SCHOOL OF ENVIRONMENTAL AND CONSTRUCTION TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

Kalasalingam Academy of Research and Education

(DEEMED TO BE UNIVERSITY)

M.Tech. in STRUCTURAL ENGINEERING

REGULATION 2018

(CHOICE BASED CREDIT SYSTEM)

M.Tech. in STRUCTURAL ENGINEERING
SCHEME OF INSTRUCTION

Course Code	Course Title	Course Type	L	T	P	C
MAT18R5001	Applied Mathematics	T	3	0	0	3
CIV18R5101	Advanced Concrete Technology	TP	3	0	2	4
CIV18R5102	Structural Dynamics	T	3	0	0	3
CIV18RXXX	Programme Elective 1	T	3	0	0	3
CIV18RXXX	Programme Elective 2	T	3	0	0	3
CIV18R5182	Advanced Structural Engineering Laboratory	L	0	0	3	2
CIV18R5104	Advanced Steel Structures	T	3	0	0	3
CIV18R5105	Advanced Concrete Design	TP	3	0	2	4
CIV18R5106	Matrix Method Of Structural Analysis	T	2	0	2	3
PGM18R5001	Research Methodology For Engineers	T	3	0	0	1
CIV18RXXX	Programme Elective 3	T	3	0	0	3
CIV18RXXX	Programme Elective 4	T	3	0	0	3
XXX18RXXX	Interdisciplinary Elective 1	T	3	0	0	3
CIV18R5183	Computer Aided Analysis And Design Laboratory	L	0	0	3	2
	Mini project		0	0	4	2
CIV18RXXX	Programme Elective 5	T	3	0	0	3
CIV18R6198	Project Work – Phase I	L	0	0	20	10
CIV18R6199	Project Work – Phase II	L	0	0	32	16

TOTAL CREDITS EARNED :71

PROGRAM ELECTIVE COURSES

CODE NO	COURSE TITLE	Course Type	L	T	P	C
CIV18R5107	Computer Aided Design	T	3	0	0	3
CIV18R5108	Design Of Bridges	T	3	0	0	3
CIV18R5109	Design Of Shell And Spatial Structures	T	3	0	0	3
CIV18R5110	Design Of Steel Concrete Composite Structures	T	3	0	0	3
CIV18R5111	Design Of Tall Buildings	T	3	0	0	3
CIV18R5112	Nonlinear Analysis Of Structures	T	3	0	0	3
CIV18R5113	Offshore Structures	T	3	0	0	3
CIV18R5114	Industrial Structures	T	3	0	0	3
CIV18R5115	Advanced Prefabricated Structures	T	3	0	0	3
CIV18R6101	Advanced Prestressed Concrete	T	3	0	0	3
CIV18R6102	Wind And Cyclone Effects On Structures	T	3	0	0	3
CIV18R6103	Theory Of Plates And Shells	T	3	0	0	3
CIV18R6104	Repair And Rehabilitation Of Structures	T	3	0	0	3
CIV18R6105	Experimental Stress Analysis	T	3	0	0	3
CIV18R6106	Finite Element Methods	T	3	0	0	3
CIV18R5103	Theory Of Elasticity And Plasticity	T	3	0	0	3

INTERDISCIPLINARY ELECTIVE COURSES

CODE NO	COURSE TITLE	Course Type	L	T	P	C
CIV18R5116	Health, Safety And Environmental Management (HSE) Practices	T	3	0	0	3
CIV18R5117	Design Of Boiler Structures	T	3	0	0	3
CIV18R5118	Random Vibrations And Structural Reliability	T	3	0	0	3
CIV18R5119	Structures In Disaster Prone Areas	T	3	0	0	3

CIV18R5101 ADVANCED CONCRETE TECHNOLOGY	L	T	P	Credit
	2	0	2	3
Pre-requisite: Nil **Course Type** : Theory with Practical Component				

Course outcome:

After Completing the course, the students will able to

CO1: Determine the properties of concrete ingredients i.e. cement, sand, coarse aggregate by conducting different tests.

CO2: Develop an advanced knowledge of the mechanical performance of cement based materials and how it can be controlled

CO3: Use various chemical admixtures and mineral additives to design cement based materials with tailor-made properties

CO4: Use advanced laboratory techniques to characterize cement-based materials.

CO5: Understand the mix design and engineering properties of special concretes such as high-performance concrete, self-consolidating concrete, fibre reinforced concrete, sprayed concrete, etc.

FRESH CONCRETE

Chemical composition, Hydration of cement, structure of hydrated cement, special cements, water, chemical admixtures, Workability –Need-Factors affecting work ability-Segregation Bleeding-Mixing of concrete- Compaction of concrete - Revibration-Self compacting concrete-Ready-mixed concrete – effect of retarders in slump retention in transportation of transit mixer—Pumped concrete-Preplaced concrete-Shotcrete-Analysis of fresh concrete

HARDENED CONCRETE

Factors affecting strength of concrete-Curing-Maturity of concrete-High strength concrete-Ultra High strength concrete-Properties of Hardened concrete and their significance-Structure of concrete-Structure concrete relationships in hydrated cement paste-Dimensional stability-Durability-Transition zone in concrete - Micro structure of concrete-Autogeneous healing-Evaluation of heat of hydration and expansion-Creep-Shrinkage-Elasticity

TESTING OF CONCRETE

Workability-Compression-Tension-Flexure-Bond strength-Factors affecting the results-Accelerated strength results-Stress strain characteristics -Pull off test- Modulus of Elasticity-In site strength determination-Durability testing of concrete-structural health monitoring of concrete – types of sensors for various applications

CONCRETE MIX DESIGN

Basic consideration-Factors in the choice of mix proportions-Mix design methods- A.C.I .Method - I.S. Method - British Method - Correction for moisture content-Bulking-Yield of

concrete-Design of High strength concrete and Self compacting concrete- EFNARC Specifications and Design of SCC mixes- Design of concrete mix using mineral admixtures – Design mix for pumpability and effect of super plasticizers in water reduction

SPECIAL CONCRETES

Properties of constituents materials and applications - Light weight concrete-Aerated concrete-No fines concrete-Heavy weight concrete for radiation shield- Fiber reinforced concrete-Polymer concrete-Geopolymer concrete--High volume flyash concrete-High performance concrete-self curing concrete-Concrete admixtures – Nano materials used in the construction industry- protective coating to save energy – energy saving materials

References

1.A. M. Neville, J. J. Brooks, Concrete Technology,Pearson Education, 2013
2.A. R. Shantha Kumar, Concrete Technology, Oxford University Press, 2007
3.M. S. Shetty, Concrete Technology, S. Chand & Co., 2010
4.Raft Siddique, Spacial Structural Concrete, Galgotia Publication, 2008
5.N. Krishna Raju, Design of Concrete Mixes, C.B.S. Publication, 2002

CIV18R5102 STRUCTURAL DYNAMICS	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course outcome:

At the end of the course, students would be able to

CO1:Apply the fundamental concepts and definitions used in structural dynamics.

