Programme: M.Tech

Civil Engineering

Scheme and Syllabi

w.e.f. Academic Session 2020-21

BUEST

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

MASTERS OF TECHNOLOGY (STRUCTURE ENGINEERING)

Semester-I						
Sr.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	PCE- 101	Advanced Structural Analysis	4	0	0	4
2	PCE- 102	Advanced RCC Design	4	0	0	4
3	PCE- 103	Theory of Plate and shells	4	0	0	4
4	PCE- 104	Advance Bridge Engineering	4	0	0	4
5	PCE- 105	Advanced Material Testing Lab	0	0	2	1
6	PCE-106	Project I	0	0	6	3
		Total	16	0	8	20
		Total Contact Hours:	24			
Semester-II						
Sr.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	PMG-151	Research Methodology	4	0	0	4
2	PMA-151	Advanced Optimization Techniques	4	0	0	4
3	PCE- 151	Plastic Analysis and Design of steel structures	4	0	0	4
4	PCE- 152	Structure Dynamics & Earthquake Analysis	4	0	0	4
5	PCE-153	Project II	0	0	8	4
		Total	16	0	8	20
		Total Contact Hours:	24			

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Semester-III						
Sr.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	PCE- 201	Finite Element Method in Structural Analysis	4	0	0	4
2	PCE- 202	Advance Foundation Design	4	0	0	4
3	PCE-203	Composite Material	4	0	0	4
4	PCE-204	Advanced Civil Software Lab	0	0	2	1
5	PCE-205	Pre-Dissertation	0	0	6	3
		Total	12	0	8	16
		Total Contact Hours:	20			

Semester-IV						
Sr.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	**PCE-XXX**	**Department Elective-I**	4	0	0	4
2	PCE-260	Dissertation/Thesis	0	0	0	20
		Total	4	0	0	24
		Total Contact Hours:	4			

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Departmental Elective-I (Semester-IV)										
S.NO	**Basket 1**		**Basket 2**		**Basket 3**		**L**	**T**	**P**	**C**
	Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**				
1	PCE-251	High Rise Buildings	PCE-253	Rehabilitation of Structures	PCE-255	Advanced Press-stressed concrete	4	0	0	4
2	PCE-252	Modern Concrete Technology	PCE-254	Industrial Structure	PCE-257	Wind effects on structures	4	0	0	4

Total Credit of the course

Semester I	Semester II	Semester III	Semester IV	Total Credit of the Course
20	**20**	**16**	**24**	**80**

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

General guidelines:

1. If a course is being taught by two or more teachers, they should coordinate among themselves the coverage of course material as well as the internal assessment of the students to maintain uniformity.
2. Each theory course in a semester has been designed for a period of 48-54 lectures. The total number of actual lectures delivered may vary at most by 10 %.
3. The books indicated as references are suggestive of the level of coverage. However, any other standard book may be followed.
4. In specialization courses, new specializations may be added to the list from time to time keeping in view the expertise available in the Department and/or the emergence of new frontier areas of specialization.
5. New experiments in the Laboratory Courses may be added from time to time.

PCE-106 : Project-I

The project work aims to define the steps students are going to take to answer their research questions or a specific list of tasks needed to accomplish the goals of the project. It emphasizes how aims are to be accomplished. Must be highly focused and feasible. Address the more immediate project outcomes. Make accurate use of concepts. Must be sensible and precisely described. Should read as an 'individual' statement to convey your intentions

PCE-153 :Project-II

This course makes a unique component of the curriculum. It is mandatory for every student to deliver a seminar of approximately 40 minutes duration on a topic as decided by the departmental seminar committee. Each and every student would get an opportunity to express his/her level of understanding of various concepts and this, apart from strengthening the subject knowledge, would help students in developing better communication skills and higher level of confidence.

PCE 205 :Pre-Dissertation

The aim of pre-thesis is to help students frame a question suitable for the senior thesis, develop a working hypothesis, and do preliminary research that will benefit them in the final thesis (PCE 260). To enable the students to clarify their topic of research and establish its importance.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

PCE 260: Dissertation/ Thesis

The main goal of this thesis to research on the topic of interest of the student and obtaining answers to research questions or testing the research hypothesis. The student becomes aware of the current trends in the field of civil engineering. The student specifies what will be done, how it will be done and for what purpose.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Objective of the course: M.Tech. CE

The M. Tech. programme in Structure Engineering is a Mastersprogramme offered to students who are interested in advanced learning and research in any area of civil engineering.

