COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6101	ADVANCED DESIGN OF CONCRETE STRUCTURES	3-1-0-4	2015

COURSE OBJECTIVES:

The objective of this course is to make students

To learn principles of Structural Design,

To design different types of structures and to detail the structures,

To evaluate performance of the structures

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Understand the principles of Structural Design
- Design and develop analytical skills.
- Summarize the principles of Structural Design and detailing
- Understand the structural performance.

MODULE	COURSE CONTENT (36 hrs)	HRS
I	Yield line method of analysis of slabs:– Characteristic features of yield lines– analysis by virtual work method – Yield line analysis by equilibrium method, Design of grid floor –Approximate method (IS code method).	9
	INTERNAL TEST 1(Module 1)	
II	Design of continuous beams:- Redistribution of moments, Design of portal frames. Design of building frames, Design of Pile foundation: Pile and Pile cap- single and group with friction and end bearing.	9
	INTERNAL TEST 2(Module 2)	
III	Design of special RC elements: – Design of slender columns, Design of shear walls (with and without boundary elements), Design of Deep beams, Design of corbels	10

IV	Design of flat slabs:– Introduction–components–IS Code recommendations– IS code method of design- with and without drop- interior and exterior panels.	8
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Pippard A J S, "The Analysis of Engineering Structures", Edward Arnold PublishersLtd.
2. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and distributers, New Delhi.
3. Krishna Raju., "Design of Reinforced Concrete Structures"
4. Punmia,Ashok K Jain,Arun K Jain,"Reinforced Concrete Vol:II".
5. P C Varghese, "Limit State Design of concrete structures".
6. P C Varghese, "Foundation engineering".
7. S Ramamrutham, R Narayan., "Design of Reinforced Concrete Structures"
8. S SBhavikatti , "Advance R.C.C Design Vol II".
9. Rajagopalan, "Design of Storage structures"
10. Reynolds Handbook.
11. BIS, IS: 456-2000, IS: 13920-1993, SP 16, SP 24, SP 34.
12. Relevant IS Codes.
13. Menon &Pillai – "Design of R.C.C. Structures"
14. Bikash Chandra chattophadhyay, Joyantamaity, "Foundation engineering".
15. N P Kurian, "Design of Foundation Systems".

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6103	THEORY OF ELASTICITY	3-1-0-4	2015

COURSE OBJECTIVES:

1. To introduce concept of stress and strain in three dimensional bodies along with compatibility, equilibrium and boundary conditions.
2. To introduce the concept of plane stress, plane strain and stress function for actual continuum problems.
3. To introduce the concept of warping and torsion in non-circular and thin-walled sections incorporating classical theories.
4. To introduce concept of plastic stage, plastic flow and elasto-plastic analysis in continuum problems.
5. To acquire knowledge of various failure criteria for general stress states.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Develop the concept of stress-strain tensors and their relationships in 3D continuum problems.
- Idealize physical problems into plane stress and plane strain problems and solve them using stress functions.
- Identify the effect of torsion in thin-walled and irregular closed/open sections.
- Apply various failure criteria for general stress states at points.

MODULE	COURSE CONTENT (36 hrs)	HRS
I	**Elasticity** Basic concepts– Body force–Surface traction–Stresses and strains–Three dimensional stresses and strains–analysis–transformation equations of 3D stresses & strains–principal stresses & strains–States of stresses & strain–Equilibrium equations–generalised Hooke's Law–Compatibility Conditions–Boundary conditions.	9
INTERNAL TEST 1 (Module 1)		
II	**Two dimensional stress–strain problems** Plane stress and plain strain– Analysis–transformation equations–stress–strain relations–equilibrium equations in Cartesian and polar coordinates Airy's stress function– Biharmonic Equilibrium–St Venant's principle–2D problems in Cartesian coordinate–cantilever with concentrated load at free end–Cantilever with moment at free end.	9
INTERNAL TEST 2 (Module 2)		

III	**Torsion** Torsion of prismatic bar– General solution–Warping function approaches – St. Venant's theory– Membrane analogy– Sand heap analogy– Torsion of Non Circular sections – Torsion of multi celled thin wall open and closed sections.	10
IV	**Plasticity** Introduction to plasticity – General concepts – Stress – Strain curves – Ideal plastic body – Plastic flow conditions – theories of failure – plastic work – Plastic potential – Yield criteria – Simple applications – Elasto – plastic analysis for bending and torsion of bars – Residual stresses.	8
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Timoshenko S P and Goodier J. N, "Theory of Elasticity", Tata McGraw Hill International Student Edition.
2. Johnson W and Mellor P. B, "Plasticity for mechanical engineers", Van Nostrand Company Ltd.
3. Sadhu Singh, "Theory of elasticity", Khanna Publishers, Delhi.
4. Sadhu Singh, "Theory of Plasticity", Khanna Publishers, Delhi.
5. Srinath L. S, "Advanced mechanics of solids", Tata McGraw– Hill Publishing Company Ltd., New Delhi.
6. Arthur P Boresi& Omar M SideBottom, "Advanced Mechanics of Materials", John Wiley & Sons.
7. Sokolnikoff, "Mathematical Theory of Elasticity".
8. T. G. Seetharam, L. GovindaRaju, "Applied Elasticity".

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE6105	CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	3-1-0-4	2015

COURSE OBJECTIVES:

To study and understand the concept of planning, scheduling and the techniques necessary for construction project. To make students appreciate the basic concepts, principles and advantages of statistical quality control.

COURSE OUTCOMES:

Upon successful completion of this course, it is expected that students will be able to estimate resource requirements for work activities, cost control and a deep knowledge in quality control.

MODULE	COURSE CONTENT (36 hrs)	HRS
I	Basic Concepts in the Development of Construction Plans Choice of Technology and Construction Method - Defining Work Tasks - Defining Precedence Relationships Among Activities -Estimating Activity Duration. Estimating Resource Requirements for Work Activities -Coding Systems	9
	INTERNAL TEST 1 (Module 1)	
II	Relevance of Construction Schedules. The Critical Path Method - Calculations for Critical Path Scheduling -Activity Float and Schedules - Presenting Project Schedules Critical Path Scheduling for Activity-on-Node and with Leads. Lags and Windows. - Calculations for Scheduling with Leads, Lags and Windows - Resource Oriented Scheduling - Scheduling with Resource Constraints and Precedences - Use of Advanced Scheduling Techniques - Scheduling with Uncertain Duration - Calculations for Monte Carlo Schedule Simulation - Crashing and Time/Cost Tradeoffs - Scheduling In Poorly Structured Problems - Improving the Scheduling Process.	9
	INTERNAL TEST 2 (Module 2)	
III	The Cost Control Problem The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Schedule Control - Schedule and Budget Updates - Relating Cost and Schedule Information.	10
IV	Statistical Quantity control: Definition - objectives- terms involved-advantages variation in quality techniques of statistical quality control-control charts- variables attributes -acceptance sampling..	8