CO2:Calculate the natural frequency of a system using equilibrium or energy methods

CO3:Determine the effect of viscous damping on the response of a freely vibrating system

CO4:Determine the response of a system to a harmonic excitation.

CO5:Understand of the fundamental concepts of earthquake engineering.

PRINCIPLES OF VIBRATION ANALYSIS

Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems, Effect of damping, Transmissibility

PRACTICAL APPLICATIONS

Idealization and formulation of mathematical models for wind, earthquake, blast and impact loading, aerodynamics, gust phenomenon, principles of analysis.

DYNAMIC ANALYSIS OF MDOF

Multidegree of freedom systems, orthogonality of normal modes, approximate methods. Mode superposition technique, numerical integration procedure,

DYNAMIC ANALYSIS CONTINUOUS SYSTEMS

Free and forced vibration of continuous systems, Rayleigh – Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work.

TWO DEGREE OF FREEDOM SYSTEMS

Equations of Motion of Two degree of freedom systems, normal modes of vibration, applications.

REFERENCES:

1. Mario Paz, Structural Dynamics : "Theory and Computation", Kluwer Academic Publication, 2006
2. Anil K.Chopra, "Dynamics of Structures", Pearson Education, 2001
3 John M.Biggs, "Introduction to Structural Dynamics", McGraw Hill, 1984
4. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J,Jatak education,2009

CIV18R5103 THEORY OF ELASTICITY AND PLASTICITY	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course outcome:

At the end of the course, students would be able to

CO1: Define stresses, strains, equilibrium and compatibility in three-dimensional problems
CO2: Identify and analyse the stress problems in an elastic body.
CO3: Identify and analyse the deformation problems in an elastic body
CO4: Acquire the concepts on theory of elasticity and theory of plasticity.
CO5: Solve selected problems of theory of elasticity.

ELASTICITY

Analysis of stress and strain, Equilibrium equations - Compatibility equations - Stress strain relationship. Generalized Hooke's law.

ELASTICITY SOLUTION

Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar co-ordinates.

TORSION OF NON-CIRCULAR SECTION

St.venant's approach - Prandtl's approach – Membrane analogy - Torsion of thin walled open and closed sections.

ENERGY METHODS

Strain energy – Principle of virtual work – Energytheorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems.

PLASTICITY

Physical Assumptions – Yield criteria - Plastic stress strain relationship. Elastic plastic problems in bending – torsion and thick cylinder.

REFERENCES:

1. Timoshenko, S. and GoodierJ.N."Theory of Elasticity", McGraw Hill Book Co., Newyork, 2002.
2. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.

3. Slater R.A.C, “Engineering Plasticity”, John Wiley and Son, New York, 2001.
4. Hearn , E.J. “Mechanics of Materials”, Vol.2, Pergamon Press, Oxford, 1995
5. Irving H.Shames and James, M.Pitarresi, “Introduction to Solid Mechanics”, Prentice Hall of India Pvt. Ltd., Newl Delhi -2002.

CIV18R5181 ADVANCED STRUCTURAL ENGINEERING LAB	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course outcomes

At the end of the course, students would be able to

CO1: Perform advanced laboratory experiments that emphasize the structure-property relationship, statistical analysis, and technical manuscript preparation.
CO2: Understand the reinforced concrete beam for strength and deflection.
CO3: Understand the steel beam for strength and deflection.
CO4: Understand the dynamic behaviour of cantilever steel beam and also able to understand the strength and quality of concrete

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever steel beam
a. To determine the damping coefficients from free vibrations.
b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames and evaluate
a. Drift of the frame.
b. Stiffness of the frame.
c. Energy dissipation capacity of the frame.
6. Determination of in-situ strength and quality of concrete using
i) Rebound Hammer
ii)Ultrasonic Pulse Velocity Tester

REFERENCES:

1. Dally J W, and Riley W F, “Experimental Stress Analysis”, McGraw-Hill Inc.New York, 1991.

CIV18R5104 ADVANCED STEEL STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course outcomes

At the end of the course, students would be able to

CO1: Learn how to design compression and tension members of a steel truss girder bridges.
CO2: Analyse and design the industrial buildings
CO3: Compute the axial forces, shear forces and bending moments in beams and columns of a multistory building frame and can sketch SFD, BMD.
CO4: Calculate the forces in various members of steel truss girder bridge and design the components of the bridge.
CO5: Compute the collapse loads, plastic moment capacities of continuous beams, portal frames and gable frames.

GENERAL
Industrial building – Selection of bay width - Structural framing – Knee bracing of columns – Methods to reduce bending moment in columns – Unbraced frames – Design of purlins , girts, rafter, tie runner, side runner, eaves strut and truss members – Design of vierendeel girder.

DESIGN OF CONNECTIONS
Types of connections – Welded and riveted – Throat and root stresses in Fillet welds – Seated connections – Unstiffened and stiffened seated connections – Moment resistant connections – Clip angle connections – Split beam connections – Framed connections.

STEEL TOWERS AND CHIMNEYS
Analysis and design of microwave / transmission line towers – Types of bracing patterns – Sag and tension calculations - Design of self supporting chimney – Design of base plates, foundations and anchor bolts - guyed steel chimney – Guy ropes – Stresses due to wind – Along wind load calculation .

PLASTIC ANALYSIS OF STRUCTURES
Introduction - shape factor - Moment redistribution – combined mechanisms - analysis of portal frames - Effect of axial force – Effect of shear force on plastic moment - Connections – requirement – Moment resisting connections - Design of straight corner connections – Haunched connections – Design of continuous beams.

DESIGN OF LIGHT GAUGE STEEL STRUCTURES

Cold formed light gauge section – Type of cross sections – stiffened - multiple stiffened and unstiffened element - flat width ratio – effective design width – Design of light gauge compression member – Effective width for load and deflection determination - Design of tension members – Design of flexural members – Shear lag – Flange curling.