The programme is a 80-credit degree programme, which is usually spread over 4 semesters for a full-time student. About two-thirds of the credits involve coursework, and the remainder consists of project work.

The emphasis is on conducting original research and writing a thesis (individually) that reports these results. The programme is flexible enough to allow a student to specialize in any topic of interest by taking elective courses and working on a research project in that area.

Our Master of Technology (CE) programme is a versatile degree that provides students with the optimal balance between a defined sequence of study and flexible course options.

The main course objectives of M.Tech. - CE are:

- Practice with an expertise in academics, entrepreneurship, design and development in computing technology, or research in a specialized area of Structure Engineering to pursue higher studies.
- Exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraints.
- Ability to communicate the findings or express innovative ideas in an effective manner with an awareness of professional, social and ethical responsibilities.
- Motivate the students towards research.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

SEMESTER-I

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCE STRUCTURAL ANALYSIS
Course Code:- PCE-101

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction to structure indeterminacy:

- Static indeterminacy
- Kinematic indeterminacy

Structural Design Methods:

- Stiffness approach
- Flexibility approach

Module 2: Introduction to Element Approach

- Member stiffness matrix
- Local or Member co-ordinate system
- Global or Structural co-ordinate system
- Rotation of axes

Module 3:Application of Stiffness and Flexibility matrices:

- Beams
- Plane Frames
- Plane Truss
- Effects of temperature change
- Support displacements

Module 4: Application of software packages.

- Introduction to SAP
- STAAD Analysis
- Development of software codes for simple structural analysis problems using MATLAB

Module 5: Plastic Analysis:

- Concept of Limit load analysis,

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Upper and lower bonds,
- Plastic analysis of beams and multi-storey frames using mechanism method

Reference Books:

1. Gere, G. M. and Weaver, Jr. W., Matrix Analysis of Framed Structures, CBS Publishers (1987).
2. McCormac, J. C. & Nelson, J. K., Structural Analysis: A Classical and Matrix Approach, Iyengar, N.G.R., Elastic Stability of Structural Elements, Macmillan India Ltd (1980).
3. Pandit& Gupta, Matrix Analysis of Structures, Tata McGraw Hill Publications (2003)
4. Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New
5. York, 1966.
6. Kanchi, Matrix Structural Analysis, Wiley Eastern Ltd., Newdelhi 1981.
7. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India. New Delhi.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCED RCC DESIGN
Course Code:- PCE-102

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction to Framed structures

- Member stiffness
- Analysis for vertical and lateral loads
- Torsion in buildings,
- Ductility of beams, design and detailing for ductility
- Reinforcement detailing in various components

Module 2: Design of Special Structural Elements

- Domes
- Deep Beams
- Brackets or Corbels
- Beam-column joints.

Module 3: Flats Slabs

- Advantages and disadvantages
- Structural behaviour
- Preliminary design
- Basic action of two-way slab
- Determination of minimum thickness of slab
- Direct Design Method
- Equivalent frame analysis

Module 4: Water Tanks

- Estimation of Wind and earthquake forces
- Design considerations
- Underground and overhead tanks
- Design of Rectangular tanks

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Design of cylindrical tanks
- Design of Intze tanks

Silos and Bunkers:

- Various theories of design
- Bunkers with sloping bottoms and with high side walls.

Module 5: Yield line Theory:

- Basic assumptions
- Methods of analysis
- Yield line patterns and failure mechanisms
- Analysis of one way and two way rectangular and non-rectangular slabs frame

Reference Books:

1. R. Park and T. Pauley, Reinforced concrete structures, John Wiley and sons
2. A. K. Jain, Reinforced Concrete: Limit State design, Nem Chand and Bros. 1999.
3. J. Krishna and OP Jain, Plain and Reinforced Concrete, Vol. I I, Roorkee, Nem Chand and Bros.
4. H. Nilson, D. Darwin and C0. W. Dolar, Design of Concrete structures, Tata McGrawHill
5. T. Paulay and M.J.N. Priestley , Seismic Design of Reinforced Concrete and Masonry
6. Plain and Reinforced Concrete, Vol.2, Jai Krishna & O.P.Jain, Nem Chand & Bros.,Roorkee.
7. IS 3370-1976(Part I to IV), Indian Standard Code of Practice for Liquid Retaining Structures.
8. IS 456-2000, Indian Standard of Practice for Plain and Reinforced Concrete, IS 1893, 4326 & 13920 Indian Standard Code of Practice for Earthquake Resistant Design of Structures.
9. Punmia, B.C. Reinforced Concrete Structures, Vol II.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- THEORY OF PLATE AND SHELLS
Course Code:- PCE-103

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Pure Bending of Plates

- Slopes and curvatures
- Relations between bending moment and curvature
- Strain energy.