END SEMESTER EXAM (ALL Modules)
1. Chitkara. K.K(1998) “Construction Project Management: Planning Scheduling and Control”, Tata McGraw Hill Publishing Company, New Delhi, 2. Calin M. Popescu, Chotchal Charoenngam (1995), “Project Planning, Scheduling and Control in Construction : An Encyclopedia of terms and Applications”, Wiley, New York, 34 3. Chris Hendrickson and Tung Au(2000), “Project Management for Construction - Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall Pittsburgh, 4. Moder, J., C. Phillips and E. Davis (1983) “Project Management with CPM, PERT and Precedence Diagramming”, Van Nostrand Reinhold Company, Third Edition, Willis, E. M., Scheduling Construction Projects 5. John Wiley & Sons, Halpin, D. W (1985). “Financial and Cost Concepts for Construction Management”, John Wiley & Sons. New York.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE6107	CONSTRUCTION MANAGEMENT & ENGINEERING ECONOMICS	2-1-0-3	2015

COURSE OBJECTIVES:

Course is designed to

- Develop basic awareness of scientific management thoughts and demarcating the authority, responsibility in an organization.
- Bring systematic knowledge of management information systems in decision taking.
- Understand the theory of construction economics.
- Study the network techniques and its application.

COURSE OUTCOMES:

At the end of the course the student will be able to

- Discuss and communicate the management evolution.
- Participate in the design and utilization of computer based information systems.
- Evaluate and take economic decisions in construction projects.
- To understand the theory and practice in construction planning, scheduling and control.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Scientific Management** Concept - elements - contributions of pioneers in scientific management - basic principles of management with reference to construction industry - Maslow's hierarchy of needs -organization - principles - construction organization setup.	8
	INTERNAL TEST 1 (Module 1)	
II	**Management information Systems** Definition - evolution - organizational theory - systems approach - computer systems -database management - information systems for decision making - MIS effectiveness and efficiency criteria -failure of MIS.	8
	INTERNAL TEST 2 (Module 2)	
III	**Engineering Economics** Definition and scope - cash flow - interest formulas and application - time value of money -bases of comparison - decision making amongst alternatives - rate of return - replacement analysis - break even analysis - incremental analysis - benefit cost analysis - capital budgeting - working capital management - construction accounting - long term and short term financing - problems and case studies.	9

IV	**Network Techniques in Construction** Introduction - planning - work scheduling -network diagram - rules for drawing network diagram - Fulkerson's rule - PERT / CPM techniques - precedence networks - least cost scheduling- resource allocation - updating - application of network techniques - related problems	7
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Dinkar Pagare. "Principles of management" - Sultan Chand & Sons,New Delhi.
2. Robert G Murdick, Joel E Ross, James R Clagget. "Information systems for Modern Management "- PHI Learning Private Limited, New Delhi.
3. R Paneerselvam. "Engineering Economics" - PHI Learning Private Limited, New Delhi.
4. Prassanna Chandra. "PROJECTS-Planning, Analysis, Selection, Financing, Implementation and Review" -Tata McGraw-Hill Education private Limited.
5. B L Gupta & Amit Gupta. "Construction management and machinery" - Standard publishers Distributors, Delhi.
6. James D Stevens. "Techniques for Construction Network Scheduling" - McGraw-Hill Publishing Company.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE6111	PRESTRESSED CONCRETE	2-1-0-3	2015

COURSE OBJECTIVES:

- To introduce the need for prestressing as well as the methods, types and advantages of prestressing.
- To understand the basic concepts of Prestressed Concrete.
- To study various devices used for Prestressing.
- Students will be introduced to the behavior of prestressed concrete structures subjected to flexure and shear.
- To analysis and design the basic structural members in Prestressed concrete based on relevant codal provisions.
- To analysis and design the special structures like Prestressed Concrete Pipes, Liquid Storage Tanks and Concrete Poles.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Understand the basic concepts of Prestressed Concrete, methods and its use.
- Analyse, Comprehend the design and detailing of Prestressed concrete structures used in practice.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Introduction: -** Basic concept of Prestressing, Analysis of prestress and bending stress: - Stress concept, Strength concept: - Pressure line and internal resisting couple and Load balancing concept for extreme fiber stresses for various tendon profile. Systems of Prestressing: - Pre tensioning and Post tensioning, Thermo elastic and Chemical prestressing. Tensioning devises and Systems, Materials for Prestressed concrete: - Need of high strength concrete and steel, Advantages of prestressed concrete over reinforced concrete. **Losses of Prestress: -** Losses of Prestress:- Stages of losses, Types of losses in pre-tensioning and post-tensioning due to Elastic shortening, Shrinkage, Creep, Relaxation, Anchorage Slip, Friction and Sudden changes in temperature. Graphical method for friction loss, Methods of overcoming friction losses. Concept of reduction factor.	8

	Deflection of beams: - Short term, Load deflection curve, Importance of control of deflections, factors influencing deflections, Pre- cracking and Post- cracking, Effect of tendon profile on deflections, Prediction of long term (Concept only,)	
INTERNAL TEST 1 (Module 1)		
II	**Cracking and Failure: -** Micro and visible cracking, Stresses in steel due to loads. Failure: - Flexural failure, Shear failure, other modes of failure. **Elastic Design**: - Shear and Torsional Resistance of PSC members: - shear and Principal stresses, Ultimate shear resistance of PSC members: - Section cracked and un cracked, Design for shear using IS code. PSC members in torsion:-Pure torsion, Combined bending moment and torsion, Combined bending moment, shear and torsion: - Codified procedures, Design of reinforcement using IS code provision. Flexural strength: - Simplified code procedure for bonded and un bonded symmetrical and unsymmetrical sections. Behaviour under flexure: - Codal provision for Limit state design:-Design stress strain curve for concrete. Design of sections for flexure: - Expressions for minimum section modulus, Prestressing force and Eccentricity. Design: - Analytical and Graphical. Limiting zone for prestressing force. **End blocks: -** Anchorage zone Stresses, Stress distribution in end block, Methods of investigation, Anchorage zone reinforcements, Design (IS Code method only)	8
INTERNAL TEST 2 (Module 2)		
III	**Design of Pre tensioned and Post-Tensioned Flexural Members: -** Dimensioning of Flexural members, Estimation of Self Weight of Beams, Design of Pre tensioned and Post tensioned members symmetrical about vertical axis. **Design of Compression members (Concepts only, no design expected):-**Design of compression members, with and without flexure, its application in the design of Piles, Flag masts and similar structures. **Prestressing of statically indeterminate structures: -** Advantages,	9

