Steel structures". Tata McGraw-Hill Education, 2000.

Course Title : DESIGN OF STRUCTRAL SYSTEMS IN BRIDGES			
Course Code: P17MCAD252	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

This course constitutes a transition from general building systems topics to specific applications within the context of structural engineering. It provides the foundation for advanced design and bridge analysis and integrates the finite element approach.

Course Contents

UNIT I

Introduction to bridge engineering: Bridge aesthetics and proportioning. Bridge geometry. Conceptual design of various structural forms. Foundations with or without piles; abutments, retaining walls and wing walls; columns and cap beams; bearings. **10Hrs**

Self-Study: Historical background of bridges and types

UNIT II

Loads on bridges (IRC6-2010) : Class 70 R, Class AA, Class A , Class B , tracked vehicle, wheeled vehicle, impact, wind, water currents, longitudinal forces: acceleration, breaking and

frictional resistance, centrifugal forces, temperature, seismic forces, snow load, collision loads. Load combinations. **10Hrs**

Self-Study: load combinations.

UNIT III

Design of Elevated Bridges: Solid slab bridges, Simple Girder bridges, PSC Girder Bridges **10Hrs**

Self-Study: Design examples

UNIT IV

Design of Underpass - Box Culverts **12Hrs**

Self-Study: Design examples

UNIT V

FE Concepts: Discrete and continuum models of bridge deck – spine, grillage, surface models, bridge piers, support and loading conditions. **10Hrs**

Self-Study: Soil-structure interaction

TEXT BOOKS:

1. Krishna Raju N "Design of Bridges," Oxford, IBH Publications New Delhi.
2. Johnson Victor, "Essential of Bridge Engineering," Oxford, IBH Publications, New Delhi
3. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.

REFERENCES:

1. IRC112 - 2011 "Code of Practice for Concrete Road Bridges and Railway Board Codes"
2. Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", Prentice Hall of India, 2004.
3. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.

Course Learning Outcome

On completion of this course, students are able to

Design an elevate bridges,
Design an underpass,
Understand concept of bridge engineering
Explain FE concepts.

Course Title : Advanced Foundation Design			
Course Code: P17MCAD261	**Semester : II**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Prerequisite:

Geo-technical engineering

Course learning objectives

1. To know the bearing capacity of soil and design parameters of foundations.
2. To learn the design of pile foundation
3. To learn the design of special foundations.
4. To learn the design of machine foundation

Course Contents

UNIT-I

Bearing capacity of soils: Generalized bearing capacity equation, settlement of shallow foundations-elastic and consolidation settlements, settlement estimation from penetration tests, settlement tolerance, allowable bearing pressure

Self-Study: Field tests for bearing capacity and settlement estimation. **10Hrs**

UNIT-II

Factors influencing selection of depth of foundation, subgrade reaction, Winkler hypothesis and beams on elastic foundation, soil line method, Design of foundation by finite difference method.

Self-Study: Design parameters for substructures **10Hrs**

UNIT-III

Pile foundations-classification of pile foundation, ultimate load capacity of piles, pile settlement, analysis of single pile and pile group, under reamed pile, pile load tests, design examples

Self-Study: General consideration of design **10Hrs**

UNIT-IV

Special foundations-foundation for transmission line towers-necessary information, forces on tower foundation , general design criteria, choice and type of foundations, design procedure and design problems. Soil-structure interaction in frame structures, foundations on expansive soils.

Self-Study: geotechnical failure of foundations during earthquake-earth quake resistant design of shallow foundations, liquefaction and remedial measures. **10Hrs**

UNIT-V

Elements if soil dynamics and design of machine foundations- IS 2974: Part I to IV machine foundation system, block foundation, frame foundation, DOF of rigid block foundation.

12Hrs

Self-Study: linear elastic spring, elastic half space Analog, and vibration isolation system.

TEXT BOOKS:

1. Varghese P.C., “Foundation engineering”, Prentice hall of India, New Delhi
2. Soil Mechanics and Foundation Engineering- Murthy V.N.S. (1996), 4th Edition, UBS Publishers and Distributors, New Delhi.
3. Foundation Analysis and Design- Bowles J.E. (1996), 5th Edition, McGraw Hill Pub. Co. New York.