Symmetrical Bending of Circular Plates:

- Differential equation in laterally loaded.
- Differential equation in Polar co-ordinates.
- Uniformly loaded circular plate with or without hole at the centre and with various edge conditions.

Module 2:Rectangular Plates:

- Differential equation of the deflection surface (Small deflection theory only)
- Fourier Series expansion for various types of loads
- Rectangular plates with various loading and edge conditions
- Navier's& Levy's methods

Module 3: Folded Plate Structures:

- Various shapes
- Advantages and Disadvantages
- Structural action of a folded plate structure
- Methods of analysis

Module 4: Shell Structures:

- Classification of shell structures
- Importance of membrane theory of shells,

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Shells in the form of a surface of revolution and loaded un-symmetrically with respect to their axis.
- Cylindrical shells
- Circular cylindrical shell loaded symmetrically with respect to its axis.

Module 5: Analysis and design of Grids

- Various methods of analyzing grids for roofs and bridges.
- Distribution of concentrated loads to various beams of grid floors.

Reference Books:

1. S. Theory and analysis of Plates by Szilard, R.
2. IS. : 2210-1982: Indian Standard Criteria for the Design of R.C.C. Shell Structures and Folded Plates (1982).
3. Jai Krishna and Jain, O.P., Vol.-II, Plain and Reinforced Concrete, Nem Chand and Bros, Roorkee (1983).
4. Ramaswamy, G.S., *Design*Construc. Concrete *Shell* Roofs, CBS Publishers (1986).
5. Timoshenko, S. P. et al, Theory of Plates and Shells, Tata McGraw Hill (1990).
6. Rudolph Szilard, Theory and Analysis of Plates, Prentice Hall, New Jercy 1986.
7. D. P. Billington, Thin shell concrete structures, Mc Graw Hill international, N

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCED BRIDGE ENGINEERING
Course Code:- PCE-104

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction to Bridge Engineering

- Definition and components of bridges
- Introduction to bridge codes
- Economic evaluation of a bridge project
- Hydraulic design of bridges
- Traffic design of bridges

Module 2: Design of deck

- Slab
- Hollow and voided slab,
- Beam and slab
- box girder

Introduction to long span bridges

- Cantilever
- Arch
- Cable stayed bridges
- Suspension Bridges

Methods of construction of Bridge:

- R.C Bridges
- Pre stressed concrete bridges
- Steel bridges

Module 3: Design of substructure

- Piers and abutments of different types

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Analysis and design of foundations
- Deep foundations
- Well foundations Caisson

Module 4:Girder bridge

- Types
- load distribution
- Design

Module 5: Rehabilitation of bridges.

- Inspection
- Maintenance

Reference Books:

1. Bridge Deck analysis by Pama & Gusens

2. Bridge deck behavior by Edward V. Hambly

3. Essentials of bridge engineering by D. Johnson Vector.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCED MATERIAL TESTING LAB
Course Code:- PCE-105

Evaluation Components for Practical Courses (Students are required to perform at least 8 practical mandatorily from the given list of practical)	
Lab Performance	10
Lab file work	10
Viva – Voce	10
Total	**30**

LTP Cr
4 0 0 4

Experiments

- Measurement of heat of hydration of cement.
- Determine the air entrainment of cement concrete mix.
- Half-cell electrical potential method, used to detect the corrosion potential of reinforcing bars in concrete.
- Schmidt/rebound hammer test, used to evaluate the surface hardness of concrete.
- Carbonation depth measurement test, used to determine whether moisture has reached the depth of the reinforcing bars and hence corrosion may be occurring.
- Permeability test, used to measure the flow of water through the concrete.
- Penetration resistance or Windsor probe test, used to measure the surface hardness and hence the strength of the surface and near surface layers of the concrete.
- Cover meter testing, used to measure the distance of steel reinforcing bars beneath the surface of the concrete and also possibly to measure the diameter of the reinforcing bars.
- Ultrasonic pulse velocity testing, mainly used to measure the sound velocity of the concrete and hence the compressive strength of the concrete.