	Effect, Method of achieving continuity, Primary, Secondary and Resultant moments, Pressure line, Concept of Linear transformation, Guyon's theorem, Concordant cable profile.	
IV	**Composite construction of Prestressed and in situ Concrete: -** Types, Analysis of stresses, Differential shrinkage, Flexural strength, Shear strength, Design of composite section. **Tension members: -** Load factor, Limit state of cracking, Collapse, Design of sections for axial tension. **Design of Special Structures (concept only, no design expected):-** Prestressed Folded plates, Cylindrical Shells, Pipes, Circular water tanks.	7
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. T.Y. Lin and H. Burns Ned., "Design of prestressed concrete structures", John Wiley and sons, New York.
2. N. Krishna Raju, "Prestressed concrete", Tata McGraw Hill Publishing Co.Ltd.
3. BIS, IS: 1343-1980, "Code of Practice for Prestressed Concrete", Bureau of Indian standards, India.
4. R. H. Evans and E. W. Bennet, "Prestressed Concrete Theory and Design", Chapman and Hall, London.
5. N. Rajagopal, "Prestressed Concrete", Narosa Publishing House, New Delhi.
6. S. Ramamrutham, "Prestressed Concrete", Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
7. Y. Guyon, "Prestressed Concrete", C. R. Books Ltd., London.
8. P.W. Abeles, "An Introduction to prestressed Concrete", Vol. I & II, Concrete Publications Ltd., London.
9. H. Nilson Arthur, "Design of Prestressed Concrete", 2nd edn. John Wiley and Sons, New York.
10. F. Leonhardt, "Prestressed Concrete and Construction2nd edn." Wilhelm Ernst and Sohn, Berlin, Munich.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6113	MODERN CONSTRUCTION MATERIALS	2-1-0-3	2015

COURSE OBJECTIVES:

To develop a strong understanding of the behaviour of construction materials and the various techniques for the characterization of construction materials..

COURSE OUTCOMES:

The students will be equipped with a thorough understanding of the behaviour of materials**.**

MODULE	COURSE CONTENT (32 hrs)	HRS
I	• Bonds - Review of chemical bonds, states of matter, structure of materials, Movement of atoms, development of microstructure • Review of mechanical behaviour - Deformation, Stress, Strain, Hooke's Law, Stress-Strain Diagram • Surface Properties: Introduction to Surface Energy, Surface Tension, Wetting, Adhesion, Adsorption, Surfactants, Capillary Rise, Colloids • Structure of Construction Materials: Description on structure and properties of Concrete, Asphalt concrete, Steel, Polymers and plastic.	8
INTERNAL TEST 1 (Module 1)		
II	• Response to stress – Elastic Properties, Plasticity, Yielding, Slip Along Atomic Planes, Strain Hardening, Annealing, Ductile Failure, Brittle Fracture ,Fatigue Failure, Creep. • Failure theories – Uni axial (Tensile) Behaviour of a Metal, Complex Inelastic Response, Multi axial Loading, Introduction to Rankine Theory, Tresca Criterion, von Mises Theory, Mohr-Coulomb Failure Theory • Introduction to fracture Mechanics - Stress Concentration, Pure Modes of Fracture -Mode I or opening crack, Linear Elastic Fracture Mechanics, Brittle-Ductile Transition, Brittle Fracture, Elasto-Plastic Fracture, Elasto-Plastic Fracture, Fracture in Polymers, Fracture in Composites, Fracture in Concrete, Nonlinear Fracture Mechanics-introduction to The Dugdale-Barenblatt Model, Fictitious crack model • Probabilistic Fracture -Tensile and Compressive Strengths, Statistics of Strength, Weibull Model • Rheology - Time-Dependent Material Response, Rheological Models, Rheological Behaviour of Liquids, Thixotropy • Thermal properties - Heat Capacity, Thermal Expansion, Thermal Stresses, Thermal Conductivity	8
INTERNAL TEST 2 (Module 2)		
III	**Construction materials** • Metals - Structure, Properties and Applications of Iron and Steel, Aluminium, Copper and Its Alloys, Zinc and Its Alloys • Timber - Structure of Wood, Properties of Wood, Seasoning of Timber, Engineering Properties, Thermal Properties, Applications of Timber,	9

	Wood-Based Composites • Bituminous materials - Structure of Bitumen, Specification of Bitumen, Asphalt Concrete Paving Mixtures • Polymers and Plastics - Structure, Properties and Applications • FRP - Structure, Properties and Applications • Concrete - Structure, Properties and Applications	
IV	**Characterisation of Construction Materials** • X-Ray Diffraction Analysis (XRD):-Introduction, Crystal Basics, X ray diffraction, X rays – generation and properties, Identification of Major Phases Present in Cement/Clinker, Sample Preparation and X-Ray Diffractometry in Concrete • Microscopy and Image Analysis: Introduction of Optical microscopy and Scanning Electron Microscopy, Specimen Preparation, Concrete under the SEM. • Thermal Analysis: - Introduction of DTA, DSC, TGA, Interpreting TGA Curves related to Concrete. • Spectroscopy Techniques: Introduction to Atomic Absorption Spectroscopy, Atomic Emission Spectroscopy, UV – Visible Light Spectroscopy, Non-Destructive Evaluation: Introduction to condition assessment, Sound-based techniques - Sound-based techniques, Pulse-echo Method, Acoustic Emission, Hardness / Penetration measurements - Rebound/Penetration Tests, Thermography and Radiography, Electromagnetic techniques.	**7**
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1 J.F. Young, S. Mindess, R.J. Gray& A. Bentur, ”The Science and Technology of Civil Engineering Materials”, Prentice Hall, 1998

2. W.D. Callister ,”Materials Science and Engineering: An introduction”, John Wiley,1994

3. Eds. J.M. Illston and P.L.J. Domone ,”Construction Materials: Their nature and behaviour”, Spon Press, 2001

4. R.A. Higgins ,”Properties of Engineering Materials”, Industrial Press, 1994

5. M.F. Ashby and D.R.H. Jones ,”Engineering Materials 1”, Elsevier, 2005

6. S. Mindess and J.F. Young ,”Concrete” , Prentice-Hall, USA, 1981

7. M.F. Ashby and D.R.H. Jones ,”Engineering Materials 1: An introduction to properties, applications and design”, Elsevier, 2005.

8. P.C. Varghese ,”Building Materials”, Prentice-Hall India, 2005.

9. V. Raghavan ,”Materials Science and Engineering: A first course”, Prentice-Hall, 2004.

10. P. Kumar Mehta and Paulo J. M. Monteiro, “Concrete, Microstructure, Properties and Materials”, Indian Concrete Institute, Chennai.