REFERENCES:

1. Subramanian .N, " Design of Steel Structures", Oxford University Press, 2012.
2. Dayarathnam.P, "Design of Steel Structures", A.H.Wheeler, India, 2007.
3. John E. Lothers, "Design in structural steel", Prentice Hall of India, New Delhi 1999.
4. Lynn S. Beedle, "Plastic Design of Steel Frames", John Wiley and Sons, New York 2003.
5. Wie Wen Yu, "Design of Cold Formed Steel Structures", McGrawHIll Book Company, New York, 2010.

CIV18R5105 ADVANCED CONCRETE DESIGN	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course outcomes

At the end of the course, students would be able to

CO1: Compare, contrast and apply alternative methods of design for reinforced concrete beams & slabs.
CO2: Analyse the flexural and shear capacity of existing RC elements.
CO3: Design for shear of RC elements. Science & Mathematics (Knowledge and understanding of mathematical models as applied to reinforced concrete design).
CO4: Design (broader knowledge and understanding of design processes for reinforced concrete structural elements and systems).
CO5: Engineering Practice (a thorough understanding of how the physical and mechanical properties of concrete influence design methods and construction processes).

DESIGN OF BEAMS AND COLUMNS

Properties and behavior of concrete and steel -Behaviour of R.C .beams in flexure, shear,torsion and combined loadings applied gradually-modes of failure interaction effectsanalysis and -design for serviceability limit states-calculations of deflections and crack width as per I.S 456 - behavior of slender R.C.columns under gradually increasing load-failure modes and interaction curves-calculation of design moments for braced andun-braced long columns-design of slender columns.

DESIGN OF HYPER STATIC R.C BEAMS AND FRAMES

Design and detailing of continuous beams and portal frames-design of multibay, multistoried R.C. frames: preliminary design-use of substitute frames for calculating stress resultants caused by gravity loading-portal method for wind and earthquake forces-design of members and detailing of reinforcements.

DESIGN OF SPECIAL STRUCTURES

R.C. Elements Design and detailing of deep beams and corbels-braced and un-braced walls - approximate analysis - design of beams circular in plan and spandrel beams

DESIGN OF SLABS

Yield line theory of slabs-virtual work and equilibrium methods-Hillerborg method of design - design of flat slabs- design of grid floors as per I.S.456

INELASTIC BEHAVIOR AND ULTIMATE LOAD ANALYSIS

Conditions for ultimate load analysis –Concept of moment redistribution and moment rotation characteristics of a R.C. section plastic hinges - check for rotation capacity of sections.

REFERENCES

1.S. UnnikrishnaPillai and DevadosMenon, Reinforced ConcreteDesign ,Tata McGraw-Hill Education, 2011
2.P. C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall, International Edition, 2008
3.N. Krishnaraju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2010
4.R. Park and T. Paulay, Reinforced Concrete Structures, John Wiley Sons, 2008
5.S. S. Bhavikatti , Advanced RCC Design volume I and II,New Age International, 2011.
6.S.N Sinha,Handbook of Reinforced Concrete Design, Tata McGraw-Hill Education, 2004
7.IS 456:2000:Plain and Reinforced Concrete Code of Practice.

CIV18R5106 MATRIX METHOD OF STRUCTURAL ANALYSIS	**L**	**T**	**P**	**Credit**
	2	**0**	**2**	**3**
Pre-requisite: Nil	**Course Type** : Theory With Practical Course			

Course outcomes

At the end of the course, students would be able to

CO1: Learn how to compute static and kinematic indeterminacies of various types of structures.

CO2: Generate the global stiffness matrix by assembling the element stiffness matrices.
CO3: Analyze the continuous beams, portal frames and trusses by matrix stiffness method.
CO4: Analyze the continuous beams, portal frames and trusses by matrix flexibility method.
CO5: Understand the necessity of shear walls and its analysis by various methods.

INTRODUCTION.

A Few Historical Remarks. Matrix Methods of Analysis of Skeletal Structures. Methods of Analysis. Displacement Method: Stiffness Relationships.

THE MATRIX DISPLACEMENT APPROACH

Introduction, Stiffness Matrix of a Bar Element subjected to Axial Force. Co-ordinate Transformations. Global Stiffness Matrix. Application to Pin- Jointed Frames. Stiffness Matrix of a Beam Element. Application to Continuous Beams.

MATRIX DISPLACEMENT ANALYSIS OF PLANAR

Matrix Displacement Analysis of Planar Rigid-Jointed Frames. Neglect of Axial Strain in the Analysis of Planar Rigid-Jointed Frames. Inclined Supports. Other Kinds of Loading & Other Kinds of Frames.

MATRIX DISPLACEMENT ANALYSIS OF GRILLAGE

Matrix Displacement Analysis of Grillage or Grid. Co-ordinate Transformations. Element Stiffness Matrix & its Application.

MATRIX DISPLACEMENT ANALYSIS OF THREE-DIMENSIONAL STRUCTURES

Matrix Displacement Analysis of Three-Dimensional Structures. Co-ordinate Transformations. Application to Space Trusses & Space Frames.

TEXT BOOK

1.Matrix & Finite Element Displacement Analysis of Structures: D.J.Dawe.
2.Computer Analysis of Structural Systems: John F. Fleming.
3.Matrix Methods of Structural Analysis:C.K.Wang.

REFERENCE

1.Matrix Analysis of Framed Structures:Gere& Weaver.
2.Introduction to Matrix Methods of Structural Analysis: Martin,H.C

CIV18R5182 COMPUTER AIDED ANALYSIS AND DESIGN LABORATORY	L	T	P	Credit
	1	0	4	3
Pre-requisite: Nil	**Course Type** : Lab Course			

Course outcomes
At the end of the course, students would be able to

CO1: Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
CO2: Create and design various civil engineering structures.
CO3: Simulate, model and analyse composite structural elements.
CO4: Proficient in using analysis and design package for designing structural elements and structures. Also the student will be efficient in using drafting packages.
CO5:simulate, model and analyse trusses, Steel beams, RC beams and columns using FEA Package.

