Kerala Technological University

Cluster 4: Kottayam

M. Tech Program in Civil Engineering

(Computer Aided Structural Engineering)

Scheme of Instruction & Syllabus: 2015 Admissions

Compiled By

Rajiv Gandhi Institute of Technology, Kottayam

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Kerala Technological University

(Kottayam Cluster)

M. Tech Program in Computer Aided Structural Engineering

Scheme of Instruction

Credit requirements **:** 67 credits (22+19+14+12)
Normal Duration : Regular: 4 semesters; External Registration: 6 semesters;
Maximum duration : Regular: 6 semesters; External Registration: 7 semesters.
Courses: Core Courses: Either 4 or 3 credit courses; Elective courses: All of 3 credits
Allotment of credits and examination scheme:- Semester 1 (Credits: 22)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Hours	
A	04 CE 6101	Analytical methods in Engineering	4-0-0	40	60	3	4
B	04 CE 6103	Theory of Elasticity	4-0-0	40	60	3	4
C	04 CE 6105	Structural Dynamics	3-0-0	40	60	3	3
D	04 CE 6107	Advanced design of concrete structures	3-0-0	40	60	3	3
E	04 CE 6XXX	Elective - I	3-0-0	40	60	3	3
	04 GN 6001	Research Methodology	0-2-0	100	0	0	2
	04 CE 6191	Seminar - I	0-0-2	100	0	0	2
	04 CE 6193	Computer Applications Lab	0-0-2	100	0	0	1
		Total	23				22

Semester 2 (Credits: 19)

A	04 CE 6102	Bridge engineering	4-0-0	40	60	3	4
B	04 CE 6104	Finite element analysis	3-0-0	40	60	3	3
C	04 CE 6106	Theory of Plates and Shells	3-0-0	40	60	3	3
D	04 CE 6XXX	Elective-2	3-0-0	40	60	3	3
E	04 CE 6XXX	Elective-3	3-0-0	40	60	3	3
	04 CE 6192	Mini Project	0-0-4	100	0	0	2
	04 CE 6194	Structural Engineering Lab	0-0-2	100	0	0	1
							19

Summer Break

	04 CE 7190	Industrial Training	0-0-4				Pass/ Fail

Semester 3 (Credits: 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Hours	
A	04 CE 7XXX	Elective-4	3-0-0	40	60	3	3
B	04 CE 7XXX	Elective-5	3-0-0	40	60	3	3
	04 CE 7191	Seminar -II	0-0-2	100	0	0	2
	04 CE 7193	Project (Phase 1)	0-0-12	50	0	0	6

Semester 4 (Credits: 12)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam	Credits
NA	04 CE 7194	Project (Phase 2)	0-0-21	70	30	12

ELECTIVE LIST

ELECTIVE GROUP	Exam Slot	Course No:	Name
1	E	04 CE 6109	Pre-stressed Concrete Structures
	E	04 CE 6111	Structural Reliability
	E	04 CE 6113	Advanced Concrete Technology
2	D	04 CE 6108	Advanced Analysis of Structures
	D	04 CE 6112	Computer Aided Design
	D	04 CE 6114	Structural Optimization
	D	04 CE 6116	Microstructure & Innovations in structural concrete
3	E	04 CE 6118	Earthquake Resistant Design
	E	04 CE 6122	Advanced Steel Structures
	E	04 CE 6124	Design of substructure
	E	04 CE 6126	Experimental Stress Analysis
4	A	04 CE 7101	Design of Steel concrete composite structures
	A	04 CE 7103	Experimental Techniques & Instrumentation
	A	04 CE 7105	Design of Cylindrical shell and Folded Plates
	A	04 CE 7107	Design of Tall Buildings
5	B	04 CE 7109	Numerical Methods in Civil Engineering
	B	04 CE 7111	Engineering Fracture Mechanics
	B	04 CE 7113	Maintenance & Rehabilitation of Structures
	B	04 CE 7115	Prefabricated structures

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6101	Analytical methods in Engineering	**3-1-0**:4	**2015**

Pre-requisites:

Course Objectives: The Student will be able to:-

- Understanding of fundamental mathematics and to solve problems of algebraic and differential equations, simultaneous equation, partial differential equations
- To provide an overview of discovering the experimental aspect of modern applied mathematics

Syllabus

Differential equations , Partial differential equations, Charpit's method, Boundary value problems ,Numerical solutions of P.D.E

Course Outcome:

- Ability to solve the model by selecting and applying a suitable mathematical method.
- Ability to interpreting the mathematical results in physical or other terms to see what it practically means and implies

Text Books:

References:

- B.S Grewal, "Numerical Methods in Engineering and Science", Khanna Publications.
- George F. Simmons, "Differential Equations with applications and historical notes", TMH Edition
- Michael D Greenberg, "Advanced Engineering Mathematics", Pearson education.
- Ian Sneddon, "Elements of Partial Differential Equations", McGraw Hill, International Editions.
- P Kandasamy, "Numerical Methods", S Chand and company.
- S.Arumugam,A. ThangapandiIssac, "Numerical methods", Scitech

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6101	**Analytical methods in Engineering**	**3-1-0**:4	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:**Differential equations** Linear differential equations–homogeneous equations–boundary value problems–Cauchy–Euler equations–factoring the operator–non-homogeneous equations–variation of parameters.		10	15
MODULE 2: **Partial differential equations** Ordinary differential equations in more than two variables – first order P.D.E–integral surface passing through a given curve–surfaces orthogonal to given system–compatible systems of first order P.D.E		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Charpit's method–solution satisfying the given conditions–P.D.E second order in physics–linear P .D.E with constant coefficients.		10	15
MODULE 4:**Boundary value problems** Elementary solutions of Laplace equations, wave equations, series solution of these equations in two dimensions–related problems in engineering		10	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Classification of second order equation– finite difference approximations to partial derivatives.		8	20
MODULE 6:**Numerical solutions of P.D.E** Solution of Laplace equation by finite difference method–solution of one dimensional wave equations		8	20
END SEMESTER EXAM			

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

Pre-requisites:

Course Objectives:

The Student will be able to:-

- Understanding the basic concepts of forces, stresses, strain etc
- Understanding the general concepts of plasticity, asymmetric problems.

Syllabus

Elasticity, Two dimensional stress–strain problems, Airy's stress function, Analysis ofasymmetric problems and Torsion, Torsion of prismatic bar, Plasticity.

Course Outcome:

The student will be able to execute the stress state, stresses and strains analysis .also they will be able to use the numerical methods for the problem of the theory of elasticity in practice.

Text Books:

References:

- Timoshenko S P and Goodier J. N, "Theory of Elasticity", Tata Mcgraw Hill International Student Edition
- Thin plates and shells, theory ,application-Edward Ventsel, Krauthammer.
- Johnson W and Mellor P. B, "Plasticity for mechanical engineers", Van Nostrand Company Ltd.
- Sadhu Singh, "Theory of elasticity", Khanna Publishers, Delhi.
- Sadhu Singh, "Theory of Plasticity", Khanna Publishers, Delhi.
- Srinath L. S, "Advanced mechanics of solids", Tata McGraw– Hill Publishing Company Ltd., New Delhi.
- Arthur P Boresi& Omar M SideBottom, "Advanced Mechanics of Materials", John Wiley & Sons.
- Sokolnikoff, "Mathematical Theory of Elasticity".

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6103	**THEORY OF ELASTICITY**	3-1-0-4	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:**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–generalized Hooke's Law– Compatibility Conditions–Boundary conditions.		10	15
MODULE 2:**Two dimensional stress–strain problems** Plane stress and plain strain– Analysis–transformation equations–stress–strain relations– equilibrium equations in Cartesian and polar co ordinates.		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Airy's stress function–Biharmonic Equilibrium–St Venant's principle–2D problems in Cartesian coordinate–cantilever with concentrated load at free end– Simply supported With UDL–Cantilever with moment at free end.		10	15
MODULE 4:**Module 4** **Analysis of asymmetric problems and Torsion** General equations in polar co ordinates–Stress distribution symmetric about an axis–Cylinder subjected to external and internal pressures– Rotating disc as a 2D problem. Effect of circular hole in stress distribution of plates.		10	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Torsion of prismatic bar– General solution–Warping function approaches – St. Venant's theory– Membrane analogy– Torsion of Non Circular sections – Torsion of multi celled thin wall open and closed sections.		8	20
MODULE 6:**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	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6105	STRUCTURAL DYNAMICS	3-0-0:3	**2015**

Pre-requisites:

Course Objectives:

The Student will be able to:-

- Learn how to model discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems.
- Also, calculate the mode shapes and frequencies for the free response of continuous systems and use modal methods to calculate theirresponse

Syllabus

Introduction to dynamic problems and their solutions.Single Degree of Freedom System and their responses to different loading conditions.Vibration isolation and transmissibility.Multidegree Freedom Systems and Continuous systems and their solutions.Approximate methods for analysis.