11. A.M. Neville, “Properties of Concrete” Addison Wesley Longman Limited, England.

12. V.S. Ramachandran and James J., “Handbook of Analytical Techniques in Concrete Science and Technology, Principles, Techniques and Applications” William Andrew Publishing, U.S.A.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6115	STRUCTURAL DYNAMICS	2-1-0-3	2015

COURSE OBJECTIVES:

To provide a good understanding of the basic principles of structural dynamics. To formulate equations of motion for continuous structures, single and multiple-degree of freedom structures subjected to various dynamic loads. Emphasizing the relevance of damping, resonance and lumping of mass in vibration problems. Solving dynamic problems using analytical and approximate methods and evaluate the dynamic characteristics of the structures.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- To understand the basic concepts of structural dynamics and relevance modelling structures as continuous system, single or multiple degree-of-freedom systems.
- To apply the principles of structural dynamics to practical problems.
- Express structural dynamics problem as equivalent problems of statics.
- Understand the significance of damping and resonance in structures.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Introduction** Objectives − types of dynamic problems − degree of freedom - D'Alemberts Principle − principle of virtual displacement − Hamilton's principle.	8
	INTERNAL TEST 1 (Module 1)	
II	**Single Degree of Freedom System** Un damped and damped free and forced vibrations −critical damping − over damping − under damping − logarithmic decrement. Response to harmonic loading − evaluation of damping − vibration isolation − transmissibility − response to periodic forces- vibration measuring equipments. Duhamel integral for un damped system - Response to impulsive loads.	8
	INTERNAL TEST 2 (Module 2)	
III	**Multi degree Freedom Systems and Continuous systems** Natural modes − orthogonality conditions − free and harmonic vibration − Free longitudinal vibration of bars and flexural vibration of beams with different end conditions. Forced vibration:- mode superposition method-	9

	mode acceleration method	
IV	**Approximate methods for Multi degree Freedom Systems (free vibration)** Rayleigh's method − Dunkerley's method − Stodola's method − Rayleigh –Ritz method − Matrix method.	7
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Clough & Penzien, "Dynamics of Structures".
2. Meirovitch. L, "Elements of Vibration Analysis".
3. W.T. Thomson , "Vibration Theory and Applications".
4. M. Mukhopadhyay , "Vibrations, Dynamics & Structural systems".
5. Paz Mario, "Structural Dynamics–Theory and Computation".
6. Denhartog, "Mechanical vibrations".
7. Timoshenko, "Vibration Problems in Engineering".
8. Anil K Chopra, "Dynamics of structures", Pearson Education.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6177	RESEARCH METHODOLOGY	1-1-0-2	2015

COURSE OBJECTIVES:

To generate awareness about the importance, types and stages of research along with different methods for data collection, analysis, interpretation and presentation of the results.

COURSE OUTCOMES:

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

- The significance of different types of research and its various stages.
- The different methods of data collection.
- Different methods for analyzing data and interpreting the results.
- The proper way of reporting and presenting the outcome.

MODULE	COURSE CONTENT (18 hrs)	HRS
I	Introduction to research methodology. Types of research, research methods Vs methodology - stages of research process. Literature review – Problem definition- Research design for exploratory, descriptive and experimental research – Brief introduction to completely randomized design, randomized block design and Latin square designs (description only).	4
	INTERNAL TEST 1 (Module 1)	
II	Sampling fundamentals -Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination. Tools and techniques of data collection: Questionnaire and schedule for field surveys, interview, observation, simulation, experimental and case study methods. Collection, recording, editing, coding and scaling of data. Scale classification and types. Measurement of validity, reliability and practicality.	4
	INTERNAL TEST 2 (Module 2)	
III	Descriptive and inferential statistics - Data analysis and interpretation – testing of hypothesis, testing of population mean, variance and proportion –Z test – t test – F test - chi square test. Test for correlation and regression –standard error of the estimate. Testing goodness of fit.	6

IV	Meaning of interpretation and inference: importance and care for interpreting results. Presentation of reports: popular reports and technical reports - structure and style. Oral and written presentations: Parts of a research report. Guidelines for writing research papers and reports – Writing different sections of a research paper – Introduction, Methodology, Results, Discussion, Conclusion, Abstract – Writing the title. Methods of giving references and appendices: referencing styles. Ethics in research. Use of computers and internet in research.	4
Internal test 3 (Modules 3 and 4)		

REFERENCES:

1. C. R. Kothari, "Research Methodology, Methods and techniques", New Age International Publishers, New Delhi, 2004).
2. R. Panneer selvam, "Research Methodology", Prentice Hall of India, New Delhi, 2011.
3. Ranjit Kumar, "Research Methodology, A step by step approach", Pearson Publishers, New Delhi, 2005.
4. K. N. Krishna swami, Appa Iyer and M Mathirajan, "Management Research Methodology", Pearson Education, Delhi, 2010
5. M N Borse, "Hand Book of Research Methodology", SreeNivas Publications, Jaipur, 2004
6. William G Zikmund ,"Business Research Methods", South – Western Ltd, 2003
7. P K Majumdar ,"Research Methods in Social Science", Viva Books Pvt Ltd, New Delhi, 2005
8. Norman Blaikie ,"Analyzing Quantitative Data", SAGE Publications , London, 2003
9. SPSS for Windows: Pearson Education New Delhi, 2007

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6191	STRUCTURAL ENGINEERING DESIGN STUDIO	0-0-2-1	2015

COURSE OBJECTIVES:

The objective of this course is to make students

To learn the software for structural analysis and design,

To investigate the performance of structures under static and dynamic forces.

COURSE OUTCOMES:

On completion of this course, students are able to

- Understand the principles of structural analysis and design
- Design and develop analytical skills.
- Summarise the performance of structures for static and dynamic forces.
- Use computer for managing projects

Application of Structural analysis & design software STAAD and management software like Primavera / MS Project. The student has to practice the packages by working out different types of problems.

A- STAAD

Linear Static Analysis, design & detailing of Continuous Beams, Portal Frames, Truss (2D and 3D), Multi storied Building.

Loading: Dead Load, Live Load, Wind Load (IS: 875 Part 1 / Part 2 / Part 3), Earth Quake Load (IS: 1893 Part 1) and its Combinations as per codal Provisions

B - PROJECT MANAGEMENT Using Primavera / MS Project software

- Practice on the GUI of the software and Input of Date.
- Practice on Creating Bar Charts/Grant charts.
- Practice on creating CPM/PERT charts and finding out critical path.
- Practice on resource allocation and levelling of resources.
- Practice on Project Monitoring (Cost &Time).
- Plotting and printing of various charts and project.
- Filters and layouts- formatting the display- printing and reports.
- Tracking progress- scheduling options and out of sequence progress.