LIST OF EXPERIMENTS
1. Solution of Linear System of Equations using mathematical Software Packages
   - Gaussian Elimination method
   - Gauss Siedel Iteration
2. Numerical Integration
3. Computer aided analysis and Design of a
   - 2D steel truss.
   - 3D steel truss.
   - Single-storey framed building.
   - Multi-storey building.
   - Bridge subjected to moving load.
   - Multi-storey building subjected to wind forces.
   - Multi-storey building subjected to seismic forces.
4. Finite Element Analysis of a
   - Deep beams
   - Plate with holes

ELECTIVES

CIV18R5107 COMPUTER AIDED DESIGN	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analysing the working principle, production and applications of different kind of lasers, hologram and optical fibre.
CO2: Know the basic concept and knowledge of sound waves and understand the production and applications of ultrasonic waves.
CO3: Learn some basic ideas of crystallography and preparation methods of single crystalline materials.
CO4: Gain the basic knowledge of the special theory of relativity and quantum physics
CO5: Understand the mechanical and thermal properties of materials

COMPUTER GRAPHICS

Graphic primitives - Transformations - Basics of 2-D drafting - Modeling of curves and surfaces – Wire frame modeling - Solid modeling - Graphic standards – Drafting software packages and usage

STRUCTURAL ANALYSIS

Computer methods of structural analysis –Analysis through software packages.

STRUCTURAL DESIGN

Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials

OPTIMIZATION

Application of linear programming - Simplex algorithm - Post-optimality analysis - Project scheduling - CPM and PERT applications

ARTIFICIAL INTELLIGENCE

Introduction - Heuristic search - knowledge based expert systems – Rules and decision tables – Inference mechanisms- Simple applications - Genetic algorithm and applications. Principles of Neural network - Architecture and applications of KBES - Expert system shells

REFERENCES:

1. Krishnamoorthy C.S and Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 1997.
2. GrooverM.P.andZimmers E.W. Jr.," CAD/CAM, Computer Aided Design and Manufacturing ", Prentice Hall of India Ltd, New Delhi, 1996.
3. Harrison H.B., “Structural Analysis and Design Vol.I and II”, Pergamon Press, 2001
4. Hinton E.and Owen D.R.J., “Finite Element Programming”, Academic Press 1977.

CIV18R5108 DESIGN OF BRIDGES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):
After completing this course, the student will be able to:

CO1: Understanding the fundamental concepts for the types of loads acting on the bridges.
CO2: Perform analysis for slab culverts and tee beams
CO3: Develop principles for long span girder bridges.
CO4: Apply thefundamental concepts for the design of prestressed bridges
CO5: Posulate the design priniciples for bearing and substructures

INTRODUCTION
Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

SHORT SPAN BRIDGES
Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.

LONG SPAN GIRDER BRIDGES
Design principles of continuous bridges, box girder bridges, balanced cantilever bridges.

DESIGN OF PRESTRESSED BRIDGES
Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

DESIGN OF PLATE GIRDER BRIDGES, BEARINGS AND SUBSTRUCTURES
Design of riveted and welded plate girder bridges for highway and railway loading – wind effects – main section, splicing, curtailment, stiffeners – Different types of bearings – Design of bearings – Design of masonry and concrete piers and abutments – Types of bridge foundations – Design of foundations.

REFERENCES:
1. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.
2. Johnson Victor, D. "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. New Delhi, 1990
3. Jagadeesh.T.R. andJayaram.M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd. 2004.

4. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.
5. Bakht, B. and Jaegar, L.G., "Bridge Analysis Simplified", McGraw Hill, 1985.
6. Derrick Beckett, "An introduction to Structural Design of Concrete Bridges", Surrey University Press, Henley Thomes, Oxford Shire, 1973.
7. Taylor, F.W., Thomson, S.E., and Smulski E., "Reinforced Concrete Bridges", John Wiley and Sons, New York, 1955.

CIV18R5109 DESIGN OF SHELL AND SPATIAL STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analysis of shell types.
CO2: Estimate the Behaviour of floated plates and their types
CO3: Gain the basic knowledge of space frames
CO4: Analysis and design of space frames
CO5: Application of special types

CLASSIFICATION OF SHELLS

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31..

FOLDED PLATES

Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof

INTRODUCTION TO SPACE FRAME

Space frames - configuration - types of nodes - general principles of design Philosophy - Behaviour.

ANALYSIS AND DESIGN

Analysis of space frames – detailed design of Space frames – Introduction toComputer Aided Design and Software Packages.

SPECIAL METHODS

Application of Formex Algebra, FORMIAN for generation of configuration.

REFERENCES:

1. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, 1982.
2. Santhakumar.A.R and Senthil.R, "Proceedings of International Conference on Space Structures", Anna University, Chennai, 1997.
3. Subramanian.N ,"Principles of Space Structures", Wheeler Publishing Co. 1999.
4. Ramasamy, G.S., "Design and Construction of Concrete Shells Roofs", CBS Publishers, 1986.

CIV18R5110 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding the basic knowledge of composite construction
CO2: To design the beams and composite trusses
CO3: Analysis ans design the connections and their types
CO4: To design the box girder
CO5: Gaining the knowledge of seismic behaviour of composite structures.

INTRODUCTION

Introduction to steel - concrete composite construction - theory of composite structures - construction.

DESIGN OF COMPOSITE MEMBERS.

Design of composite beams, slabs, columns, beam – columns - design of composite trusses.

DESIGN OF CONNECTIONS

Types of connections, Design of connections in the composite structures – shear connections. Degree of shear connection – Partial shear interaction

COMPOSITE BOX GIRDER BRIDGES

Introduction - behaviour of box girder bridges - design concepts.

MISCELLANEOUS

Case studies on steel - concrete composite construction in buildings – seismic behaviour of composite structures.

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.

CIV18R5111 DESIGN OF TALL BUILDINGS	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To estimate the Gravity loading Wind loading, Earthquake loading
CO2: Gain the basic knowledge Rigid frames, braced frames, Infilled frames,
CO3: Analysis of buildings as total structural system
CO4: To estimate the Sectional shapes, properties and resisting capacity
CO5: To evaluate the stability of tall buildings

DESIGN PRINCIPLES AND LOADING

Design philosophy, Loading, sequential loading, materials - high performance, concrete - Fibre reinforced Concrete - Light weight concrete - design mixes. Gravity loading Wind loading Earthquake loading

BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS

Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega systems..

ANALYSIS AND DESIGN

Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerized general three dimensional analysis.

STRUCTURAL ELEMENTS

Sectional shapes, properties and resisting capacity, design, deflection, cracking,prestressing, shear flow, Design for differential movement, creep and shrinkageeffects, temperature effects and fire resistance.

STABILITY OF TALL BUILDINGS

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and PDelta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

REFERENCES:

1. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 1991.
2. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

3. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
5. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988.
6. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.