Course Outcome:

- The student will be able to understand the principles associated with effective project management and application of these principles in avoiding common difficulties associated with project management

Text Books:

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 PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6105	STRUCTURAL DYNAMICS	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Objectives, types of dynamic problems, degree of freedom. Vibration- types, need of vibration analysis. Basics of D'Alemberts Principle, principle of virtual displacement, Hamilton's principle Energy principle-		6	15
MODULE 2:Developing equations of motion for different systems. Numerical problems. vibration measuring equipments		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Damping- types, response for free vibration to harmonic loading. critical damping – over damping – under damping – logarithmic decrement. Numerical problems		7	15
MODULE 4:Vibration isolation and transmissibility. response to periodic forces.Duhamel integral for undamped system. Response to impulsive loads. Numerical problems		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Natural modes –orthogonality conditions – modal Analysis – free and harmonic vibration – Free longitudinal vibration of bars – flexural vibration of beams with different end conditions – forced vibration..		8	20
MODULE 6:Rayleigh's method –Dunkerley's method –Stodola's method – Rayleigh –Ritz method – Matrix method.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6107	ADVANCED DESIGN OF CONCRETE STRUCTURES	3-0-0:3	**2015**

Pre-requisites:

Course Objectives:

- To learn the fundamentals of design, analysis, and proportioning of reinforced concrete members and structures.
- Methods for analysis and design of the elements under flexure, shear, and axial loads will be examined

Syllabus

Review of limit state design of beams,Design of slender columns, Yield line theory.

Course Outcome:

The students will be familiar with advanced methods used for concrete structural design and also they can Identify underlying concepts in modern concrete design methods

Text Books:

References:

- Arthur.H.Nilson, David Darwin& Charles W Dolan, "Design of Concrete Structures", Tata Mcgraw Hill, 2004
- Sinha.N.C. and Roy S.K., “Fundamentals of Reinforced Concrete”, S.Chand and Company Limited, New Delhi, 2003.
- Park.R&Paulay T "Design of Concrete Structures",John Wiley & Sons, NewYork
- Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
- Varghese P.C, “Limit State Design of Reinforced Concrete, Prentice Hall of India, 2007.
- Purushothaman, P, “Reinforced Concrete Structural Elements : Behaviour Analysis and Design”, Tata McGraw Hill, 1986

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6107	ADVANCED DESIGN OF CONCRETE STRUCTURES	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Review of limit state design of beams, slabs and columns according to IS Codes. Calculation of deflection and crack width		6	15
MODULE 2:Design of slender columns - Design of RC walls - ordinary and shear walls. Strut and tie method of analysis for corbels and deep beams, Design of corbels.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Grid floors- Design of flat slabs and flat plates- Design of spandrel beams-Design of shear reinforcement		7	15
MODULE 4:Yield line theory and Hillerborgs strip method of design of slabs.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Introduction-Method of analysis-Analysis of Multi-Storey Buildings with Moment resistant Joints for Lateral loads-Analysis of Multi-Storey Buildings with Moment resistant Joints for Gravity loads(Vertical Loads)		8	20
MODULE 6:Design of cast-in-situ joints in frames. Detailing for ductility - Fire resistance of structural members – Quality of control of concrete.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6109	Advanced Concrete Technology	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives:

To give the Student:-

- To study the properties of concrete making materials such as cement, aggregates and admixtures
- To study the properties and tests on fresh and hardened concrete

Syllabus

Aggregate classification, Cement, garde of Cement, Hydration of Cement, Principles of Concrete mix design, methods of Concrete mix design, Design of high strength and high performance concrete.

Non destructive testing and quality control, Durability, corrosion protection and fire resistance.

Modern trends in concrete manufacture and placement techniques, different types of concrete.

Course Outcome:

Students who successfully complete this course canexecute and test the concrete made with cement, aggregates and admixtures and alsodescribe the properties and durability of fresh and hardened concrete and their testing methods

Text Books:

References:

1. Krishnaraju, N., ”Advanced Concrete Technology”, CBS Publishers.
2. Nevile, A. M., “Concrete Technology”, Prentice Hall, Newyork, 1985.
3. Santhakumar A.R. –“Concrete Technology”.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6109	Advanced Concrete Technology	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Aggregate classification, Testing Aggregates, fibres. Cement, grade of Cement, chemical composition, Hydration of Cement, Structure of hydrated Cement		7	15
MODULE 2:Special Cement, Water, Chemical and Mineral Admixtures.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Principles of Concrete mix design, methods of Concrete mix design, Design of high strength and high performance concrete.		8	15
MODULE 4:Rheological behaviour of fresh Concrete, Properties of fresh and hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength. Non destructive testing and quality control, Durability, corrosion protection and fire resistance		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Modern trends in concrete manufacture and placement techniques, Methods of transportation, Placing and curing-Extreme whether concreting, Special concreting methods, Vacuum dewatering of concrete– Under water concreting.		6	20
MODULE 6:Light weight Concrete, Fly–ash Concrete, Fibre reinforced Concrete, Polymer Concrete, Epoxy resins and screeds for rehabilitation – properties and application – Emerging trends in replacement of fine aggregates.		6	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6111	PRESTRESED CONCRETE STRUCTURES	**3-0-0-3**	**2015**

Pre-requisites:

Course Objectives:

- To Explain the effects of prestress on the behaviour of concrete beams and identify situations when prestress is needed
- To determine the combined stresses induced by prestress and applied loads
- To define and determine the different types of losses of pre-stressed concrete

Syllabus

Analysis and design of simply supported (post and pre tensioned) ,Design for shear, bond and torsion – Design of end blocks (IS code method),Design of tension members - Design of compression members ,Composite construction with precast RC beamsStatically indeterminate structures – Analysis and design – Continuous beams

Course Outcome:

The students will be familiar the concepts of pre-stressed concrete, dealing with load analysis. also be introduced to types pre stressed concrete structures

Text Books:

References:

1. Krishna Raju N, “Prestressed Concrete” , 4th Edition TMH New Delhi , 2000
2. Sinha N.C. & Roy, “Fundamentals of Prestressed Concrete”, S.Chand& Co, 1985
3. Rajagopalan N, “Prestressed Concrete”, Narora Publishing house, 2002
4. Lin T.Y, “Design of Prestressed Concrete Structures”, John Wiley & Sons , 1960
5. Pandit and Gupta, “Prestressed concrete”, CBS, 2002
6. F K Kong and R H Evans, “ reinforced and prestressed concrete”, TMH, 1999

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6111	PRESTRESED CONCRETE STRUCTURES	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Analysis and design of simply supported (post and pre tensioned) - PSC flexural members – Basic concepts – Stresses at transfer and service loads, ultimate strength in flexure – short term deflections and long term deflections as per IS Code		6	15
MODULE 2:Design and analysis of post and pre tensioned PSC slabs.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)7			
MODULE 3:Design for shear, bond and torsion – Design of end blocks (IS code method) – Design of prestressed concrete cylindrical water tanks – Design of prestressed concrete pipes		7	15
MODULE 4:Design of tension members - Design of compression members – compression members with and without flexure – Design of piles .		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Composite construction with precast RC beams- Analysis and design – Ultimate strength – Partial prestressing– Definitions – principles and design approaches.		8	20
MODULE 6:Statically indeterminate structures – Analysis and design – Continuous beams – concept linear transformation – concordant cable profile and cap cables.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6113	STRUCTURAL RELIABILITY	**3-0-0-3**	**2015**

Pre-requisites:

Course Objectives:

- To provide a brief review of mathematical tools for quantifying uncertainties using theories of probability ,random variables and random processes
- To provide necessary background to carryout reliability based design

Syllabus

Concepts of structural safety,Probability theory, resistance distribution and parameters,Probabilistic analysis of loads,Basic structural reliability,Level-2 Reliability method