Reference Books:

1. Krishnaraju, N., Advanced Concrete Technology, CBS Publishers, 1985.
2. Nevile, A.M., Concrete Technology, Prentice Hall, Newyork, 1985.
3. A.R. Santhakumar, :Concrete Technology" Oxford University Press, 2006.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

SEMESTER-II

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- RESEARCH METHODOLOGY
Course Code:- PMG-151

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

LTP Cr
4 0 0 4

Module 1: Research Concepts:

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, and Applied & Experimental). Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Selection of Research task.

Module 2: Statistical Methods of Analysis:

Descriptive statistics: Meaning, graphical representations, mean, range and standard deviation, characteristics and uses of normal curve.

Inferential statistics: Parametric tests of Hypothesis, t-test, z-test, Chi-square tests, correlation & Regression, ANOVA (one way, two way), Latin Squares.

Module 3: Design of experiment

Definition of Experimental Design, Examples, Design using Orthogonal arrays, Taguchi's robust parameter design.

Module 4: Report Writing

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

Reference Books:

1. Research Methodology by C. R. Kothari, New Age Publishers
2. Statistical Method for Management by Richard I. Levin and David S. Rubin, Pearson Education
3. Probability and Statistics by R. H. Myers and S.L. Myers , Pearson Education
   Formulation of Hypothesis by K. L, Bandera P. L, Himalaya Publication.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCE OPTIMIZATION TECHNIQUES
Course Code:- PMA-151

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Linear programming:

- Simplex method
- Artificial variables
- Dual phase method.

Module 2:Non-linear programming:

- Unconstrained extremal problems
- Necessary and sufficient conditions for Extrema
- Fibonacci method
- Golden search methods.

Module 3: Other programming method:

- Separable programming
- Quadratic programming
- Geometric programming
- Linear combination methods

Module 4:Constrained Optimisation

- Gradient methods
- Direct search methods

Module 5: Constrained extremal problems

- Equality constraints
- Jacobian and Lagrangean methods
- Inequality constraints
- Extension of Lagrangean method
- The Kuhn -Tucker conditions

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Applications of Optimization Techniques in Civil Engineering

Reference Books:

1. Operations Research, Taha, 7th ed, 2002, Prentice Hall.
2. Operations Research, Ravindran, Phillips and Solberg, 2nd edition 2000, John Wiley and Sons.
3. Numerical Methods for Engineers, Chapra and Canale, 4th edition, 2005, Tata Mc Graw Hill.
4. Engineering Optimization, S.S.Rao, 3rd edition, 2000, New Age.Course

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title PLASTIC ANALYSIS AND DESIGN OF STEEL STRUCTURES
Course Code PCE-151

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Types of connections:

- Design of framed beam connections
- Seated beam connection
- Unstiffened, Stiffened Seat connections
- Continuous beam – to - beam connections
- Continuous beam–to–column connection both welded and bolted
- Cold formed Steel Sections

Module 2:Deflections in steel members

- Assumption
- Calculation of deflection at ultimate loads permissible rotations.
- Design of compression and Tension members

Module 3: Design of steel members using plastic theory

- Continuous beams
- Frames

Module 4:Design of members subjected to lateral and axial loads

- Principles of analysis
- Design of Industrial buildings
- Crane gantry girder

Module 5:Special consideration in steel structures:

- Design of structures using light gauge metals
- Design of steel towers

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Reference Books:

1. K.Mukhanov, Design of Metal structures.
2. B Bresler, T Y Lin and J B Scalzi, Design of Steel structures.
3. P Dayaratnam, Design of Steel Structures
4. Plastic Design by Neal
5. Plastic Design of Steel Frames by Beedle
6. Arya, A.S., Design of Steel Structures, New Chand & Brothers, New Delhi 1982.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- STRUCTURE DYNAMICS AND EARTHQUAKE ANALYSIS
Course Code:- PCE-152

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Single Degree of Freedom (SDOF) systems:

- Free and forced vibrations
- Damped and undamped systems

Module 2: Dynamics of continuous elastic systems:

- Flexural beams-shear
- Beams-columns
- Base excited system-formulation of equations for SDOF & MDOF systems

Module 3: Multi Degree Freedom Systems:

- Two degrees of freedom systems,
- Orthogonal properties – Rayleigh's method, StodolaVianolla Method, Method of matrix iterations, Lumped mass matrix
- Determination of frequency and modes