CIV18R5112 NONLINEAR ANALYSIS OF STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding the principles of elastic and inelastic properties of structures.
CO2: To bring out knowledge of analytical concepts related to the vibration theory in the flexural members
CO3: Learn some basic ideas of non linear mechanics concepts.
CO4: Gain the basic knowledge of the special theory of elasticity and inelasticity.
CO5: Analysing the specific conditions related to instability criteria

ELASTIC ANALYSIS OF FLEXURAL MEMBERS

Introduction to nonlinear mechanics; statically determinate and statically indeterminate flexible bars of uniform and variable thickness.

INELASTIC ANALYSIS OF FLEXURAL MEMBERS

Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of flexible bars of uniform and variable stiffness members with and without axial restraints

VIBRATION THEORY AND ANALYSIS OF OF FLEXURALMEMBERS

Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading

ELASTIC AND INELASTIC ANALYSIS OF PLATES

Elastic and inelastic analysis of uniform and variable thickness plates

NONLINEAR VIBRATION AND INSTABILITY

Nonlinear vibration and Instabilities of elastically supported beams.

REFERENCES:

1. Sathyamoorthy, M.,"Nonlinear Analysis of Structures", CRC Press, Boca Raton, Florida, 1997.
2. Fertis, D. G.,"Nonlinear Mechanics", CRC Press, Boca Raton, Florida, 1998.
3. Reddy.J.N, "Non linear Finite Element Analysis", Oxford University Press,2008

CIV18R5113 OFFSHORE STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding the working principle and construction of offshore platforms.
CO2: Gain knowledge regarding the forces acting on the offshore structures and Morison equation.
CO3: Analyse the proper soil condition for the establishment of offstore structures.
CO4: Learn the basic concepts of hydrodynamics that governs the stability of offstore structures.
CO5: To Design the platforms, helipads

WAVE THEORIES

Wave generation process, small and finite amplitude wave theories.

FORCES OF OFFSHORE STRUCTURES

Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

OFFSHORE SOIL AND STRUCTURE MODELLING

Different types of offshore structures, foundation modeling, structural modeling.

ANALYSIS OF OFFSHORE STRUCTURES

Static method of analysis, foundation analysis and dynamics of offshore structures.

DESIGN OF OFFSHORE STRUCTURES

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

REFERENCES:

1. Chakrabarti, S.K. "Hydrodynamics of Offshore Structures", Computational Mechanics Publications, 1987.
2. Dawson.T.H., "Offshore Structural Engineering", Prentice Hall Inc Englewood Cliffs, N.J. 1983
3. Brebia, C.A and Walker, S., "Dynamic Analysis of Offshore Structures", New Butterworths, U.K. 1979.
4. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dalls,Tex,2000.
5. Reddy, D.V. and Arockiasamy, M., "Offshore Structures", Vol.1 and Vol.2,Krieger Publishing Company, Florida, 1991.

CIV18R5114 INDUSTRIAL STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding theClassification of Industries and Industrial structures.
CO2: Know the basic concept and knowledge of Design the Corbels and Nibs – Machine foundations
CO3: To gaining the knowledge of Types of power plants
CO4: Gain the basic knowledge of the Transmission Line Towers and the design concepts.
CO5: To evaluate the aspects of Chimneys and cooling Towers

PLANNING AND FUNCTIONAL REQUIREMENTS

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety – Protection against noise and vibration - Guidelines of Factories Act

INDUSTRIAL BUILDINGS

Roofs for Industrial Buildings - Steel and RCC - Gantry Girders - Design of Corbels and Nibs – Machine foundations.

POWER PLANT STRUCTURES

Types of power plants – Design of Turbo generator foundation – containment structures..

POWER TRANSMISSION STRUCTURES

Transmission Line Towers - Substation Structures - Tower Foundations – Testing Towers..

AUXILLIARY STRUCTURES

Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures

REFERENCES:

1. Manohar S.N, “Tall Chimneys - Design and Construction”, Tata McGraw Hill,1985
2. Santhakumar A.R.an d Murthy S.S., “Transmission Line Structures”, Tata McGraw Hill, 1992.
3. Srinivasulu P and Vaidyanathan.C, “Handbook of Machine Foundations”, Tata McGraw Hill, 1976.
4. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, “Industrial Buildings: A Design Manual”, Birkhauser Publishers, 2004.
5. Procs. of Advanced course on “Industrial Structures”, Structural Engineering Research Centre, Chennai, 1982.

CIV18R5115 ADVANCED PREFABRICATED STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding the specific requirements for planning and layout of prefabricates plant.
CO2: Design the one way and two way prefabricated slabs
CO3: Knowing the Types of wall panels and their design
CO4: Gaining the knowledge in Description of joints, their behaviour and reinforcement requirements
CO5: To design the Components of single-storey industrial sheds with crane gantry systems.

DESIGN PRINCIPLES

General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications.Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

REINFORCED CONCRETE

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, - Connections – Beam to column and column to column.

FLOORS , STAIRS AND ROOFS

Types of floor slabs, analysis and design example of cored and panel types and twoway systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

WALLS

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

INDUSTRIAL BUILDINGS AND SHELL ROOFS

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hypar-prefabricated shells, Erection and jointing, joint design, hand book based design.

REFERENCES:

1. B.Lewicki, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/New York, 1966

2. Koncz.T., Manual of Precast Concrete Construction, Vol.I II and III, Bauverlag, GMBH, 1971.
3. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland BetorVerlag, 1978.
4. LassloMokk, Prefabricated Concrete for Industrial and Public Sectors, AkademiaiKiado, Budapest, 1964.
5. Murashev.V., Sigalov.E., and Bailov.V., Design of Reinforced Concrete Structures, Mir Publishers, 1968.
6. Gerostiza. C.Z., Hendrikson, C. and Rehat D.R., Knowledge Based Process Planning for Construction and Manufacturing, Academic Press, Inc., 1989.
7. Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper and Row, 1990.

CIV18R6101 ADVANCED PRESTRESSED CONCRETE	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding thetypes and systems of prestressing
CO2: To analysis the Behaviour of flexural members and determination of ultimate flexural strength
CO3: To knowing the Design of compression members with and without flexure
CO4: To understanding the application of prestressed pipes and prestressed concrete cylindrical water tanks
CO5: To design the Composite beams and their behavior.

PRINCIPLES OF PRESTRESSING

Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts.