Course Outcome:

The student will understand the theories of probability ,random variables and random processes. And also able to carryout reliability based design

Text Books:

References:

1. NobrertLlyd Enrick, “Quality control and reliability”, Industrial press New York.
2. A K Govil, “Reliability engineering”, Tata McGraw Hill, New Delhi.
3. Alexander M Mood, “Introduction to the theory of statistics”, McGraw Hill, Kogakusha Ltd.
4. Ranganathan, “Reliability of structures”.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6113	STRUCTURAL RELIABILITY	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Concepts of structural safety:-Basic statistics:-Introduction-data reduction-histograms-sample correlation.		6	15
MODULE 2:Probability theory, resistance distribution and parameters:-Introduction- statistics of properties of concrete and steel, statistics of strength of bricks and mortar		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Dimensional variations-characterisation of variables of compressive strength of concrete in structures and yield strength of concrete in structures and yield strength of steel – allowable stresses based on specified reliability		7	15
MODULE 4:Probabilistic analysis of loads: - Gravity load-introduction-load as a stochastic process. Wind load-introduction-wind speed-return period-estimation of lifetime wind speed-probability model of wind load.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Basic structural reliability: - Introduction-computation of structural reliability. Monte carlo study of structural safety and applications.		8	20
MODULE 6:Level-2 Reliability method: - Introduction-basic variables and failure surface-first order second moment methods like Hasofer and Linds method-nonnormal distributions-determination of B for present design-correlated variables.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
09 GN 6001	RESEARCH METHODOLOGY	0-2-0:2	2015

Pre-requisites:

Course Objectives:

To enable the students:

- To get introduced to research philosophy and processes in general.
- To formulate the research problem and prepare research plan
- To apply various numerical /quantitative techniques for data analysis
- To communicate the research findings effectively

Syllabus

Introduction to the Concepts of Research Methodology, Research Proposals, Research Design, Data Collection and Analysis, Quantitative Techniques and Mathematical Modeling, Report Writing.

Course Outcome:

Students who successfully complete this course would learn the fundamental concepts of Research Methodology, apply the basic aspects of the Research methodology to formulate a research problem and its plan. They would also be able to deploy numerical/quantitative techniques for data analysis. They would be equipped with good technical writing and presentation skills.

Text Books:

1. Research Methodology: Methods and Techniques', by Dr. C. R. Kothari, New Age International Publisher, 2004
2. Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, SAGE Publication*s* Ltd; Third Edition

References:

1. Research Methodology: An Introduction for Science & Engineering Students', by Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004
2. Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, Juta and Company Ltd, 2004
3. Research Methodology, G.C. Ramamurthy, Dream Tech Press, New Delhi
4. Management Research Methodology' by K. N. Krishnaswamy et al, Pearson Education

COURSE CODE:	COURSE TITLE	CREDITS	
09 GN 6001	RESEARCH METHODOLOGY	0-2-0: 2	
MODULES		Contact Hours	
MODULE : 1 Introduction to Research Methodology: Concepts of Research, Meaning and 2 Objectives of Research, Research Process, Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical		5	
MODULE :2 Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.		4	
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 **Research Design :** Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review, Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.		5	
MODULE 4: **Quantitative Techniques:** Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods, Concepts of correlation and regression - Fundamentals of time series analysis and spectral analysis.		5	
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 **Report Writing:** Principles of Thesis Writing, Guidelines for writing reports & papers, Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement.		5	
MODULE: 6 Documentation and presentation tools – LaTeX, Office with basic presentations skills, Use of Internet and advanced search techniques.		4	

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6193	COMPUTER APPLICATIONS LAB	0-0-2:1	2015

Application of Structural analysis & design software like STRAP, STAAD and management software like SURETRACK. The student has to practice the packages by working out different types of problems.

Semester 2

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6102	BRIDGE ENGINEERING	3-1-0:4	2015

Pre-requisites:

Course Objectives:

1. To study the various bridge forms and typical loadings on the bridges.
2. To get familiarised with the design of short span bridges.

Syllabus

Planning of bridges, Design of girder bridges and bearings, Construction methods

Course Outcome:

The student will understand the design theories for super structure and substructure of bridges and able to design Culvert, R.C.C T beam bridge

Text Books:

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.Relevant IS Codes, and IRC Codes.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE **6102**	**BRIDGE ENGINEERING**	**3-1-0:4**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:Investigation for bridges, need for investigation, selection of site, subsoil exploration, investigation report– importance for proper Investigation. Types of bridges, components of bridges		8	15
MODULE 2:Design of RCC bridges– IRC loading, economical span, analysis and design of slab bridges and box culvert.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:T-beam bridges– Analysis and design of deck slab, longitudinal girders and cross girders–Pigeaud's method– Courbon's method		8	15
MODULE 4:Morice and Little method, Hendry–Jaegar method– prestressed concrete bridges(simply supported case only).		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: 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		12	20
MODULE 6: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.		12	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6104	FINITE ELEMENT ANALYSIS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

To make the Student:-

- understand the general plate bending theories
- obtain an understanding of the fundamental theory of FEA
- develop the ability to generate the governing differential equations

Syllabus

Introduction to FEM -General procedure of FEA - Displacement approach-Variational principles-Derivation of Shape functions-Convergence criteria - Conforming & nonconforming elements-Derivation of Stiffness matrix-axisymmetric problems Isoparametric elements - Numerical Integration.- Gauss-Quadrature General plate bending elements-Plate bending theory – Kirchhoff's theory – Mindlin's theory – locking problems - -spurious modes.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understandthe fundamental concepts of theory of FEA and will be able use the basic finite elements for structural applications using truss, beam, frame and planeelements

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6104	**FINITE ELEMENT ANALYSIS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:**Introduction to FEM** Historical development - Idealization of structures-Mathematical model - General procedure of FEA - Displacement approach		6	15
MODULE 2:**Variational Approaches to FEM** Variational principles weighted residual approach and method of virtual work. Derivation of equilibrium equations**.**		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:**Shape functions** Introduction to Shape Functions-characteristics-Derivation of Shape functions using different methods- -Lagrangian and Hermition Interpolation–Generalised coordinates–Natural coordinates		7	15
MODULE 4:**Stiffness matrix** Derivation of Stiffness matrix of Bar element - Beam element - Plane stress and plane strain and axisymmetric problems -Triangular elements - Constant Strain Triangle - Linear Strain Triangle – using generalized coordinates-natural coordinates etc. – Fellipas method		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:**Convergence Criteria & Numerical Integration** Compatibility-$C^{\circ}$and C^{1} elements - Convergence criteria - Conforming & nonconforming elements – Patch test. Legrangian and Serendipity elements, static condensation - Isoparametric elements - Numerical Integration.- Gauss- Quadrature – Computer implementation of finite element method		8	20
MODULE 6:**General plate bending elements** Plate bending theory – Kirchhoff's theory – Mindlin's theory – locking problems - preventive measures – reduced integration – selective integration-spurious modes		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6106	Theory of Plates and Shells	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To provide an elementary knowledge of mechanics of materials and mathematics
- To provide a simple and comprehensive mathematical analysis of plate theories and their application to plate bending problems
- Give an insight into the behavior of the plate structure, maintaining a fine balance between analytical and numerical methods
- To provide a knowledge of the fundamentals of theory of shells and folded plates

Syllabus

Plates: Introduction; Pure bending of plates; Laterally loaded rectangular plates; Simply supported rectangular plates under sinusoidal load; Circular plates. Shells: Introduction; Classical theory of shells. Folded plates: Fundamental concepts.

Course Outcome:

- Students will be able to apply fundamental concepts of mechanics of materials and mathematics to practical engineering problems.
- Students will be able to determine the properties and behavior of plates and shells

Text Books:

1. S.P Timoshenko, S.W Krieger (2001), " Theory of plates and shells", McGraw Hill, New York
2. Lloyd Hamilton Donnell (1976), "Beams, plates and shells", McGraw Hill, New York.