REFERENCES

1. PRIMAVERA Reference Manual
2. MS Project Reference Manual
3. STAAD Pro reference Manual

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6102	FINITE ELEMENT ANALYSIS	3-1-0-4	2015

COURSE OBJECTIVES:

1. To provide the fundamental concepts of the theory of the finite element method.
2. To enable the students to formulate the design problems into FEA.
3. To understand how the finite element technique works.
4. To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays and solution of the resulting algebraic systems.
5. To learn how the finite element method is implemented (both algorithmically and numerically)
6. To develop finite element formulations of engineering problems from a variety of application areas.

COURSE OUTCOMES:

On successful completion of this course,

- The students will understand the fundamental theory of the FEA method.
- The students will get the ability to generate the governing FE equations for systems governed by partial differential equations.
- The students will understand the use of the basic finite elements for structural applications using truss, beam and plane elements.
- The students will identify mathematical model for solution of common engineering problems.
- The students will be able to formulate simple problems into finite elements.
- The students will derive the element matrix equation by different methods by applying basic laws in mechanics.

MODULE	COURSE CONTENT (36 hrs)	HRS
I	**Introduction to FEM** - Historical development - Idealization of structures -Mathematical model - General procedure of FEA - Displacement approach. Variational principles weighted residual approach and method of virtual work. Derivation of equilibrium equations.	9
	INTERNAL TEST 1 (Module 1)	
II	**Shape functions** – Polynomials - Lagrangian and Hermitian Interpolation – Generalised coordinates – Natural coordinates - Compatibility - C^0 and C^1 elements - Convergence criteria - Conforming & nonconforming elements – Patch test.	9
	INTERNAL TEST 2 (Module 2)	
III	**Stiffness matrix** - Bar element - Beam element - Plane stress and plane strain and axi-symmetric problems -Triangular elements - Constant Strain Triangle - Linear Strain Triangle – Legrangian and Serendipity elements, static condensation – **Iso parametric elements** - Numerical Integration.- Gauss- Quadrature.	10
IV	**General plate bending elements** - Plate bending theory – Kirchhoff's theory – Mindlin's theory – locking problems - preventive measures – reduced integration – selective integration-spurious modes.	8
	END SEMESTER EXAM (ALL Modules)	

REFERENCES:

1. O C Zienkiewicz,."Finite Element Method", fifth Edition, McGraw Hill, 2002
2. R.D.Cook, "Concepts and Applications of Finite Element Analysis", John Wiley & Sons.
3. C.S. Krishnamoorthy,"Finite Element Analysis", Tata McGraw Hill .New Delhi,1987.
4. S. Rajasekharan, "Finite Element Analysis in Engineering Design", S Chand & Co.
5. T. Kant, "Finite Element Methods in Computational Mechanics", Pergamons Press.
6. K.J.Bathe, "Finite Element Procedures in Engineering Analysis", Prentice Hall,
7. Mukhopadhyay M.,"Matrix Finite Element Computer and Structural Analysis", Oxford & IBH,1984.
8. Irving H. Shames,"Energy &Finite Element Methods in Structural Mechanics".
9. Desai C.S. & Abel J.F., "Introduction to Finite Element Methods", East West Press.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6104	ADVANCED CONCRETE TECHNOLOGY	2-1-0-3	2015

COURSE OBJECTIVES:

To develop a strong understanding about the latest developments in the area of concrete Technology with a clear knowledge about the fundamental mechanisms

COURSE OUTCOMES:

The students will get a clear idea about the advancements in concrete technology and the judicious use of concrete for various purposes with a strong fundamental background.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Cement** – Production, composition, hydration chemistry, Structure of hydrated Cement, Solids in hydrated cement paste, Voids in hydrated cement paste and Water in hydrated cement paste. **Aggregates** – Geology of concrete aggregates, classification, testing of aggregates **Chemical Admixtures** – Different Types, Influence on the properties of concrete **Supplementary Cementitious Materials:-** Different materials, Pozzolanic reaction, Influence on the properties of concrete **Fibres** – Types, Influence on the properties of concrete, Advantages and Disadvantages	8
INTERNAL TEST 1 (Module 1)		
II	**Concrete Mix design** - Methods of Concrete mix design, High performance and high strength concrete mixture proportioning **Advanced topics in fresh concrete** – Rheology, pumping of concrete **Advanced topics in hardened concrete** – Behavior under various loads, stress-strain relationships, Variability of concrete strength, creep and shrinkage. **Durability problems of concrete** – General, Chemical attack of concrete, Corrosion of steel rebars, Carbonation, Freeze-thaw resistance, Durability design of concrete.	8
INTERNAL TEST 2 (Module 2)		

III	**Special Concretes:** Self compacting Concrete - Introduction, Definition and terms like Addition, Admixture, Binder, Filling ability, Fines (Powder), Flowability, Fluidity, Passing ability, Robustness, Segregation resistance, Slump-flow, Thixotrophy, Mix design, Test methods, Engineering Properties, Requirements. **Other special concretes**: Fibre reinforced Concrete, Light weight Concrete, Heavy Weight concrete, High strength concrete, Ultrahigh strength concrete, Polymer Concrete, Roller compacted concrete, Pervious/no fines concrete, Coloured concrete.	9
IV	**Special Topics** Modern trends in concrete - manufacture, placing, transportation and curing, Non destructive testing and quality control, Emerging trends in replacement of conventional materials in concrete ,Vacuum dewatering of concrete, Under water concreting ,Effect of temperature on the properties of concrete, Extreme weather concreting	7
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1.. Krishnaraju, N., "Advanced Concrete Technology", CBS Publishers.
2. Nevile, A. M., "Concrete Technology", Prentice Hall, New york, 1985.
3. Santhakumar A.R. – "Concrete Technology".
4. P. Kumar Mehta and Paulo J. M. Monteiro, "Concrete, Microstructure, Properties and Materials" Indian Concrete Institute, Chennai.
5. A.M. Neville, "Properties of Concrete" Addison Wesley Longman Limited, England.
6. EFNARC, "The European Guidelines for Self-Compacting Concrete, Specification, Production and Use" EFNARC-2005, UK.
7. S. Mindess and J.F. Young ,"Concrete", Prentice-Hall, USA, 1981

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE6106	PROJECT PLANNING AND IMPLEMENTATION	2-1-0-3	2015

COURSE OBJECTIVES:

The course is designed to

- To develop the awareness about different stages of construction planning.
- To help to know the importance of productivity and the techniques for improving it.
- To generate the importance of quality in construction
- To learn about the concept of safety in the field of construction.