REFRENCES:

1. Das B.M., "Principles of foundation Engineering", Thomson Brooks/ Cole Publishing Company, Singapore
2. Swamy Saran, "Analysis and Design of Substructures", 5th edition, Oxford and IBH Publishing co., Pvt, Ltd, New Delhi,1996.
3. Dr.B.C. Punmia, "Soil Mechanics and Foundation Engineering". Laxmi Publications,113, Golden House, Darya Ganj, New Delhi - 110002, India

Course Outcome (CO)

After learning all the units of the course, the student is able to

1. Define the proportioning of shallow foundation.
2. Describe pile foundation
3. Describe special foundation
4. Define and design foundations on expansive soil
5. Describe machine foundation

Course Title : DESIGN OF TALL STURCTURES			
Course Code: P17MCAD262	**Semester : III**	**L-T-P-H: 4 – 0 – 0 - 4**	**Credits:4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weightage :CIE:50% SEE:50%**	

Course learning objectives

To understand the behaviour of high raised buildings under different loads.

Course Contents

UNIT –I

Introduction The Tall Building in the Urban Context - The Tall Building and its Support Structure - Development of High Rise Building Structures. 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. **10Hrs**

Self-Study:General Planning Considerations

UNIT –II

The vertical structure plane Dispersion of Vertical Forces- Dispersion of Lateral Forces - Optimum Ground Level Space - Shear Wall Arrangement. 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 –Multistorey Box Systems. **10Hrs**

Self-Study: Behaviour of Shear Walls under Lateral Loading.

UNIT – III

Common high-rise building structures and their behaviour 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. **10Hrs**

Self-Study: The Counteracting Force or Dynamic Response.

UNIT – IV

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.

10Hrs

Self-Study: The Hollow Tube Structure.

UNIT – V

Other high-rise building structure Deep - Beam Systems -High-Rise Suspension Systems - Pneumatic High -Rise Buildings - Space Frame Applied to High - Rise Buildings. **10Hrs**

Self-Study: Capsule Architecture.

TEXT BOOKS:

1. Wolfgang Schuller - " High - rise building Structures", John Wiley and Sons, New York 1976.
2. Bryan Stafford Smith and Alex Coull, " Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc., 1991.

REFERENCES:

1. Coull, A. and Smith, Stafford, B. " Tall Buildings ", Pergamon Press, London, 1997.
2. LinT.Y. and Burry D.Stotes, " Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994.
3. Lynn S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1996.
4. Taranath.B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill,1998.

Course Outcome

On successful completion of this course, students are able to understand and explain:

1. Develop High Rise Building Structures,
2. Dispersion of Lateral Forces,
3. Approximate Design of Rigid Frame Buildings,
4. Space Frame Applied to High Rise Buildings and Capsule Architecture.

Course Title : CAD LAB-II			
Course Code: P17MCADL27	**Semester : II**	**L-T-P-H: 0 – 0 –3-3**	**Credits:02**
Contact Period : Lecture :39Hr		**Weightage :CIE:50% SEE:50%**	

Course learning objectives (CLO)

In professional design scenario, it is very important to use industry standard software's in a proficient manner besides knowing the theoretical concepts of structural analysis. The programming exercises helps in understanding the implementation of algorithms in to a program.

Course Contents

Introduction to ETABS: Modeling - Load case - Analyse the model - analysis output-Design

Applications using ETABS:

1. Soil - Structure Interaction Problems.
2. FE Analysis of Framed structures due to Seismic forces using modal dynamics.
3. FE Analysis of Plane Stress and Plane Strain Problems.
4. Flexural Behaviour of Slab Panels with different aspect ratio and boundary conditions.

Program Development for Matrix operations- Multiplication, Transpose, Inverse, Gauss elimination and Gauss-Siedel, Cholesky methods for solution of linear system of equations.

Course Learning Outcome

On successful completion of this course, students are able to

1. Use industry standard software in a professional set up.
2. Understand the elements of finite element modelling, specification of loads and boundary condition, performing analysis and interpretation of results for final design.
3. Develop customized design automation tools.

TEXT BOOKS:

1. .Bathe. K.J, "Finite element procedures in Engineering Analysis".PHI. New Delhi
2. .Krishnamoorthy C.S, "Finite Element Analysis", Tata-McGraw-Hill Publishing Company

REFERENCES:

2. ETABS Manual and instructions