References:

1. Owen F Hughes (1983), "Ship structural design", John Wiley & Sons, New York
2. G.S. Ramaswamy (1986), "Design and Construction of Concrete Shell Roofs", Tata McGraw Hill Book Co.Ltd
3. Krishna Raju N. (1998), "Advanced Reinforced Concrete Design", CBS Publishers and distributers, New Delhi

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6106	Theory of Plates and Shells	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:**1Plates** Introduction – classification of plates – thin plates and thick plates – assumptions in the theory of thin plates – differential equation for cylindrical bending of rectangular plates		7	15
MODULE 2:**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.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:**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		7	15
MODULE 4:**Simply Supported rectangular plates under sinusoidal Load**Navier solution for simply supported plates subjected to uniformly distributed - Levy's solution for simply supported rectangular plates– uniformly distributed and concentrated load		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:**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 center.		8	20
MODULE 6:**Classical theory of Shells** Structural behavior 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		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6108	Structural Optimisation	3-0-0: 3	**2015**

Pre-requisites:

- **Course Objectives**: To introduce the fundamentals of optimization concepts, their applications in the structural engineering field andto study the linear programming methods of the optimization.

Syllabus

Introduction and Problem formulation with examples;Single Variable Unconstrained Optimisation Techniques ,Multi Variable Unconstrained Optimisation Techniques,ConstrainedOptimisationTechniques;Classical methods and Specialized Optimisation techniques.

Course Outcome:

The student will be able to apply the basic ideas in optimization to make the structures as lightly as possible and also apply the linear programming techniques in engineering optimization

Text Books:

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 Hil

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6108	Structural optimisation	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Introduction –Problem formulation with examples; Single Variable Unconstrained Optimisation Techniques – Optimality Criteria; Bracketing methods– Unrestricted search, Exhaustive search		7	15
MODULE 2: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.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Multi Variable Unconstrained Optimisation Techniques – Optimality Criteria; Unidirectional Search ; Direct Search methods – Random search, Grid search, Univar ate method, Hooke's and Jeeves' pattern search method, Powell's conjugate direction method, Simplex method;		7	15
MODULE 4:Gradient based methods–Cauchy's (Steepest descent) method, Conjugate gradient (Fletcher–Reeves) method, Newton's method, Variable metric (DFP)method, BFGS method.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Constrained OptimisationTechniques;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.		7	20
MODULE 6:Specialized Optimisation techniques – Dynamic programming, Geometric programming, Genetic Algorithms.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6112	Advanced Analysis Of Structures	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives:

1. Study about Fundamental concepts of flexibility and stiffness matrices for the single and two coordinate system.
2. Study about Indeterminate structures and transformation of stiffness and flexibility matrices from system coordinate to element coordinate

Syllabus

Review of work and energy principles - Maxwell, Betti, Castiglianotheorems,static& kinematic indeterminacy Stiffness method,Structure stiffness matrix,ElementFlexibility matrix– equilibrium–compatibility–analysis of beams & frames (rigid and pin jointed), grids

Course Outcome:

Students will be able understand the basic concept of flexibility & stiffness, principle of superposition and methods of structural analysis and they will be Able to transform the unknown from system coordinates to element coordinates

References:

1. Mukhopadhyay M., "Matrix Finite Element Computer and Structural Analysis", Oxford & IBH, 1984.
2. Weaver & Gere, "Matrix Analysis of Structures", East West Press.
3. Moshe F Rubinstein– "Matrix Computer Analysis of Structures"– Prentice Hall, 1969.
4. Meek J.L., "Matrix Structural Analysis", McGraw Hill, 1971.
5. Reddy C.S., "Basic Structural Analysis", Tata McGraw Hill Publishing Co.1996.
6. Smith J.C. "Structural Analysis", Macmillian Pub.Co.1985.
7. Rajesekharan&Sankarasubramanian,G., "Computational Structural Mechanics", Prentice Hall of India, 2001.
8. Mukhopadhyay M., "Matrix Finite Element Computer and Structural Analysis", Oxford & IBH, 1984.
9. Wang C.K.& Solomon C.G.," Introductory Structural Analysis", McGraw Hill.1968.
10. Pezemieniecki, J.S, "Theory of Matrix Structural Analysis", McGraw Hill Co.,1984.
11. Seeli F.B.& Smith J.P., "Advanced Mechanics of Materials", John Wiley &Sons, 1993.
12. Norris & Wilbur, "Elementary Structural Analysis", McGraw Hill.

DamodarMaity, "Computer Analysis of Framed Structures", I K International

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6112	Advanced Analysis Of Structures	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Matrix methods-Review of work and energy principles - Maxwell, Betti, Castigliano theorems- principles virtual work		8	15
MODULE 2:Classification of structures–discrete structures–elements–nodes–degrees of freedom–static& kinematic indeterminacy Stiffness method–coordinate systems–element stiffness matrix.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Stiffness method – analysis of pin jointed frames (temperature effect, lack of fit), continuous beams (settlement of supports), rigid jointed frames and grids.		7	15
MODULE 4:Direct stiffness approach-Structure stiffness matrix–assembly–equivalent joint load – incorporation of boundary conditions –solutions–Gauss elimination–matrix inversion–analysis of pin jointed frames, continuous beams.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:ElementFlexibility matrix–truss element–beam element–force transformation matrix – equilibrium–compatibility		7	20
MODULE 6:Analysis of beams & frames (rigid and pin jointed), grids.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6114	COMPUTER AIDED DESIGN	**3-0-0:3**	**2015**

Pre-requisites:

1. **Course Objectives**: To familiarise with graphic primitives, transformations and 2-D drafting of computer graphics.

2.To get practiced with computer methods of structural analysis

Syllabus

History and overview of CAD– advantages of CAD over manual drafting and design ,Popular CAD packagesConstruction activities:- The critical path method- General application software's- Civil engineering packages

Course Outcome:

The student will be familiarized with 2 D drafting and can use drafting software. And they can perform structural analysis using analysis package

Text Books:

1. **References**: Sujith Kumar Roy &SubrataChakrabarty, "Fundamentals of Structural Analysis", S Chand $ Company Ltd., New Delhi.
2. B.Sengupta& H. Guha, "Construction Management and Planning", Tata McGraw Hill Publishing Co. Ltd, New Dehi.
3. R.L Peurifoy, "Constuction Planning, Equipment and methods", Tata McGraw Hill Publishing Co. Ltd, Kogakusha.
4. Mikell P. Groover&Emroy W Zimmers,Jr, "CAD/CAM Computer Aided Design and Computer Aided Manufacturing"
5. L S Sreenath, CPM – PERT.
6. C.S. Krishnamoorthy, S.Rajeev, A Rajaraman, "Computer Aided Design – Software and Analytical Tools",Narosa Publishing House, New Delhi

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6114	COMPUTER AIDED DESIGN	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:History and overview of CAD– advantages of CAD over manual drafting and design – hardware requirements – computers and workstation, elements of interactive graphics, input/out put display, storage devices in CAD, and an overview of CAD software – 2D Graphics, 3D Graphics.		6	15
MODULE 2:Popular CAD packages, Type of structure, Unit systems, structure geometry and Co-ordinate systems - global co- ordinate system, Local co-ordinate systems –Relationship between Global and Local co-ordinate systems Edit Input-Command Formats-Text Input		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Graphical Input Generation-"Concurrent" Verifications-Library Geometry-Generation–Dimensioning-loading- Analysis		7	15
MODULE 4:Construction activities:- The critical path method-Definitions of terms and symbols- Steps in critical path scheduling-Developing a critical path schedule - Determining free float-Determining total cost of project		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Manual versus Computer analysis of critical path methods–Popular packages in Construction Management and MIS.		8	20
MODULE 6:Information types and uses:- General application software's- Civil engineering packages, Project management software, advanced structural engineering software's, Expert systems for construction.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6116	**MICROSTRUCTURE AND INNOVATIONS IN STRUCTURAL CONCRETE**	3-0-0: 3	**2015**

Pre-requisites:

- **Course Objectives**: To prepare the graduates as best civil engineers with an excellent comprehension of fundamental of concrete structures at micro & macro levels and to make the graduates best fit in the concrete construction industry by providing knowledge in advanced topics like application of SEM,Non destructive testing methods

Syllabus

The Structure of Concrete,Structure property relationships in hydrated cement paste, Transition zone in concrete, Self-compacting Concrete, Engineering Properties, Effect of Temperature on Concrete, Important material properties of concrete under temperature, Supplementary Cementitious Materials, Characterization of Concrete (Concept Only)

Course Outcome:

- Able to recognize the mechanism of degradation of concrete structures and conduct preliminary forensic assessment of deteriorated concrete structures and the ability to monitor the non destructive evaluation of concrete structures

Text Books:

1. **References**: P. Kumar Mehta and Paulo J. M. Monteiro, “Concrete, Microstructure, Properties and Materials” Indian Concrete Institute, Chennai.
2. J.A. Purkiss, “Fire Safety Engineering” Butterworth-Heinemann.
3. E.G. Butcher and A.C. Parnell, “Designing for Fire Safety” John Wiley and Sons.
4. E.E. Smith and T.Z. Harmathy, “Design Buildings for Fire Safety” ASTM Special Technical Publication 685, A Symposium Sponsored by ASTM Committee EQ5 on Fire Standards.
5. A.M. Neville, “Properties of Concrete” Addison Wesley Longman Limited, England.
6. A.M. Neville and J.J. Brooks, “Concrete Technology” Pearson Education, Asia.
7. P.C. Varghese, “Advanced Reinforced Concrete Design” PHI Learning Private Limited, New Delhi.
8. EFNARC, “The European Guidelines for Self-Compacting Concrete, Specification, Production and Use” EFNARC-2005, UK.
9. P.J.M. Bartos, M. Sonebi and A.K. Tamimi, “Workability and Rheology of Fresh Concrete: Compendium of Tests” RILEM Publications S.A.R.L,France.
10. 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.
11. George Widmann, “Interpreting TGA Curves” User Com.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6116	**MICROSTRUCTURE AND INNOVATIONS IN STRUCTURAL CONCRETE**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:The Structure of Concrete: -Significance and Complexities, Structure of aggregate phase, Structure of hydrated cement paste, Solids in hydrated cement paste, Voids in hydrated cement paste and Water in hydrated cement paste. Structure property relationships in hydrated cement paste:-Strength, Dimensional stability and Durability		6	15
MODULE 2:Transition zone in concrete: -Significance of transition zone, Structure of transition zone, Strength of transition zone and Influence of transition zone on properties of concrete. Self-compacting Concrete:-Introduction, Definition and terms like Addition, admixture, Binder, Filling ability, Fines (Powder), Flow ability, Fluidity, Passing ability, Robustness, Segregation resistance, Slump-flow, Thixotrophy, Viscosity modifying admixture, constituent materials, Mix design, Test methods and conformation.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Engineering Properties:-Compressive strength, Tensile strength, Modulus of elasticity, Creep, Shrinkage, Coefficient of thermal expansion, Bond to reinforcement, Shear force capacity, Fire resistance and durability. Requirements:- Basic and Additional requirements and Requirements in fresh state, Consistence classification, Slump flow, Viscosity, Passing ability and Segregation resistance.		7	15
MODULE 4:Effect of Temperature on Concrete:-Stressed, Unstressed and Unstressed residual test methods. Important material properties of concrete under temperature:-Thermal expansion, Thermal conductivity, Thermal capacity and thermal diffusivity, Modulus of elasticity, Poisson's ratio, Stress-strain relationship and Creep deformation		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Strength: -Compressive and Tensile. Influence of aggregate type. Supplementary Cementitious Materials:-Different materials, Pozzolanic reaction.		8	20
MODULE 6:Characterization of Concrete (Concept Only):- X-Ray Diffraction Analysis (XRD):- Introduction, Basic Principle, Identification of Major Phases Present in Cement/Clinker, Sample Preparation and X-Ray Diffractometry in Concrete, Hydrated Cement Paste, Aggregate		8	20

Interface. Scanning Electron Microscope (SEM) Analysis: Introduction of Scanning Electron Microscopy, Specimen Preparation, Concrete under the SEM, Mineral Admixtures in Concrete. Thermo Gravimetric Analysis (TGA): -Introduction, Interpreting TGA Curves related to Concrete.		
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6118	**ADVANCED STEEL STRUCTURES**	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: To give the Student:-

- To study and design members subjected to lateral loads and axial loads
- To focus on the study and design of various steel towers and steel chimneys& light gauge steel structures.

Syllabus

Design of members subjected to lateral loads and axial loads ,Crane gantry girders and crane columns,Bracing of industrial buildings and bents.,Analysis and design of steel towers,Self supporting and guyed stacks lined and unlined,Stresses due to wind and earthquake forces – Design of foundations– Moment redistribution Static, Kinematic and uniqueness theorems – Combined mechanisms Connections, moment resisting connectionsDesign of light gauge sections ,Types of connections

Course Outcome:

- Students who successfully complete this course will gain knowledge of designing different types of steel members.alsodesigning light gauge steel structures

Text Books:

1. **References**: Punmia B.C, “Comprehensive Deign of Steel structures”, Laxmi publications Ltd, 2000.
2. Arya, A.S, “Design of Steel Structures”, Newchand& bros, Roorkee, 1982
3. Ram Chandra, “Design of Steel Structures II”, Standard Book House, Delhi.
4. Dayaratnam, “Design of steel structures”.
5. Rajagopalan, “Design of Storage structures”.
6. Baker, “Steel skeleton”.
7. S.K.Duggal , “Design of Steel Structures”, McGraw Hill.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6118	ADVANCED STEEL STRUCTURES	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Design of members subjected to lateral loads and axial loads		6	15
MODULE 2:Principles of analysis and design of Industrial buildings and bents – Crane gantry girders and crane columns – Bracing of industrial buildings and bents.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Analysis and design of steel towers, trestles and masts – Design of industrial stacks – Self supproting and guyed stacks lined and unlined – Stresses due to wind and earthquake forces – Design of foundations		7	15
MODULE 4:Introduction – Shape factors – Moment redistribution Static, Kinematic and uniqueness theorems – Combined mechanisms – Analysis Portal frames. Method of plastic moment distribution – Connections, moment resisting connections		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Design of light gauge sections – Types of cross sections – Local buckling and post buckling – Design of compression and Tension members – Beams – Deflection of beams – Combined stresses and connections.		8	20
MODULE 6:Types of connections, Design of framed beam connections, Seated beam connection, Unstiffened, Stiffened Seat connections, Continuous beam – to – beam connections and continuous beam–to–column connection both welded and bolted		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6122	DESIGN OF SUBSTRUCTURES	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: To give the Student:-

- To impart knowledge on the types and purposes of different foundation systems and structures
- To provide students with exposure to the systematic methods for designing foundations

Syllabus

Substructures,RaftFoundations,PileFoundations,Load capacity of single piles
Pier Foundations,Types of piers and Uses ,Well Foundations,Types – Construction of Wells Substructures in Expansive soils

Course Outcome:

- Students who successfully complete this course willbe able to understand the nature of soil condition and design the foundation structure and also to analyze, design detailing, estimation and costing of Structural components with high level of competency

Text Books:

1. **References**: J.E.Bowles, “Foundation Analysis and Design”, Mc. Graw Hill Publishing Co., New
2. York
3. 2. Tomlinson, “Pile Design and Construction Practice”, A View Point Publication.
4. 3. Swami Saran, “Design of Substructures”, Oxford & IBH publishers, New Delhi.
5. 4. W.C. Teng, “Foundation Design”, Prentice Hall of India, New Delhi .
6. 5. Ninan P. Kurian – “Modern Foundations”.
7. 6. Lamb &Whileman – “Soil Mechanics

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6122	DESIGN OF SUBSTRUCTURES	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Substructures-Definition and Purpose – Design principles – Design loads – Permissible settlements –Considerations in seismic design of sub structures		6	15
MODULE 2:Raft Foundations-Types of raft – Bearing capacity and settlement of rafts – Beams on elastic foundation –Methods of design of rafts		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Pile Foundations-Load capacity of single piles – Static and dynamic formulae – Pile load tests – Cyclic pileload tests – Laterally loaded piles. Pile groups – Group Efficiency – Design of pile groups – Settlement of single and pilegroups in clays and sands – Negative skin friction on single and pile groups		7	15
MODULE 4:Pier Foundations-Types of piers and Uses – Allowable bearing capacity – Design and construction of Piers –Settlement of Piers		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Well FoundationsTypes – Construction of Wells – Failures and Remedies – Bearing capacity Design of wellfoundations – Lateral stability – sinking of wells.		8	20
MODULE 6:Substructures in Expansive soilsCharacteristics of Expansive soils – Foundation problems – Foundation alternatives –Methods of Foundations – Design and Construction of under reamed piles		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6124	EARTHQUAKE RESISTANT DESIGN	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: To give the Student:-