DESIGN OF FLEXURAL MEMBERS

Behaviour of flexural members, determination of ultimate flexural strength – Codal provisions - Design of flexural members, Design for shear, bond and torsion. Design of end blocks.

DESIGN OF CONTINUOUS BEAMS

Analysis and design of continuous beams - Methods of achieving continuity – concept of linear transformations, concordant cable profile and gap cables

DESIGN OF TENSION AND COMPRESSION MEMBERS

Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - its application in the design piles, flagmasts and similar structures.

DESIGN OF COMPOSITE MEMBERS

Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing - its advantages and applications.

REFERENCES:

1. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill Publishing Co,2000.
2. Sinha.N.C.and.Roy.S.K, "Fundamentals of Prestressed Concrete", S.Chand and Co., 1998.
3. Lin.T.Y., "Design of Prestressed Concrete Structures", John Wiley and Sons Inc,1981.
4. Evans, R.H. and Bennett, E.W., "Prestressed Concrete", Champman and Hall, London, 1958.
5. Rajagopalan.N, Prestressed Concrete, Narosa Publications, New Delhi, 2008.

CIV18R6102 WIND AND CYCLONE EFFECT ON STRUCTURES	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analysis of the wind effects on the structures
CO2:To analysis the basic concept and knowledge of wind and cyclone effects on the structures
CO3: Wind and cyclone behaviour against the buildings
CO4:To determine the properties of wind load on the existing structure
CO5:Apply the mechanical and thermal properties of wind

INTRODUCTION

Introduction, Spectral studies, Gust factor, Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects.

WIND TUNNEL STUDIES

Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

EFFECT OF WIND ON STRUCTURES

Wind on structures, Rigid structures, Flexible structures, Static and dynamic effects, Tall buildings, chimneys.

IS CODES AND SPECIAL STRUCTURES

Application to design, IS 875 code method, Buildings, Chimneys, Roofs, Shelters

CYCLONE EFFECTS

Cyclone effect on structures, cladding design, window glass design.

REFERENCES:

1. Cook.N.J., "The Designer's Guide to Wind Loading of Building Structures", Butterworths, 1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, "Wind Effects on Civil Engineering Structures", Elsevier Publications, 1984
3. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, New York,1972.

CIV18R6103 THEORY OF PLATES AND SHELLS	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analysing the Levy's solution for plates and shell.
CO2: Analysis and design of folded plates
CO3: To learn the Structural behaviour of thin Shells
CO4: Analysis of membrane force
CO5: To Design and detailing of RC spherical shell and conical shells

Analysis of Rectangular Plates

Introduction – General behavior of plates – Assumptions – Small deflection theory of thin plates – Governing differential equation for deflection of plate – Boundary conditions. Bending of Isotropic Rectangular Plates: Navier solution for an all – round simply supported rectangular plate subjected to uniformly distributed load, sinusoidal load and point load – Levy's solution for a rectangular plate with different boundary conditions and subjected to uniformly distributed load.

Analysis of Circular plates

Symmetrical bending of circular Plates – Simply supported solid circular plate subjected to an uniformly distributed load, an end moment and partially distributed load.

Analysis and design of folded plates

Structural behaviour of folded plates – Assumptions – Analysis of folded plates – Design of prismatic folded plate roofs as per ASCE task committee recommendations – Reinforcements details.

Analysis of shell structures

Structural behaviour of thin Shells – Classification of shells – methods of generating the surface of different shells like conoid, hyperbolic and elliptic paraboloid - Membrane Theory of shells– Edge disturbances - Geometry of hyper Shell – Analysis of membrane forces - forces in the edge members

Design of Shell structures

Design of cylindrical shells with edge beams using theory for long shells – Design of cylindrical shell with ASCE manual coefficients – Detailing of reinforcement in shells and edge beams. - Design of R. C. hyper shell roof of the inverted and tilted inverted umbrella type – Design and detailing of RC spherical shell and conical shells – Design example.

References

1. N. Krishnaraju,*Advanced Reinforced Concrete Design*, CBS Publishers and Distributors, NewDelhi, 2003.
2. G. S. Ramasamy, *Design and Construction of Concrete Shell Roofs*, CBS Publishers & Distributions, New Delhi, 1999.
3. B. K. Chatterjee, *Theory and Design of Concrete Shells*, Chapman and Hall Ltd., London, 1988.
4. *Design of Cylindrical Concrete Shell Roofs* ASCE – Manuals of Engineering Practice – No.31,ASCE, Newyork, 1952.

CIV18R6104 REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Facets of Maintenance, importance of Maintenance various aspects of Inspection
CO2: To understanding the Quality assurance for concrete construction concrete properties.
CO3: To knowing the concepts for Special concretes and mortar, concrete chemicals
CO4: To learn the Rust eliminators and polymers coating for rebars during repair
CO5: Chemical disruption, weathering corrosion

MAINTENANCE AND REPAIR STRATEGIES

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

SERVICEABILITY AND DURABILITY OF CONCRETE

Quality assurance for concrete construction concrete properties- strength, permeability, thermalproperties and cracking. - Effects due to climate, temperature, chemicals, corrosion – designand construction errors - Effects of cover thickness and cracking.

MATERIALS FOR REPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

TECHNIQUES FOR REPAIR AND DEMOLITION

Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and drypack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoringand underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistantsteels, coatings and cathodic protection. Engineered demolition techniques for dilapidatedstructures - case studies.

REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure

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.

5. Raikar, R.N., Learning from failures - Deficiencies in Design, Construction and Service - R&D Centre (SDCPL), RaikarBhavan, Bombay, 1987.
6. N.Palaniappan, Estate Management, Anna Institute of Management, Chennai, 1992.
7. Lakshmipathy, M. etal. Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 - 30th October 1999.

CIV18R6105 EXPERIMENTAL STRESS ANALYSIS	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn the Dimensional analysis and Factors influencing model design
CO2: To knowing the performance characteristics of wire and foil strain gauges
CO3: To estimate objectives of non destructive testing and their applications
CO4: To evaluate the effects of stressed model in a polariscope for various arrangements
CO5: To learn the compensation techniques – calibration methods – separation methods

INTRODUCTION

Introduction and Strain measurement methods – Model & Prototype – Dimensional analysis-Factors influencing model design – Scale factors and Model material properties – Methods of model design. Definition of strain and its relation to experimental determinations - properties of strain gauge systems – Mechanical, Optical, Acoustic and Pneumatic types.