Module 4: Philosophy of earthquake resistant design:

- Ductility
- Redundancy & Over strength
- Damping
- Base Isolation Supplemental Damping

Module 5:Seismic behaviour and design of Structures:

- Concrete structures
- Steel and masonry structures
- Material properties

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Reference Books:

1. Paz, M., Structural Dynamics – Theory and Computation, C.B.S. Publishers & Distributor, 2nd edition (2004).
2. Mechanical Vibrations by G.K. Grover
3. Dynamics of Structures by Walter C. Hurty& Moshe F. Rubinsten
4. Dynamics of Structures by John's Biggs
5. Elementary Earthquake Engineering by Jai Krishna &ChanderShekhran
6. Clough, R.W., Penzin, J., Dynamics of Structures, McGraw Hill International Editions (1993).
7. Roy R Craig, Jr., Structural Dynamics, John Wiley & Sons, 1981.
8. A.K. Chopra "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001
9. L. Meirovitch, Elements of Vibration Analysis, 2nd Ed., McGraw-Hill, 1986.
10. IS: 1893 - 2002 Criteria for Earthquake Resistant Design of Structures.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

SEMESTER-III

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- FINITE ELEMENT METHOD IN STRUCTURAL ANALYSIS
Course Code:- PCE-201

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1:**Basic Concepts of FEM:**

- Discretization
- Displacement
- Force and hybrid models
- Interpolation functions for general element formulations
- Compatibility and completeness

Polynomial Forms:

- One dimensional elements
- Geometric isotropy
- Triangular elements
- Rectangular elements
- Three dimensional elements
- Isoperimetric formulations
- Axisymmetric elements
- Numerical integration

Module 2:Applications in Solid Mechanics

- Plane stress/strain
- FE formulation, CST, LST
- Stiffness matrix, load matrix formation
- Rectangular element
- Isoparametric formulation
- Plate elements and shell elements
- Three dimensional elements
- Axisymmetric stress analysis
- Torsion

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Interface elements and infinite elements.

Module 3:Introduction to Nonlinear Problems:

- Geometric and material (elasto- plastic) solution methods
- Newton-Raphson method
- Modified Newton- Raphson method
- Arc method
- Problem of geometric nonlinearity

Module 4:Stationary principles:

- Rayleigh Ritz method and interpolation
- Weighted residual methods and variational methods
- Numerical errors and convergence

Module 5:Application of Software:

- Such as ABAQUS and ANSYS

Reference Books:

1. Bathe, K.J., "Finite Element Procedures", Prentice-Hall of India Private Limited.
2. Cook, R.D., Malkus, D.S. and Plesha M.E., "Concepts and Applications of Finite Element Analysis", John Wiley & Sons.
3. Zeinkwicz, O.C., "The Finite element Method", Tata McGraw Hill
4. Reddy, J.N., "An introduction to Finite element Method", McGraw- Hill.
5. Bhavikatti S.S. "Finite Element Analysis",

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCED FOUNDATION DESIGN
Course Code:- PCE-202

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction

Subsurface Exploration:

- Introduction to Boring, Sampling, SPT, CPT
- Geophysical methods, Bore log and soil report.

Shallow Foundations:

- Terzaghi's Theory
- Meyerhoff's Theory
- Hansen's Theory
- Bearing capacity based on SPT, layered soils, eccentric and inclined loads.
- Bearing capacity on slopes
- Foundation settlements
- Design of Combined and Raft Foundations:
- Design of combined footings by Conventional and elastic line methods.

Module 2: Earth Retaining structures

- Design of Retaining walls:
- Lateral earth pressure
- Retaining wall stability

Sheet Pile and Braced Cuts:

- Cantilever and Anchored sheet pile walls
- Pressure envelopes and design of various components

Module 3: Deep Foundations

- Pile Foundations : Load transfer mechanism, Pile capacity in various soil types, negative skin friction, group action, settlements, laterally loaded vertical piles

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Drilled Piers and Caissons: Design considerations, bearing capacity equations, Settlements, Lateral loads, Types of caissons, stability analysis

Module 4: Machine Foundations:

- Free and forced vibration with and without damping,
- Elastic half space for rigid footings
- Vibration analysis of foundations subjected to vertical, sliding and rocking modes
- Design criteria for machine foundations

Module 5: Introduction to Reinforced Earth:

- Materials required
- General considerations
- Design and Stability

Reference Books:

1. Course Notes by the Instructor
2. Principles of Foundation Engineering by Braja M Das
3. Basics for geotechnical engineering explorations; by OlaviTammemäe
4. N.S.V kameswraRao, Theory and Practice ; Foundation Design; John Wiley &Sons.
5. Geotechnical Engineering – by John N Cernica

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- COMPOSITE MATERIALS
Course Code:- PCE-203

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
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MODULE 1

FIBRE REINFORCED CONCRETE :

- Properties of Constituent Materials, Mix Proportions, Mixing and Casting Procedures,
- Properties of Freshly mixed FRC, Mechanics and properties of Fiber reinforced concrete,
- Composite Material approach, Application of fiber reinforced concrete.

FLY ASH CONCRETE :

- Classification of Indian Fly ashes,
- Properties of Fly ash, Reaction
- Mechanism, Proportioning of Fly ash concretes,
- Properties of Fly ash concrete in fresh and hardened state, Durability of fly ash concrete.

MODULE 2

POLYMER CONCRETE :

- Terminology used in polymer concrete,
- properties of constituent materials,
- Polymer impregnated concrete,
- Polymer modified concrete,
- Properties and applications of polymer concrete and polymer impregnated concrete.

FERRO CEMENT :

- Constituent materials and their properties,
- Mechanical properties of Ferro cement,
- Construction techniques and application of ferro cement.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

MODULE 3

HIGH PERFORMANCE CONCRETE :

- Materials for high performance concrete,
- Supplementary cementing materials,
- Properties and durability of high performance concrete,
- Introduction to silica fume concrete,
- Properties and applications of silica fume concrete.

MODULE 4

SULPHUR CONCRETE AND SULPHUR INFILTRATED CONCRETE :

- Process technology,
- Mechanical properties,
- Durability and applications of sulphur concrete, Sulphur infiltrated concrete,
- Infiltration techniques,
- Mechanical properties, Durability and applications of sulphur infiltrated concrete.

LIGHT WEIGHT CONCRETE :

- Properties of light weight concretes,
- Pumice concrete,
- Aerated Cement mortars,
- No fines concrete,
- Design and applications of light weight concrete.

Reference Books:

1. R.M. Jones, *Mechanics of Composite materials*, Taylor and Francis
2. M. Daniel and O. Ishai, *Engineering mechanics of Composite materials,* Oxford Press
3. Kollar, L.P. and Springer, G.S., "Mechanics of Composites Structures", Cambridge Press.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCED CIVIL SOFTWARE LAB
Course Code:- PCE-204

Evaluation Components for Practical Courses **(Students are required to perform atleast 8 practical mandatorily from the given list of practical)**	
Lab Performance	10
Lab file work	10
Viva – Voce	10
Total	**30**

L T P Cr
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- Introduction to Ductile Detailing of structures using Auto CAD.
- Analysis of Steel Truss using STAAD PRO.
- Analysis of Multi storey building using STAAD PRO.
- Analysis of Multi storey building using ETABS.
- Introduction and application of SAP
- Introduction to MATLAB

Reference Books:

1. Software manuals
2. Class Notes
3. Practice of different software packages
4. Study of design specifications(IS codes)

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

SEMESTER-IV

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- HIGH RISE BUILDINGS
Course Code:- PCE-251

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

- **Module 1**: **Tall Building systems and Concepts**:
  - Environmental systems
  - Service systems
  - Construction system
  - Foundation design
  - Architectural- structural interaction

- **Module 2: Tall building criteria and loading**:
  - Gravity load
  - Earthquake loadings
  - Wind loading and effects
  - Fire and blast
  - Quality control crib Structural safety

- **Module 3: Structural design of tall steel buildings:**
  - Structural standards
  - Elastic analysis and design
  - Plastic analysis and design, stability
  - Design methods based on stiffness
  - Fatigue and fracture
  - Load factor (Limit State) design

Module 4: Structural design of tall concrete and masonry buildings:

- Structural standards
- Plastic analysis-strength of members and correction
- Non-linear analysis and limit state design
- Stiffness and crack control
- Creep, shrinkage and temperature effects
- Limit state design of masonry structures

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- **Module 5: Frame-shear wall systems**
  - Twist of frame
  - Analysis of shear wall
  - Frame wall interaction
  - Analysis of coupled shear wall
  - Computation of earthquake load
  - Dynamic analysis of tall building
  - Case Study

Reference Books:

1. Structural Analysis and design of Tall Buildings by Tara NathBungale.
2. Advances in tall buildings by Beedle L.S.
3. Design of multistory reinforced concrete buildings for earthquake motion by J.A.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- MODERN CONCRETE TECHNOLOGY
Course Code:- PCE-252

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction:

- Structure of hydrated Cement
- Special Cements
- Chemical admixtures
- Concept of Green Concrete using Mineral Admixtures
- Corrosion protection
- Fire resistance
- Sulphate attack on concrete
- Diffusion of chlorides in concrete
- Evaluation of concrete strength
- NDT Techniques

Module 2: Concrete mix design:

- Principles of Concrete mix design
- Methods of Concrete mix design
- Design of high strength concrete and
- High performance concrete

Module 3: Properties of concrete:

- Rheological behavior of fresh Concrete
- Properties of fresh concrete
- Properties of hardened concrete
- Strength
- Elastic properties
- Creep and Shrinkage
- Variability of concrete strength
-

Module 4: Green innovation & sustainability:

- Criteria for choosing appropriate green energy technologies

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Renewable energy technologies
- Industrial ecology, agro ecology and other appropriate green technologies

Module 5: Newer Energy Materials:

- Carbon nano-tubes (CNTs) and multiwall carbon nanotubes (MWCNTs) -methods of production, properties and its utility in energy devices.
- Polymers and composites -classification, methods of production, properties, fabrication methods, and its utility in making energy devices.
- Silicon processing methods.

Reference Books:

1. Krishnaraju, N., Advanced Concrete Technology, CBS Publishers, 1985.
2. Nevile, A.M., Concrete Technology, Prentice Hall, Newyork, 1985.
3. A.R. Santhakumar, :Concrete Technology" Oxford University Press, 2006.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- Rehabilitation of Structures
Course Code:- PCE-253

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

- **Module 1: Deterioration of concrete buildings**:
  - Deterioration of concrete
  - Embedded metal corrosion
  - Disintegration mechanisms
  - Moisture effects
  - Thermal effects
  - Structural effects
  - Faulty construction

- **Module 2:Condition Assessment:**
  - Evaluation of concrete buildings
  - Visual investigation
  - Destructive testing systems
  - Non-destructive testing techniques
  - Semi-destructive testing techniques
  - Chemical testing.

- **Module 3: Structural Health Monitoring:**
  - Vibration based monitoring technique
  - Smart materials
  - Monitoring sensors
  - Elastic analysis and design

Module 4: Repair Methodology:
- Type and selection of repair materials
- Surface preparation and repair
- Retrofitting techniques
- Repairing Strategy & design
- Bonding repair materials to existing concrete
- Placement methods

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- **Module 5: Structural strengthening:**
    - Structural strengthening techniques
    - Beam shear capacity strengthening
    - Shear transfer strengthening between members
    - Column strengthening
    - Flexural strengthening
    - Crack stabilization.

Reference Books:

1. Emmons, P.H., "Concrete Repair and Maintenance Illustrated", Galgotia Publications Pvt. Ltd.(2001)
2. Bungey, S., Lillard, G. and Grantham, M.G., "Testing of Concrete in Structures", Taylor and Francis (2001).
3. Malhotra, V.M. and Carino, N.J., Handbook on Non-destructive Testing of Concrete, CRC Press(2004).
4. Bohni, H., "Corrosion in Concrete Structures", CRC Press(2005).
5. FEMA 273; NEHRP Guidelines for the Seismic Rehabilitation of Buildings(1997).
6. ATC- 40: Seismic Evaluation and Retrofit of Concrete Buildings, Vol. 1 & 2(1997).
7. Priestley, M.J.N., Seible, F. and Calvi, G.M., "Seismic Design and Retrofit of Bridges", John Wiley & Sons (1997).

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- INDUSTRIAL STRUCTURES
Course Code:- PCE-254

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Review of Plastic Design:

- Concept of minimum weight design
  Storage Structures
- Design of containers like bunkers, silos

Module 2: Design of Industrial Buildings:

- Framing
- Crane girders & columns
- Analysis of trussed bents
- Design of industrial frame

Module 3: Design of Space Structures:

- Transmission towers
- Steel domes
- Pre-cast building components.