COURSE OUTCOMES:

On the completion of course the student will be

- Familiar with different stages of planning in construction
- Acquire knowledge about productivity analysis.
- Familiar with quality management
- Understand and learn the safety measures used in construction.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Project Planning** Objectives of planning-stages of planning by different agencies-sanctions-tendering-contracts-execution of works-measurements-disputes-arbitration	8
	INTERNAL TEST 1 (Module 1)	
II	**Work and Productivity Analysis** Work study-factors influencing productivity-measurement of productivity-productivity improvement techniques-human relations-motivation-leadership-communication	8
	INTERNAL TEST 2 (Module 2)	
III	**Quality in Construction** Evolution of Quality-inspection, quality control and quality assurance in projects-factors affecting quality of construction-ISO standards-TQM in construction	9
IV	**Safety in Construction** Importance of safety-causes of accidents-human factors in construction safety management-safety in various construction operations-safety codes-	7

	safety committee and inspection-measuring of safety-approaches to improve safety in construction	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Sengupta and H. Guha (1995), "Construction Management and Planning", Tata McGrew Hill Publishing Company Pvt. Ltd. New Delhi.

2. Clarkson Oglesby, Henry Parker (1989), Gregory Howell, "Productivity improvement in construction", McGraw Hill Book Company.

3. S. Seetharaman, "Construction Engineering and Management", Umesh publications.

4. Kumar NeerajJha, "Construction Project Management", Pearson

5. R.P. Mohanty and R.R. Lakhe, "Total quality management", Jaico publishing house

6. K.N. Vaid, "Construction Safety Management", National Institute of Construction Management and Research.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6122	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	2-1-0-3	2015

COURSE OBJECTIVES:

1. To understand the principles of engineering seismology.
2. To provide an idea about earthquakes and its effects on structures.
3. To introduce the basic concepts of earthquake resistant design.
4. To study IS code provisions for the analysis, design and detailing of earthquake resistant structures.
5. To study the methods for improving the performance of buildings during earthquakes.
6. To learn different techniques to reduce earthquake effects and damage to the structures.
7. The students will get an idea about the concepts of repair and rehabilitation of earthquake affected structures and apply practically.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Understand the basic concepts and its importance on the design of seismic resistant structures.
- Select appropriate structural systems, configurations and proportions so as to resist earthquake effects.
- Do the design and detailing of structures for seismic resistance as per Indian Standards and for ductile behaviour as per codal provisions.
- Understand detailing of RCC and steel members
- Summarize the Seismic evaluation and retrofitting of structures.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	Seismic Hazards:-Need of special emphasis to earthquake engineering, Ground shaking, structural hazards, Liquefaction, Lateral spreading, Landslides, Life line hazards, Tsunami and Seiche hazards. The Earth And its Interior: - The Circulation, Continental drift, Plate tectonics, Plate boundaries, Faults and its geometry. The Earthquake: - Elastic rebound theory, Terminology like hypocenter, epicenter and related distances. Seismic Waves: - Terminology, Body waves: - P- waves and S- waves, Surface waves: – Love waves and Rayleigh waves. Calculation of wave velocity, measuring instruments, locating epicenter of earthquakes numerically from traces and wave velocity. Earthquake Size: - Intensity – RF, MMI, JMA and MSK. Comparison of above. Magnitude – Local magnitude, Calculation (Analytically and graphically), Limitations, Surface wave magnitudes, Moment magnitudes and its Calculation, Saturation of magnitude scales.	8
INTERNAL TEST 1 (Module 1)		
II	Earthquake Ground Motion: - Parameters: - Amplitude, Frequency and duration. Calculation of duration from traces and energy. Response Spectra: - Concept, Design Spectra and normalized spectra, Attenuation and Earthquake Occurrence. Guttenberg- Richter Law. Concept of Earthquake Resistant Design: - Objectives, Design Philosophy, Limit	8

	states, Inertia forces in Structure. Response of Structures – Effect of deformations in structure, Lateral Strength, Stiffness, Damping and ductility. Floor diaphragms: -Flexible and rigid, Effect of in plane and out of plane loading, Numerical example for lateral load distribution. Torsion and Twists in Buildings: - Causes Effects, Centre of mass and rigidity. Torsionally coupled and uncoupled system, Lateral load distribution, Numerical example based on IS code recommendation. Building Configurations: - Size of Building, Horizontal and Vertical layout, Vertical irregularities, Adjacency of Building, Open-ground storey and soft storey, short columns. Effect of shear wall on Buildings. Effect of torsion.	
INTERNAL TEST 2 (Module 2)		
III	R.C.C for Earthquake Resistant Structures: - How to make buildings ductile, Concept of capacity design, Strong Column weak beam, Soft Storey. Ductile design and detailing of beams and shear walls. Calculation of Base shear and its distribution by using codal provision. Detailing of columns and Beam joints. Performance of R.C.C. Building. Ductile detailing:-Study of IS: 13920-1993. Repair: - Methods, Materials and retrofitting techniques.	**9**
IV	Earthquakes in India: - Past earthquakes in India an overview, Behavior of buildings and structures during past earthquakes and lessons learnt from that. Seismic Code: - Provisions of IS: 1893-2002.Masonry Buildings:- Performance during earthquakes, Methods of improving performance of masonry walls, box action, influence of openings, role of horizontal and vertical bands, rocking of masonry piers. Reduction of Earthquake Effects: - Base Isolation and dampers; Do's and Don'ts During and after Earthquake.	**7**
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Bruce A. Bolt, "Earth quakes", W.H. Freeman and Company, New York
2. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India Private Limited, New Delhi, India.
3. Steven L. Kramer, "Geotechnical Earthquake Engineering", Pearson Education, India.
4. S. K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi.
5. Murthy C. V. R, "Earthquake tips, Building Materials and Technology Promotion Council", NewDelhi, India.
6. Pauly. T and Priestley M.J.N , "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and sons Inc.
7. David A Fanella, "Seismic detailing of Concrete Buildings", Portland Cement Association, Illinois.
8. Repair and Strengthening of Reinforced Concrete, Stone and Brick Masonry Buildings, United Nations Industrial Development Organization, Vienna.
9. BIS, IS: 1893(Part 1)-2002 and IS : 13920-1993, Bureau of Indian Standards.
10. Anil K. Chopra, "Dynamics of Structures",. Pearson Education, India.
11. Kamalesh Kumar, "Basic Geotechnical Earthquake Engineering",

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6124	THEORY OF PLATES AND SHELLS	2-1-0-3	2015

COURSE OBJECTIVES:

- To generate awareness about different types of plates and their solution strategy when subjected to different types of loads and boundary conditions.
- To Generate awareness about different types (and behaviour) of shells and their solution strategy when subjected to different types of loads

COURSE OUTCOMES:

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

- Classification of plates and relevant theory to be applied for their analysis
- The classic theory of thin plates and apply Navier's and Levy's solution to analyse problems related to thin plates
- Analysis of circular plates subjected to axis symmetric loads
- The behaviour of shells and apply classic theory (membrane theory and bending theory) for analysis of simple shells.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Plates:-**Introduction- classification of plates- thin plates and thick plates – assumptions in the theory of thin plates- Differential equation for cylindrical bending of rectangular plates. **Pure bending of plates:-** slope and curvature of slightly bent plates – relation between bending moment and curvature in pure bending – stresses acting on a plate inclined to x and y axes-Particular cases of pure bending of rectangular plates.	8
	INTERNAL TEST 1 (Module 1)	
II	**Laterally loaded rectangular plates:-** Small deflections of Laterally loaded thin plates-Differential equation of plates- derivation of fourth order differential equation -Solution techniques for fourth order differential equation– boundary conditions – simply supported, built- in and free edges.	8

	Simply Supported rectangular plates under sinusoidal Load:- Navier's solution for simply supported plates subjected to uniformly distributed and concentrated load. - Levy's solution for simply supported rectangular plates – uniformly distributed load.	
INTERNAL TEST 2 (Module 2)		
III	**Circular plates** – polar coordinates – differential equation of symmetrical bending of laterally loaded circular plates- uniformly loaded circular plates with clamped edges and simply supported edges– circular plates loaded at the centre.	9
IV	**Classical theory of Shells –** Structural behaviour of thin shells – Classification of shells – Singly and doubly curved shells with examples – Membrane theory and bending theory of doubly curved shells.-equilibrium equations. **Folded plates** – Introduction, Classification, Structural action and analysis.	7
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Lloyd Hamilton Donnell, "Beams, plates and shells", McGraw Hill, New York.
2. S.P Timoshenko, S.W Krieger, "Theory of plates and shells", McGraw Hill.
3. Owen F Hughes, "Ship structural design", John Wiley & Sons, New York, 1983.
4. William Muckle, "Strength of ship structures", Edqward Arnold Ltd, London, 1967.
5. Gol'oenveizen, "Theory of elastic thin shells", Pergaman press, 1961.
6. J Ramachandran, "Thin shell theory and problems", Universities press.
7. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and distributers, New Delhi.
8. G.S Ramaswamy, "Design and Construction of Concrete Shell Roofs", Tata- McGraw Hill Book Co. Ltd.,.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6126	CONSTRUCTION PERSONNEL MANAGEMENT	2-1-0-3	2015

COURSE OBJECTIVES:

To understand various aspects of manpower management in construction.

COURSE OUTCOMES:

The student will acquire knowledge on planning, organising, and controlling various operations likes of procuring, developing, maintaining and utilising a labour force in a construction organisation**.**

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Manpower Planning** Manpower Planning, Organizing, Staffing, Directing and Controlling-Personnel Principles-Challenges of managing people in construction organization.	8
	INTERNAL TEST 1 (Module 1)	
II	**Organization** Organization-Span of control-Organization charts-Staffing plan-Development and Operation of Human resources-Managerial Staffing-Recruitment-Selection-Placement, Training and Development.	8
	INTERNAL TEST 2 (Module 2)	
III	**Human Relations and Organisational Behaviour** Introduction to the field of Management-basic individual psychology-motivation-Personality and creativity-job design and job redesign - Managing groups at work-self managing work teams-Inter group behaviour - conflict in organizations-Leadership-Engineer as Manager-Behavioural aspects of decision making-Communication and negotiation skills	9
IV	**Management and Development Methods** Compensation-Wages and Salary, Employee Benefits, -Safety and Health-Discipline and Discharge-Special human resource problems -Employee Hand Book and Personnel Manual- Performance appraisal-and assessment-Employee services.	7

END SEMESTER EXAM (ALL Modules)
REFERENCES 1. Memoria, C.B., “Personnel Management ", Himalaya Publishing Co. 2. Andrew Dainty, Martin Loosemore, ”Human Resource Management in Construction Projects”, Routledge,2012. 3. R.S. Dwivedi, “Human Relations and Organizational Behaviour ", Macmillon India Ltd . 4. Shamil Naoum, “People and Organizational Management in Construction”,Thomas Telford 5. Carleton Counter II and Jill Justice Coulter, “The Complete Standard Hand Book of Construction Personnel Management ", Prentice Hall, Inc., New Jersey. 6. K.K Chitkara, “Construction Project Management, Planning, scheduling and controlling” Tata McGraw Hill Education private limited.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6132	BRIDGE ENGINEERING	2-1-0-3	2015

COURSE OBJECTIVES:

The objective of this course is to make students to learn principles of Structural Design; It provides the foundation for advanced design and bridge analysis and design. To evaluate performances of the structures.

COURSE OUTCOMES:

On completion of this course, students are able to

- Understand and use the basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
- Develop an intuitive feeling about the sizing of bridge elements and the conceptual design part
- Assess the load flow mechanism and loads on bridges.
- Design of bridge and its foundation starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Planning of bridges:**– Investigation for bridges– need for investigation– selection of site– economical span– subsoil exploration– investigation report– importance for proper investigation–Design of RCC bridges**–** IRC loading– types of bridges– components of bridges– analysis and design of slab bridges and box culvert.	8
	INTERNAL TEST 1 (Module 1)	
II	**Design of girder bridges:–** T-beam bridges– Analysis and design of deck slab, longitudinal girders and cross girders – Pigeaud's method – Courbon's method– Morice and Little method– Hendry – Jaegar method – prestressed concrete bridges(simply supported case only).	8
	INTERNAL TEST 2 (Module 2)	
III	**Bearings: –** importance of bearings– bearings for slab bridges– bearings for girder bridges–Design of elastomeric bearings –Joints –Appurtenances. Substructure- different types- materials for piers and abutments- substructure design– piers and abutments – shallow footings – well foundation.	9
IV	**Construction methods:**– Inspection and maintenance and construction of bridges–case studies of recently constructed major bridges–critical studies of failure of major bridges. Features of suspension bridges and cable stay bridges.	7

END SEMESTER EXAM (All Modules)

REFERENCES:

1. Raina V.K (1991), "Concrete Bridge Practice– Analysis, design & economics", Tata Mc–GrawHill, publishing company, New Delhi.
2. Raina V.K (1988), "Concrete Bridge Practice– Construction Maintenance & Rehabilitation", Tata Mc–GrawHill, publishing company, New Delhi.
3. Victor D.J (19991), "Essentials of Bridge Engineering", Oxford & IBH publishing company, New Delhi.
4. Ponnuswami S (1993), "Bridge Engineering", Tata Mc–GrawHill, publishing company, New Delhi.
5. Krishna Raju N (1996), "Design of Bridges", TataMcGrawHill, publishing company, New Delhi
6. BIS, IS: 456-2000, IS: 1343-1980
7. IRC, IRC 5, IRC 6, IRC 18, IRC 21, IRC 83 (Part 1-3)

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6134	ADVANCED FOUNDATION DESIGN	2-1-0-3	2015

COURSE OBJECTIVES:

- To expertise students in structural design (limit state method) of shallow foundation, piles, well foundation, foundation for towers and conical shell foundation.