ELECTRICAL RESISTANCE STRAIN GAGES

Introduction – gauge construction – strain gauge adhesives - mounting methods – gauge sensitivities and gage factor – performance characteristics of wire and foil strain gauges – environmental effects. Analysis of strain gauge data – the three element rectangular rosette – the delta rosette – correction for transverse sensitivity.

NON-DESTRUCTIVE TESTING

Introduction – objectives of non destructive testing. Ultrasonic pulse velocity method – Rebound Hammer method (Concrete hammer) – Acoustic Emission- application to assessment of concrete quality.

THEORY OF PHOTO ELASTICITY

Introduction – temporary double refraction – Index ellipsoid and stress ellipsoid – the stress optic law – effects of stressed model in a polariscope for various arrangements - fringe sharpening.

TWO DIMENSIONAL PHOTO ELASTICITY

Introduction – iso-chromatic fringe patterns – isoclinic fringe patterns – compensation techniques – calibration methods – separation methods – materials for photoelasticity – properties of photo-elastic materials.

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. and Stanley.R.K., "Course Material on Non-destructive Evaluation",
6. McGraw Hill Publishing Company, New York.1989
7. Ravisankar.K.andChellappan.A., "Advanced courseon Non-Destructive Testing and Evaluation of Concrete Structures", SERC, Chennai, 2007.
8. Ganesan.T.P, "Model Analysis of Structures", University Press, India, 2000

CIV18R6106 FINITE ELEMENT METHODS	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course outcomes

At the end of the course, students would be able to

CO1: Learn how to apply it to basic (linear) ordinary and partial differential equations.
CO2: Learn how to implement the finite element method efficiently in order to solve field problems.
CO3: Identify mathematical model for solution of common engineering problems.
CO4: Solve structural, fluid flow, impact and crash problems.
CO5: Solve complicated 3D structural problems for stress analysis under different loads

INTRODUCTION

Boundary Value Problems – Approximate Solutions – Variational and Weighed Residual Methods – Ritz and Galerkin Formulations – Concept of Piecewise Approximation and Finite Element – Displacement and Shape Functions –Weak Formulation – Minimum Potential Energy – Generation of Stiffness Matrix and Load Vector

STRESS ANALYSIS

Two Dimensional problems – Plane Stress, Plane Strain and Axisymmetric Problems – Triangular and Quadrilateral Elements –Natural Coordinates – Isoparametric Formulation - Numerical Integration – Plate Bending and Shell Elements — Brick Elements –Elements for Fracture Analysis

MESHING AND SOLUTION PROBLEMS

Higher Order Elements – p and h Methods of Mesh Refinement – ill conditioned Elements – Discretisation Errors – Auto and Adaptive Mesh Generation Techniques - Error Evaluation

NONLINEAR, VIBRATION AND THERMAL PROBLEMS

Material and Geometric Nonlinearity – Methods of Treatment – Consistent System Matrices – Dynamic Condensation – Eigen Value Extraction - thermal analysis.

APPLICATIONS

Modeling and analysis using recent softwares.

REFERENCES:

1. S. S. Bhavikatti, “Finite Element Analysis”, New Age Publishers, 2007.
2. C. S. Krishnamoorthy, “Finite Element Analysis: Theory and Programming”, Tata McGraw-Hill, 2012
3. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.
4. Bathe, K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall Inc., 1996.
5. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, McGraw – Hill, 1997.
6. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Prentice Hall of India, 2007.

INTER DISCIPLINERY ELECTIVES

CIV18R5116 HEALTH SAFETY AND ENVIRONMENTAL MANAGEMENT PRACTICES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Type** : Theory Course			

Course Outcome(s):

After completing this course, the student will be able to:

- **CO1:** To understand safety, health and environmental management.
- **CO2:** To be familiar with hazard classification and assessment, hazard evaluation and hazard control, environmental issues and management.
- **CO3:** To get exposed to accidents modeling, accident investigation and reporting, concepts of HAZOP and PHA.
- **CO4:** To be familiar with safety measures in design and process operations.
- **CO5:** To get exposed to risk assessment and management, principles and methods.

INTRODUCTION

Introduction to safety, health and environmental management - Basic terms and their definitions - Importance of safety - safety assurance and assessment - safety in design and operation - organizing for safety.

HAZARDOUS WASTE MANAGEMENT

Hazard classification and assessment - hazard evaluation and hazard control. Environmental issues and Management - atmospheric pollution - flaring and fugitive release - water pollution - Environmental monitoring - environmental management.

MODELING SOFTWARES

Accidents modeling - release modeling - fire and explosion modeling - toxic release and dispersion modeling - accident investigation and reporting - concepts of HAZOP and PHA.

SAFETY MEASURES

Safety measures in design and process operations - inerting, explosion, fire prevention, sprinkler systems.

RISK ASSESMENT

Risk assessment and management - Risk picture - definition and characteristics - risk acceptance criteria - quantified risk assessment - hazard assessment - fatality risk assessment - risk management principles and methods.

Reference Books

1. Skelton. B, Process Safety Analysis, Gulf Publishing Company, Houston, 210pp., 1997.
2. Terje Aven and Jan Erik Vinnem, Risk Management with Applications from Offshore Petroleum Industry, Springer, 200pp., 2007.

CIV18R5117 DESIGN OF BOILER STRUCTURES	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil **Course Type** : Theory Course				

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand boiler structures, types of boilers.
CO2: To learn structural components of boilers, design and construction of boilers.
CO3: To understand safety monitoring and operation, drum lifting structure.
CO4: To be familiar with design loads, foundation analysis.
CO5: To be exposed to platform structure.

INTRODUCTION TO BOILERS

Type of boilers: Top supported - Utility boilers - Tower type - Two pass system -Once through boiler - Bottom supported - Industrial boilers - Bi drum Layout configuration - Front mill layout - Rear mill layout - Side mill layout - column configuration for 210MW-250MW-500MW and lower capacity boilers.

COMPONENTS OF BOILERS

Boiler Structure - Structural components – Columns – beams - vertical bracings -ceiling structure including ceiling girders - girder pin connection - horizontal truss work-platforms - weather protection structure - stair ways - mid landing plat forms -handrails - floor grills - post and hangers - inter connection platforms - lift structure -mill maintenance plat form structure - duct supports - furnace guide supports - Eco coil handling structure - ID system structure - Fan handling structure.

DRUM LIFTING STRUCTURES

Drum lifting Structure: pressure parts – ducts – fuel pipe – platform - critical pipe -lining and insulation – silencer - weather protection roof - side cladding - cable tray and pipe rack.