- To assists inanalyzing the interaction between civil infrastructure and the ground, including the consequences of earthquakes on structures.
  For the proper design and construction of buildings in accordance with building codes, so as to minimize damage due to earthquakes

Syllabus

Engineering Seismology ,Dynamics of Structures (SDOFS/ MDOFS), Response Spectra Structural Systems -Types of Buildings, Causes of damage, Earthquake Resistant Earthen Buildings, Earthquake Resistant Masonry Buildings -Design consideration –Guidelines Lateral load analysis -Design and detailing ,Shear wall Capacity based design

Course Outcome: Students who successfully complete this course will be exposed to proper design of buildings so they will resist damage due to earthquakes, but at the same time not be unnecessarily expensive

Text Books:

References: PankajAgarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2006 .
2. S K Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 2007.
3. Course Notes "Design of Reinforced Concrete Buildings", IIT Kanpur, June 1999

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6124	EARTHQUAKE RESISTANT DESIGN	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Engineering Seismology (Definitions,Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation		7	15
MODULE 2:Dynamics of Structures (SDOFS/ MDOFS), Response Spectra -Average Response Spectra -Design Response Spectra,Evaluation of Earthquake Forces as per codal provisions, Effect of Earthquake on Different Types of Structures, Lessons Learnt From Past Earthquakes		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Structural Systems -Types of Buildings, Causes of damage, Planning Considerations, Philosophy and Principle of Earthquake Resistant Design, Guidelines for Earthquake Resistant Design		6	15
MODULE 4:Earthquake Resistant Earthen Buildings, Earthquake Resistant Masonry Buildings -Design consideration –Guidelines. Earthquake Resistant Design of R.C.C. Buildings -Material properties		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Lateral load analysis -Design and detailing – Rigid Frames –Shear wall –Coupled Shear wall- Mathematical modeling of multistoried RC Buildings –Capacity based design.		7	20
MODULE 6:Vibration Control -Tuned Mass Dampers –Principles and application, Basic Concept of Seismic Base Isolation –various Systems-Case Studies, Important structures		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6126	EXPERIMENTAL STRESS ANALYSIS	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: To give the Student:-

- Able to demonstrate basic understanding of experimental methods commonly used in solid mechanics.Eg- Strain gauge, photo elasticity, image correlation etc
- To familiarize the students with various strain measurements and non destructive testing techniques

Syllabus

Strain measurement: mechanical, optical acoustical strain gauges– linear variable differential transformer (LDVT), Photo elasticity – Light and optics as related to photoelasticity.Methods of measuring sensitivity like cantilever calibration, determination of ultimate strength, refrigeration techniques,Introduction to moiré fringe techniques of stress analysis.

Course Outcome:

- Students who successfully complete this course willbeable to use strain gauges and its principles also to understand the non destructive testing methods

Text Books:

References:

1. Dalley and Rilley, “Experimental Stress Analysis”.
2. P.H. Adams & R.C. Dove, “Experimental Stress Analysis and motion Measurement”.
3. M. Hetney, Hand book of experimental stress analysis.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6126	EXPERIMENTAL STRESS ANALYSIS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:Strain measurement: mechanical, optical acoustical strain gauges. Electrical resistance strain gauges, strain rosettes.		6	15
MODULE 2:Measurement of displacements – potentiometers – linear variable differential transformer (LDVT), Accelerometeres,		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Measurement of force : Load cells, Electrical resistance based: Ring type force transducer, pressure transducer		8	15
MODULE 4:Photo elasticity – Light and optics as related to photoelasticity, theory of photo elastic model materials, analysis techniques. Separation and compensation methods.Introduction to 3–dimensional photoelasticity.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Methods of measuring sensitivity like cantilever calibration, determination of ultimate strength, refrigeration techniques, relaxation techniques, double crack analysis of brittle coating data		7	20
MODULE 6:Introduction to moiré fringe techniques of stress analysis		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6194	**STRUCTURAL ENGINEERING LAB**	0-0-2:1	**2015**

1. Mix design of concrete of different grades and using admixtures.
2. Tensile and flexural strength of concrete of different grades.
3. Testing of simply supported RCC beams for flexural failure.
4. Testing of simply supported RCC beams for shear failure.
5. Study on the behavior of prestressed concrete beam.
6. Testing of simply supported RCC beam for combined bending and shear failure.
7. Testing of RCC column.
8. Non-destructive testing of concrete including rebound hammer and ultrasonic pulse method.
9. Structural Dynamics:

    i. Free vibration analysis of cantilever beam.
    ii. Free vibration analysis of simply supported beam.
    iii. Free vibration analysis of simply supported beam with tuned mass.

Note: Students should design the concrete mix and cast RCC and PSC beams. Calculate the theoretical loads and conduct experiments on the beams. Measure load, deformation and strain and plot load-deformation curve and moment-curvature relationship.

SEMESTER 3

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7101	**DESIGN OF CYLINDRICAL SHELL AND FOLDED PLATES**	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: The Student will be able to:-

- To classify and analyse the different type of shell structures
- To classify and analyse the different type of folded plates

Syllabus

Classification of shells, Design of cylindrical shell, Design of shells with double curvature, Design of paraboloid shells, Types of Hyperbolic paraboloids, Analysis of the edge members, Folded plate, Design of reinforcements in folded plates and supporting diaphragms

Course Outcome:

- Students who successfully complete this course will be able to analyse various shells and understand the behaviour of folded plates.

Text Books:

1) **References**: P.C.Varghese., "Design of reinforced concrete shells and folded plates" - PHI-New Delhi - 2010
2) Krishna Raju .N., "Advanced Reinforced concrete Design". - CBS Publishers and distributor –New Delhi-2003
3) Ramaswamy G.S., "Design and construction of concrete shell roofs" – CBS Publishers
4) Chatterjee B.K., "Theory and Design of concrete shell"- Chapman & Hall
5) Bandhopadhyay., "Thin shell structures"- New age International Publishers – New Delhi
6) Chandrasekhar., " Analysis of thin concrete shells" - New age International Publishers– New Delhi.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7101	DESIGN OF CYLINDRICAL SHELL AND FOLDED PLATES	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:General classification of shells - shells of revolution - translational shells - ruled surfaces - folded plates (hipped plates).Gausian curvature – thin – thick shells – long shells – short shells – Design of cylindrical shell based on membrane theory		7	15
MODULE 2:Design of cylindrical shell with edge beams-Design of transverse stiffners of long shells. Design of shells with double curvature – Design of spherical domes		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Membrane analysis-Analysis of domes with skylight – Design of ring beams (edge member)- Design of conical shells - conical dome roof with ring beams.		7	15
MODULE 4:Design of paraboloid shells-(shells formed from two parabolas). Types of Hyperbolic paraboloids – Types of hyper shells with straight rectangular edges – shallow and deep H.P shells			15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Analysis of shell part of shallow hyper shells with straight edges-Analysis of the edge members. Folded plate – introduction-methods of analysis – complete analysis of folded plates		7	20
MODULE 6: Design of reinforcements in folded plates and supporting diaphragms – Design of steel for transverse moments- Design of longitudinal steel.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7103	Design Of Steel Concrete Composite Structures	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: The Student will be able to:-

- To get introduced to composite construction and composite behavior of steel concrete composite structures.
- To obtain the knowledge to conceptualize and design the composite structures

Syllabus

Introduction to steel - concrete composite construction, Design of composite beams, slabs, columns, beam – columns, Design of connections in the composite structures, Behaviour of box girder bridges, Case studies

Course Outcome:

- Students who successfully complete this course will possess knowledge of the composite behavior of structures and have the ability to design various composite structural elements

Text Books:

References:

1. Johnson R.P., “Composite Structures of Steel and Concrete”, Blackwell Scientific Publications, UK, 2004.
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Pergamon press, Oxford, 1995.
3. Proceedings of Workshop on “Steel Concrete Composite Structures”, Anna University, 2007

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7103	Design Of Steel Concrete Composite Structures	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Introduction to steel - concrete composite construction - theory of composite structures -construction.		7	15
MODULE 2:Design of composite beams, slabs, columns		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Design of beam – columns - design of composite trusses.		7	15
MODULE 4:Types of connections, Design of connections in the composite structures –shearconnections. Degree of shear connection – Partial shear interaction		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Introduction - behaviour of box girder bridges - design concepts. Case studies on steel - concrete composite construction in buildings		7	20
MODULE 6:seismic behaviour of composite structures.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7105	**DESIGN OF TALL BUILDINGS**	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: The Student will be able to:-