Module 4: Aluminum structures:

- Permissible stresses
- Tension members
- Compression members
- Design of beams
- Local buckling of compression elements
- Riveted and bolted construction

Design of chimneys

- Load analysis
- Design of steel supporting chimney

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Chimney foundation

Module 5: Construction Practices:

- Shop practice in steel construction
- Fabrication erection and production

Reference Books:

1. Ajmani, A. L. and Arya, A. S., Design of Steel Structures, Nem Chand and Brothers (2000).
2. Dunham, C.W., Planning of Industrial Structures, John Wiley and Sons (2001).
3. Gary, W., Steel Designer's Manual, Prentice Hall (2008).
4. Glower, F., Structural Pre-cast Concrete, Oxford Publishers (2008).

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- ADVANCE PRE-STRESSED CONCRETE
Course Code:- PCE-255

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction to Pre-stressed concrete

- Different systems of prestressing
- Characteristics of concrete and steel
- Other suitable design of section for flexure, shear and torsion

Module 2: Design of Pre-stressed member:

- Limit state design as per IS code.
- Comparison of design with respect to British, Australian and American code
- Partial prestressing
- Stress distribution in end-block of post tensioned Section
- Magnel's method, Guyen's method, Rowe's method and IS code method

Module 3: Deflection of prestressed structures

- Short term and long term deflections of uncracked and cracked members

Module 4: Indeterminate structures:

- Principles of design of prismatic continuous beams of two and three equal, unequal spans with variable moments of inertia
- Cap cable
- Jeaques Muller's theorem

Module 5: Design of special structures

- Circular tanks
- Pipes
- Pre stressing of rigid frames
- Construction of prestressed and in-situ concrete

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Mast and materials
- Losses in prestress

Reference Books:

1. Y. Guyen, *Prestressed concrete Vol-I & Vol.-II,* John Willey & Sons, New York-1960.
2. N. Krishnaraju, *Prestressed concrete,* Tata McGraw-Hill, New Delhi-2004.
3. T. Y. Lin and H. Burns Ned, *Design of Prestressed concrete structures*, John Willey &
4. Sons, New York-1982.
5. S. K. Mallik and A. P. Gupta, *Prestressed concrete,* Oxford & IBH, New Delhi-1982.
6. E. W. Bennet, *Prestressed concrete theory & design,* Chapman & Hall, London-1962.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

Course Title:- WIND EFFECTS ON STRUCTURES
Course Code:- PCE-257

Assessment and Evaluation Components	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	25
Mid Term Tests (MTE)	20
Attendance Marks	05
End Term Examination	50
Total	**100**

L T P Cr
4 0 0 4

Module 1: Introduction to wind engineering

- Nature of wind storm.
- Design wind speed
- Atmospheric boundary coyer
- Wind turbulence.
- Atmospheric pressure and gradient wind,
- Wind climate and structure, peak 3-sec, 10 min and hourly mean wind speeds,
- Low cycle energy and large scale pressure systems,
- Wind energy and turbulence.

Module 2: Wind characteristics:

- Spectral Distribution and Boundary Layer (ABL) & its characteristics,
- Aerodynamics of bluff bodies, vortex shedding and associated unsteady along and across wind force, extreme winds, correlation and spectral function.

Module 3: Wind effects on Low Buildings:

- Low buildings with different roof shapes and multi-span buildings. Wind effects on Tall Buildings:

- Along wind effects,
- Across wind effects and
- Vortex shedding

Module 4: Wind effects on Bridges:

- Basic force coefficients for bridges,
- Nature of dynamic response of long span bridges,

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory

- Flutter instability
- Buffeting of long span bridges.

Module 5: Wind Tunnel :

- Basic wind tunnel instrumentation for the measurement of flow parameters, forces, displacements and strains.
- Use of statistical methods for the analysis of measured data and its interpretation,
- Procedures for along wind and across wind forces,
- Wind tunnel and its salient features
- ABL simulation

Reference Books:

1. Liu, H., "Wind Engineering A Hand Book for Structural Engineers", Prentice- Hall India Pvt. Ltd.
2. Meroney, R.N. and Bienkiewicz, B., "Computational Wind Engineering", Elsevier Science.
3. Simiu, E. and Seaman, R.H., "Wind Effect on Structures", John Wiley & Sons.
4. McDonald, J., "Wind Loading on Buildings", Applied Science Publishers Ltd.
5. Sean, P., "Wind Forces in Engineering", Pergamon Press.

Note for End Term Examination: Attempt five questions in all, selecting one question each from the sections A, B, C and D. Section E is compulsory