COURSE OUTCOMES:

- After studying this course, students should be able to design different types of shallow and deep foundations. Students should also be able to design special foundations such as conical shell foundation and that for towers.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	Introduction to Limit State Design of reinforced concrete in foundations; Soil pressure for structural design; structural design of spread footings, isolated footings, combined footings, column pedestals, column footings, strap footings, strip footings under several column.	8
	INTERNAL TEST 1 (Module 1)	
II	Structural design of mat foundations–beam and slab rafts–combined piled raft foundations (CPRF) –circular and annular rafts–Analysis of flexible beams on elastic foundations ACI method for the analysis of beams and grids on elastic foundations– Analysis of flexible plates on elastic foundations.	8
	INTERNAL TEST 2 (Module 2)	
III	Structural design of different types of piles – under reamed pile foundations – Design of pile cap – pile foundation – Design of large dia socketed piles – in filled vireneel frame foundations – steel column bases. Structural design of well foundation	9
IV	Special foundations. Design of foundation for towers – Steel towers – foundation to water tank, chimneys – Shells for foundations– hyperbolic paraboloid (Hyper) foundations– Design of conical shell foundations.	7
	END SEMESTER EXAM (All Modules)	

REFERENCES:

1. P.C.Varghese, "Design of Reinforced Concrete Foundations", PHI–LTD–New Delhi, 1998

2. Kurien N.P., " Design of foundation systems–Principles and Practices" Narora Publishing

house – New Delhi (third edition),1992

3. Bowles J.E., "Foundation Analysis and Design" (4Ed.), Mc.Graw Hill, NY, 1996

4. Shamsher prakash, Gopal Ranjan, & Swami Saran, "Analysis and design of foundations and retaining structures", Sarita Prakashan, New Delhi , 1979

5. V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6136	STRUCTURAL OPTIMIZATION	2-1-0-3	2015

COURSE OBJECTIVES:

- 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 OUTCOMES:

On successful completion of this course, students are able to

- Understand the need and concepts of design optimization.
- To use conventional and modern optimization methods in structural applications.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	Introduction –Problem formulation with examples; Single Variable Unconstrained Optimisation Techniques – Optimality Criteria; Bracketing methods– Unrestricted search, Exhaustive search; Region Elimination methods:–Interval Halving methods, Dichotomous search, Fibonacci method, Golden section method; Interpolation methods–Quadratic Interpolation method, Cubic Interpolation method; Gradient Based methods– Newton–Raphson method, Secant method, Bisection method.	8
INTERNAL TEST 1 (Module 1)		
II	Multi Variable Unconstrained Optimisation Techniques – Optimality Criteria; Unidirectional Search ; Direct Search methods – Random search, Grid search, Univariate method, Hooke's and Jeeves' pattern search method, Powell's conjugate direction method, Simplex method; Gradient based methods–Cauchy's (Steepest descent) method, Conjugate gradient (Fletcher–Reeves) method, Newton's method, Variable metric (DFP)method, BFGS method.	8

INTERNAL TEST 2 (Module 2)		
III	Constrained Optimisation Techniques; Classical methods – Direct substitution method, Constrained variation method, method of Lagrange multipliers, Kuhn–Tucker conditions. Linear programming problem: Standard form, Simplex method; Indirect methods –Elimination of constraints, Transformation techniques, and Penalty function method; Direct methods – Zoutendijk's method of feasible direction, Rosen's gradient Projection method.	9
IV	Specialized Optimisation techniques – Dynamic programming, Geometric programming, Genetic Algorithms	7
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Rao S. S., "Engineering Optimisation – Theory and Practice", New Age International.
2. Deb, K., "Optimisation for Engineering Design – Algorithms and examples", Prentice Hall.
3. Kirsch U., "Optimum Structural Design", McGraw Hill.
4. Arora J S. "Introduction to Optimum Design", McGraw Hill
5. Rajeev S and Krishnamoorthy C. S., "Discrete Optimisation of Structures using Genetic Algorithms", Journal of Structural Engineering, Vol. 118, No. 5, 1992, 1223–1250.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6166	**SEMINAR - I**	**0-0-2-2**	**2015**

Each student is required to present a technical paper on a subject approved by the department. The paper should be on a recent advancement/trend in the field of Structural Engineering or Construction Management. He/she shall submit a report of the paper presented to the department.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6188	**MINI PROJECT**	**0-0-4-2**	**2015**

The mini project is designed to develop practical ability and knowledge about practical problems related to the industry. Students can take up any structural / management project of relevance in the field of structural engineering and construction management. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. For external projects, students should obtain prior permission after submitting the details of the guide and synopsis of the work. The project guide should have a minimum qualification of PG degree in structural Engineering or PG degree in construction / management related fields. Students are expected to gain exposure to field problems and managing site conditions by making several visits to various construction sites which are at different stages of construction. Internal assessment and corrective guidance shall be made at least in 2 phases prior to the final presentation. At the end of each phase, presentation of the project should be conducted, which will be evaluated by a panel of examiners. A detailed project report duly approved by the guide in the prescribed format should be submitted for end semester assessment. Marks will be awarded based on the report and their performance during presentations.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 6192	COMPUTER APPLICATION LAB	0-0-2-1	2015

COURSE OBJECTIVES:

In professional design scenario, it is very important to use industry and research standard softwares in a proficient manner besides knowing the theoretical concepts of structural analysis.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Achieve Knowledge of analysis and development of programming skills
- Use industry and research standard software in a professional set up.
- Understand the elements of finite element modelling, specification of loads and boundary
  condition, performing analysis and interpretation of results for final design

Application of STRAP / ETABS and ANSYS in modelling, simulation, analysis, design and drafting of structural components using the concepts given in theory papers. The student has to practice the packages by working out different types of problems mentioned below.

STRAP / ETABS

Linear Static Analysis of Continuous Beams, Portal Frames, Truss (2D and 3D), Multi storied Building.

Loading: Dead Load, Live Load, Wind Load (IS: 875 Part 1 / Part 2 / Part 3), Earth Quake Load (IS: 1893 Part 1) and its Combinations as per codal Provisions

Design and Detailing: As per Indian Standards

ANSYS

Linear Static Analysis of Continuous Beams, Portal Frames, Truss (2D and 3D), Plates (Plane Stress and Plane Strain)