- Plan tall buildings considering structural systems, fire rating, local considerations etc
- Evaluate loading for tall structures · Analyze and design of tall structural systems including structural connections

Syllabus

Design Philosophy,Gravity loading, Earthquake loading, Behaviour of High rise structures, Analysis and Design principles of various horizontal load transfer systems, Stability Analysis

Course Outcome:

- At the end of this course the student will be able toKnow design principles and different types of loading
- Describe the various structural systems used in the construction of Tall structures

Text Books:

References:

Taranath.B.S.,"Structural Analysis and Design of Tall Buildings",McGraw Hill Co.1988.
2.Schuller.W.G."High Rise Building Structures",John Wiley &sons,1977.
3.Lynn.S.Beedle,"Advances in tall Buildings",CBS Publishers and Distributors,New Delhi,1986.
4.Lin T.Y and StotesBurry.D,"Structural concepts and systems for Architects and Engineers",John Wiley and Sons,1988.
5.Dr.Gupta.Y.P,Editor,"Proceedings of National Seminar on High Rise Structures-Design and Construction practices for Middle Level Cities",Nov-14-16,1955.New Age International Publishers Ltd.,Chennai.
6.Smith.B.S and Coull.A.,"Tall Building Structures",Analysis and Design',John Wiley&sons,inc.,1991

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7105	DESIGN OF TALL BUILDINGS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:Design Philosophy-History-advantages and disadvantages-Vertical city concepts-essential amenities-Fire safety-water supply-drainage and garbage disposal-service systems-structural and foundation systems. Factors affecting height, growth and form-Human comfort criteria		7	15
MODULE 2:Gravity loading-Dead and live load-calculation-Impact and construction loads. Wind loading-static and dynamic approach-Analytical and wind tunnel experimental method.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Earthquake loading-Equivalent lateral force, Modal analysis-combination of loading in various design philosophies. Materials for tall buildings-High strength concrete-Light weight concrete-Fibre reinforced concrete Composite materials.		7	15
MODULE 4:Behavior of High rise structures-Different system for load distribution in steel and concrete-Vertical and horizontal load resistant systems-Rigid frames-braced frames-infilled frames-shear walls-Wall frames-tubular systems-outrigger braced systems-Mega systems.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Analysis and Design principles of various horizontal load transfer systems-approximate methods-Modelling for accurate analysis-3D analysis-Member forces-displacements. Analysis for various secondary effects-Creep, shrinkage and temperature		8	20
MODULE 6:Stability Analysis-Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity loading, P-effect and various methods of analysis –influence of foundation instability, out of plumb effects-Elastic Deformations.Dynamic Analysis-Principles of design of tall braced frames for earthquake and blast resistant design.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7107	**Experimental Techniques And Instrumentation**	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives: To give the Student:-

- To access the errors in measurement and learn the principles of measurement using various electronic and physical testing machines.
- To test various civil engineering structures using non-destructive testing methodologies

Syllabus

Choice of Experimental stress analysis methods, Characteristics of Structural Vibrations,Photo elasticity - principle andapplications. Principles of Pressure and flow measurements ,Diagnosis of distress in structures – crack observation and measurements –corrosion of reinforcement in concrete

Course Outcome:

- Students who successfully complete this course will be able to choose the methodology of measuring errors and strains and calibrate the machineries and equipment used in the laboratory. They can also perform advanced NDT methods in accessing the load testing of structures.

Text Books:

References:

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996
2. Dalley .J.W and Riley.W.F, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991
3. Srinath.L.S, Raghavan.M.R, ingaiah.K, Gargesha.G, Pant.B and Ramachandra.K, “Experimental Stress Analysis”, Tata McGraw Hill Company, New Delhi, 1984
4. Sirohi.R.S.,Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997
5. Bray.D.E. andStanley.R.K., “Course Material on Non-destructive Evaluation”,
6. McGraw Hill Publishing Company, New York.1989
7. Ravisankar.K.andChellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.
Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7107	Experimental Techniques And Instrumentation	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Choice of Experimental stress analysis methods, Errors in measurements –Straingauge, principle, types, performance and uses		6	15
MODULE 2:Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long-term monitoring – vibrating wire sensors– Fibre optic sensors		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Characteristics of Structural Vibrations – Linear Variable Differential Transformer(LVDT) – Transducers for velocity and acceleration measurements. Vibration meter –Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems		7	15
MODULE 4:Principles of Pressure and flow measurements – pressure transducers – sound levelmeter – venturimeter and flow meters – wind tunnel and its use in structural analysis– structural modeling – direct and indirect model analysis		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Diagnosis of distress in structures – crack observation and measurements –corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stressmeasurements		8	20
MODULE 6:Non – Destructive testing methods- Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – useof laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonicpulse echo, Impact echo, impulse radar techniques, GECOR , Ground penetratingradar (GPR).		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7109	**ENGINEERING FRACTURE MECHANICS**	**3-0-0:3**	**2015**

Pre-requisites:

- **Course Objectives**: To introduce linear and non linear fracture mechanics principles and their applications to structural design.

To discuss the fracture phenomena in metals and non metals

Syllabus

Significance of fracture mechanics, Linear Elastic Fracture Mechanics (LEFM),Crack tip plasticity, Energy Balance Approach, Elastic plastic fracture mechanics (EPFM):– Fatigue CrackGrowth:–Sustained load fracture

Course Outcome:

The student will understand able to predict material failure for any combination of applied stresses. And also to estimate failure conditions of a structure .

Text Books:

References:

1.Ewalds, H.L. &Wanhill, R.J.H., "Fracture Mechanics" – Edward Arnold
2. David Broek, "Elementary Engineering Fracture Mechanics", Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands.
3. Ed L. Elfgren and S.P. Shah, "Analysis of Concrete Structure by Fracture Mechanics", Proc of Rilem Workshop, Chapman and Hall, London.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7109	ENGINEERING FRACTURE MECHANICS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:Introduction:–Significance of fracture mechanics, Griffith energy balance approach,Irwin's modification to the Griffith theory, Stress intensity approach, Crack tip plasticity,Fracture toughness, sub–critical crack growth, Influence of material behaviour, I, II & III modes, Mixed mode problems		6	15
MODULE 2:Linear Elastic Fracture Mechanics (LEFM):–Elastic stress field approach, Mode I elasticstress field equations, Expressions for stresses and strains in the crack tip region, Finitespecimen width, Superposition of stress intensity factors (SIF), SIF solutions for wellknown problems such as centre cracked plate, single edge notched plate and embedded elliptical cracks		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Crack tip plasticity:–Irwin plastic zone size, Dugdale approach, Shape of plastic zone, State of stress in the crack tip region, Influence of stress state on fracture behaviour		7	15
MODULE 4:Energy Balance Approach:–Griffith energy balance approach, Relations for practical use, Determination of SIF from compliance, Slow stable crack growth and R–curve concept, Description of crack resistance.LEFM Testing:–Plane strain and plane stress fracture toughness testing, Determination of R–curves, Effects of yield strength and specimen thickness on fracture toughness, Practical use of fracture toughness and R–curve data		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Elastic plastic fracture mechanics (EPFM):–Development of EPFM, J–integral, Crackopening displacement (COD) approach, COD design curve, Relation between J and COD, Tearing modulus concept, Standard JIc test and COD test.FatigueCrackGrowth:–Description of fatigue crack growth using stress intensity factor, Effects ofstress ratio and crack tip plasticity – crack closure, Prediction of fatigue crack growthunder constant amplitude and variable amplitude loading, Fatigue crack growth fromnotches – the short crack problem.		8	20
MODULE 6:Sustained load fracture:–Time–to–failure (TTF) tests, Crack growth rate testing,Experimental problems, Method of predicting failure of a structural component, Practical significance of sustained load fracture testing. Practical Problems:–Through cracks emanating from holes, Corner cracks at holes, Cracks approaching holes, fracture		8	20

toughness of weldments, Service failure analysis, applications in pressure vessels, pipelines and stiffened sheet structures		
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7111	Maintenance and Rehabilitation of Structures	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives:

To give the Student:-

- Identify scope of rehabilitation work for dilapidated / obsolete buildings
- Identify and apply appropriate structural and construction technologies to rectify maintenance problems