FOUNDATION ANALYSIS

Dead loads - Live load - wind load - seismic load - guide load - temperature load -customer load - handling loads - contingency load etc. - Foundation analysis -Foundation materials - main columns - auxiliary columns - horizontal beams - vertical bracings - MBL concept - horizontal truss work – girder - pin connection - ceiling main girders - cross girders - pressure parts support beams - ceiling truss work -drum floor – stairs - mid landing plat forms - hand rails - floor grills - fasteners.

PLATFORM STRUCTURES

Dead loads - Live load - wind load - seismic load - guide load - temperature load -customer load - handling loads - contingency load etc. - Foundation analysis -Foundation materials - main columns - auxiliary columns - horizontal beams - vertical bracings - MBL concept - horizontal truss work – girder - pin connection - ceiling main girders - cross girders - pressure parts support beams - ceiling truss work -
drum floor – stairs - mid landing plat forms - hand rails - floor grills - fasteners.

Reference Books

1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2008.
2. Bhavikatti, S. S., Design of Steel Structures, I. K. International Publishing House Pvt. Ltd., New Delhi, 2010.
3. Punmia B. C., Comprehensive Design of Steel Structures, Lakshmi Publications, New Delhi, 2000.
4. Vasant Matsagar, Advances in Structural Engineering: Materials, Volume Three, Springer, 2015.
5. Brad Buecker, Basics of Boiler and HRSG Design, 2002.

CIV18R5118 RANDOM VIBRATIONS AND STRUCTURAL RELIABILITY	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To get an understanding of the various methods of reliability assessments and its application as well as importance.
CO2: To apply the knowledge of the application of reliability study in various fields of structural engineering and its relevance.
CO3: To understand various methods and techniques as well as provisions in reliability assessment.
CO4: To assess partial safety factors by FORM analysis.
CO5: To use crude Monte-Carlo Simulation technique to solve practical problems.

REVIEW OF PROBABILITY

Review of probability: probability space, random variables, functions of random variables, sequence of random variables and limit theorems for sums, products and extremes.

REVIEW OF RANDOM PROCESSES

Review of random processes: stationarity, ergodictiy, power spectrum and auto covariance.

CALCULUS OF RANDOM PROCESSES
Calculus of random processes. Input-output relations for linear systems.

EXTREME VALUE DISTRIBUTIONS.
Stochastic steady state. Level crossing and first passage problems. Extreme value distributions.

RELIABILITY OF EXISTING STRUCTURES
Reliability index based analyses: FORM and SORM. Monte Carlo simulations and variance reduction. Reliability of existing structures.

Reference Books

1. N C Nigam, Introduction to Random Vibrations, MIT Press, Boston, 1983
2. R E Melchers, Structural Reliability Analysis and Prediction, John Wiley, Chichester, 1999

CIV18R5119 STRUCTURES IN DISASTER PRONE AREAS	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course Outcome(s):
After completing this course, the student will be able to:

CO1: To understand earthquake resistant design, cyclone resistant design, flood resistant design, by laws.
CO2: To be familiar with traditional and modern structures, response of different structures to multi hazard, different types of foundation, ground improvement techniques.
CO3: To understand various methods of strengthening, strengthening of different structures exposed to multi hazard.
CO4: To be exposed to testing and evaluation of structures, classification of structures, qualification test, modern materials for disaster reduction.
CO5: To get to learn modern analysis, design and construction techniques, optimization for performance, damage survey, improve hazard resistance.

EARTHQUAKE RESISTANT DESIGN
Philosophy for design to resist Earthquake, Cyclone and flood – By-laws of urban and Semi-Urban areas - Traditional and modern structures.

RESPONSE TO MODERN STRUCTURES
Response of dams, bridges, buildings – Strengthening - Testing and evaluation –Classification of structures for safety point of view.

STRENGTHENING FOR DIFFERENT DISASTERS:
Methods of strengthening for different disasters – Qualification test.

EVALUATION FOR DISASTER REDUCTION
Use of modern materials, their impact on disaster reduction – Use of modern analysis, design and construction techniques, optimization for performance.

HAZARD RESISTANCE
Damage surveys – Maintenance and modifications to improve hazard resistance –Different types of foundation and its impact on safety – Ground improvement techniques.

Reference Books

1.Allen, R. T. and Edwards, S. C., Repair of Concrete Structures, Blakie and Sons, 1980.
2. Moskvin V, Concrete and Reinforced Structures – Deterioration and Protection, Mir Publishers, Moscow, 1980.
3. A K Jain, Practical Guide to Disaster Management, Pragun Publication, 2008.
4. Denison Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical, UK, 1991.
5. Srinivasan Chandrasekaran, Luciano Nunzinate, Giorgio Seriino, Federico Caranannate, Seismic Design Aids for Nonlinear analysis of Reinforced Concrete Structures, CRC Press, Florida (USA), 2009.

	L	T	P	Credit
CIV18R5120 STRUCTURES FOR POWER PLANTS	**3**	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** : Theory Course				

Course Outcome(s):
After completing this course, the student will be able to:

CO1: To understand power plant structure, different types of power plants.

CO2: To understand planning, analysis and design of power plants.

CO3: To be familiar with the analysis and design of chimneys, cooling towers.

CO4: To be exposed to analysis and design of turbo generator foundation.

CO5: To understand the components of intake towers, storage structures

TYPES OF POWER PLANTS
Power plant Types and Working

DESIGN OF POWER PLANTS
Planning, Analysis and design of different types of power plants –

DESIGN OF CHIMNEYS
Chimneys, Induced draught and Natural draught cooling towers,

DESIGN OF TURBO GENERATOR FOUNDATION
Turbo generator Foundation, Material handling structures

STORAGE STRUCTURES
Intake towers, storage structures and other supporting structures for equipment.

Reference Books

1. Kam W. Li and A. Paul Priddy., Power Plant System Design by John and Willey Sons Inc.
2. E. E. Khalil., Power Plant Design An abacus book Energy and Engineering Science Series, Abacus Press, 1990.
3. P. C. Sharma., Power Plant Engineering, S. K. Kataria and Sons, 2009.
4. Krishna Raju, Advanced Reinforced Concrete Design (IS: 456-2000), CBS Publishers and Distributors, 2008.
5. Srinivasulu P and Vaidyanathan. C, Handbook of Machine Foundations, Tata McGraw Hill, 1976.