Syllabus

Quality assurance for concrete construction ,Influence on serviceability and durability, Maintenance and repair strategies,, Assessment procedure for evaluating a damaged structure,testing techniques. Materials for repair,Special concretes and mortar,Techniques for repair:– Examples of repair to structures

Course Outcome:

Students who successfully complete this course can recognize the mechanisms of degradation of concrete structures and to design durable concrete structures and also they can learn how to conduct field monitoring and non-destructive evaluation of concrete structures

Text Books:

References:

1. Denison Campbell, Allen and Harold Roper, “Concrete Structures , Materials, Maintenance and Repair”,Longman Scientific and Technical UK, 1991.
2. R.T.Allen and S.C.Edwards, “Repair of Concrete Structures” ,Blakie and Sons, UK, 1987.
3. M.S.Shetty, “Concrete Technology – Theory and Practice” ,S.Chand and Company, New Delhi, 1992.
4. Santhakumar, A.R., " Training Course notes on Damage Assessment and repair in Low Cost Housing "," RHDC–NBO " Anna University, July, 1992.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7111	Maintenance and Rehabilitation of Structures	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Quality assurance for concrete construction as built concrete propertiesstrength, permeability, thermal properties and cracking		6	15
MODULE 2:Influence on serviceability and durability:–Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosioninhibitors, corrosion resistant steels, coatings, cathodic protection.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Maintenance and repair strategies:–Definitions : Maintenance, repair andrehabilitation, Facets of Maintenance importance of Maintenance, Preventive measures onvarious aspects Inspection, Assessment procedure for evaluating a damaged structure,causes of deterioration , testing techniques.		7	15
MODULE 4:Materials for repair:–Special concretes and mortar, concrete chemicals, specialelements for accelerated strength gain, Expansive cement, polymer concrete, sulphurinfiltrated concrete, ferro cement, Fibre reinforced concrete.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Techniques for repair:–Rust eliminators and polymers coating for rebars during repairfoamed concrete, mortar and dry pack, vacuum concrete, Gunite and ShotcreteEpoxyinjection, Mortar repair for cracks, shoring and underpinning.		8	20
MODULE 6:Examples of repair to structures:–Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marineexposure–case studies.		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7113	**NUMERICAL METHODS IN CIVIL ENGINEERING**	**3-0-0:4**	**2015**

Pre-requisites:

Course Objectives:

- To introduce the principles of numerical techniques to students.
- To review and implement the basic principles of interpolation and polynomial approxiamation,numerical integration, solving simple ordinary differential equations and partial differential equation

Syllabus

Solution of Linear and Non–linear Equations, Solution Techniques for Eigen Value Problems

Interpolation and integration, Finite difference technique

Course Outcome:

The student will beable to apply knowledge of mathematics,science&Engineering
And they can identify, formulate and solve engineering problems

Text Books:

References:

Rajasekaran S, “Numerical Methods in Science and Engineering – A practical approach”, AH Wheeler & Co.
2. Bathe K J, “Finite Element Procedures in Engineering Analysis”, Prentice Hall Inc.
3. James M L, Smith G M, and Wolford J C, “Applied Numerical Methods for Digital computation”, Harper and Row Publishers.
4. Krishnamoorthy E V and Sen S K, “Computer Based Numerical algorithms”, Afiliated East West Press.
5. Stanton R C, “Numerical Methods for Science and Engineering”, Prentice Hall of India.
6. M.K Jain,S.R.KIyengar,R.K Jain “Numerical Methods for Scientific and Engineering Computation”.
7. R.W. Hamming, “Numerical methods for scientist and engineers”, McGraw Hill, 1998.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7113	NUMERICAL METHODS IN CIVIL ENGINEERING	3-0-0:4	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:Solution of Linear and Non–linear Equations:–Review of Gaussian Elimination andCholesky methods – Storage schemes – Substructure concept – submatrix equation solver.Non linear system of equations: Newton Raphson , modified Newton Raphson Methods		6	15
MODULE 2:Solution Techniques for Eigen Value Problems:– Introduction – Forward iteration,inverse iteration, Jacobi, Given's method		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Transformation of generalized Eigen valueproblem to a standard form – Sturm sequence property – Subspace iteration method.		7	15
MODULE 4:Interpolation and integration:–Lagrange – Hermitian and cubic spline methods –Isoparametric style of interpolation. Numerical Integration –Newton-Cotes quadrature–Gaussian quadrature – Weights and Gauss points – Application to deflection of beams and plates.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Finite difference technique:–Initial and Boundary value problems of ordinary and partialdifferential equations applicable to beams and plates only		8	20
MODULE 6:Finite difference method,Newton' s Method, Variational and weighted residual methods. .		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7115	**Prefabricated Structures**	3-0-0: 3	**2015**

Pre-requisites:

Course Objectives:

- The students will get exposed to appreciate modular construction, industrialized construction Identify the design some of the prefabricated elements and also have the knowledge of the construction methods using these elements.

Syllabus

Types of prefabrication, prefabrication systems and structural schemes, Handling and erection stresses, Dimensioning and detailing of joints for different structural connections, Designing and detailing prefabricated units.

Course Outcome:

The student will be able to appreciate modular construction, industrialized construction and be able to Identify the design prefabricated elements .

Text Books:

References:

1. Hass,A.M.Precast Concrete Desibg and Applications,Applied Science publishers,1983.
2. Promyslolw,V Design And erection of Reinforced Concrete Structures,MIR Publishers, Moscow 1980
3. Koncz.T.,Manual of Precast Concrete Construction,Vol.I,II and III,Bauverlag,GMBH,1971
4. STructural Design Manual,Precast concrete connection Detaills,Society for studies in the use of Precast Concrete,NetherlandBetor Verlag,1978

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS
04 CE 7115	Prefabricated Structures	3-0-0:3

MODULES	Contact Hours	Sem. Exam Marks (%)
MODULE 1:Types of prefabrication,prefabricationsyatems and structural schemes- Disuniting of structures	7	15
MODULE 2:Structural behavior of precast structures	7	15
INTERNAL TEST 1 (MODULE 1 & 2)		
MODULE 3:Handling and erection stresses – Application of prestressing of roof members- floor systems two way load bearing walls,Wallpanels,hipped plate and shell structures.	7	15
MODULE 4:Dimensioning and detailing of joints for different structural connections; construction and expansion joints.Production,Transportation& erection	7	15
INTERNAL TEST 2 (MODULE 3 & 4)		
MODULE 5:Shuttering and mould design.Dimensional tolerance-Erection of R.C structures,Total prefabricated buildings	7	20
MODULE 6:Designing and detailing prefabricated units for (1) Industrial structures (2) Multistorey buildings and (3) Water tanks,silos bunkers etc , (4) Application of prestrerssed concrete in prefabrication	7	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6191/7191	SEMINAR –I/II	0-0-2: 2	2015

Course Objectives:

1. Improve the technical presentation skills of the students.
2. To train the students to do literature review.
3. To impart critical thinking abilities.

Methodology

Individual students are required to choose a topic of their interest from related topics to the stream of specialization, preferably from outside the M. Tech syllabus. The students are required to do a moderate literature review on the topic and give seminar. A committee consisting of at least three faculty members (preferably specialized in the respective stream) shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a write up of his seminar topic. The seminar report shall not have any plagiarised content (all sources shall be properly cited or acknowledged). One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other shall be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. It is encouraged to do simulations related to the chosen topic and present the results at the end of the semester.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7193	PROJECT PHASE - I	0-0-12: 6	2015

Course Objectives:

The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real-life problems related to industry and current research.

The project work can be a design project/experimental project and/or computer simulation project on any of the topics related to the stream of specialisation. The project work is chosen/allotted individually on different topics. Work of each student shall be supervised by one or more faculty members of the department. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to carry out their main project outside the parent institute, subject to the conditions specified in the M. Tech regulations of the Kerala Technological University. Students are encouraged to take up industry problems in consultation with the respective supervisors.

The student is required to undertake the main project phase-1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase-1 consist of preliminary work, two reviews of the work and the submission of a preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CE 7194	PROJECT PHASE - II	0-0-21: 12	2015

Main project phase II is a continuation of project phase-I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre -submission presentation before the evaluation committee to assess the quality and quantum of the work done. It is encouraged to prepare at least one technical paper for possible publication in journals or conferences. The project report (and the technical paper(s)) shall be prepared without any plagiarised content and with adequate citations, in the standard format specified by the Department /University.