KALASALINGAM
Academy of Research and Education
DEEMED TO BE UNIVERSITY
Estd.U/S 3 of UGC Act 1956. Accredited by NAAC with "A" Grade
Anand Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

M.Tech
STRUCTURAL ENGINEERING
(Regulations 2018)

Curriculum and Syllabus

SCHOOL OF ENVIRONMENTAL AND CONSTRUCTION TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

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SCHOOL OF ENVIRONMENTAL AND CONSTRUCTION TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

VISION:

To be a Centre of Excellence in Civil Engineering through Quality Education and Research

MISSION:

1. To produce Civil Engineers of high caliber, technical skills and ethical values to serve society and nation
2. To inculcate acumen for lifelong learning, research and capability to adapt to various challenges in the domain of civil engineering
3. To practice ethics and provide sustainable environment conscious solutions to problems in civil engineering

PROGRAMME EDUCATIONAL OBJECTIVES

PEO	DESCRIPTION
PEO1	Graduates will be able to provide solutions in the field of structural engineering by adapting latest techniques and practices.
PEO2	Graduates will be able to contribute towards research and provide cost effective and environment friendly solutions to the problems in structural engineering.
PEO3	Graduates will contribute towards societal development by adapting professional attitude and ethics.

PROGRAMME OUTCOMES:

PROGRAMME OUTCOMES	DESCRIPTION
PO1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

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M.Tech (Structural Engineering) Curriculum Structure

S.No	Course Component	Total number of credits
1	Program Core	21
2	Program Electives	15
3	Interdisciplinary Electives	3
4	Supportive Course	4
5	Mini Projects	2
6	Major Project	26
Total number of Credits		71

SEMESTER –I

Sl. No	Course Code	Course Title	Course Type	L	T	P	C
1	MAT18R5001	Applied Mathematics	T	3	0	0	3
2	CIV18R5101	Advanced Concrete Technology	T	4	0	0	4
3	CIV18R5102	Structural Dynamics	T	3	0	0	3
4	CIV18RXXX	Programme Elective 1	T	3	0	0	3
5	CIV18RXXX	Programme Elective 2	T	3	0	0	3
6	CIV18R5182	Advanced Structural Engineering Laboratory	L	0	0	3	2
TOTAL CREDITS							**18**

SEMESTER –II

Sl. No	Course Code	Course Title	Course Type	L	T	P	C
1	CIV18R5104	Advanced Steel Structures	T	3	0	0	3
2	CIV18R5105	Advanced Concrete Design	T	4	0	0	4
3	CIV18R5106	Matrix Method of Structural Analysis	T	3	0	0	3
4	PGM18R5001	Research Methodology For Engineers	T	3	0	0	1
5	CIV18RXXX	Programme Elective 3	T	3	0	0	3
6	CIV18RXXX	Programme Elective 4	T	3	0	0	3
7	XXX18RXXX	Interdisciplinary Elective 1	T	3	0	0	3
8	CIV18R5183	Computer Aided Analysis And Design Laboratory	L	0	0	3	2
9	CIV18R5199	Mini project		0	0	3	2
TOTAL CREDITS							**24**

SEMESTER –III

Sl. No	Course Code	Course Title	Course Type	L	T	P	C
1	CIV18RXXX	Programme Elective 5	T	3	0	0	3
2	CIV18R6198	Project Work – Phase I	L	0	0	20	10
3	AUD18R5001	English For Research Paper Writing	MC	1	0	0	0
4	AUD18R5002	Pedagogy Studies	MC	1	0	0	0
TOTAL CREDITS							**13**

SEMESTER – IV

Sl. No	Course Code	Course Title	Course Type	L	T	P	C
1	CIV18R6199	Project Work – Phase II	L	0	0	32	16
TOTAL CREDITS							**16**

TOTAL CREDITS TO BE EARNED - 71

PROGRAM ELECTIVE COURSES

CODE NO	COURSE TITLE	Course Type	L	T	P	C
CIV18R5020	Life Cycle Assessment for Sustainable Development	T	3	0	0	3
CIV18R5103	Theory of Elasticity and Plasticity	T	3	0	0	3
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
CIV18R5116	Finite Element Methods	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	Stability of Structures	T	3	0	0	3
CIV18R6107	Characterization of Construction Materials	T	3	0	0	3
CIV18R6108	Sustainable Building Materials	T	3	0	0	3
CIV18R6109	Fracture Mechanics of Concrete Structures	T	3	0	0	3
CIV18R6110	Design of Sub Structures	T	3	0	0	3

INTERDISCIPLINARY ELECTIVE COURSES

CODE NO	COURSE TITLE	Course Type	L	T	P	C
CSE18R5051	Cloud computing	T	3	0	0	3
CSE18R5052	IoT and Applications	T	3	0	0	3
MEC18R5023	Environmental Safety	T	3	0	0	3
MEC18R6052	Safety in Construction	T	3	0	0	3

MAT18R5001	APPLIED MATHEMATICS	L	T	P	C
		3	0	0	3
Course Category : Program Core	**Course Type** : Theory				

Course Objective

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for engineering. This course will also help the students to identify, formulate, abstract and solve problems in engineering using mathematical tools from variety of mathematical areas, including matrix theory, probability, random variables, queueing theory, classical optimization and linear programming.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Evaluate matrix norms and generalized eigen vector

CO#2: Apply the concept of probability, random variables, various probability distributions and its applications.

CO#3: Apply the techniques of Queueing models in real life situations.

CO#4: Understand the various concepts of classical optimization techniques.

CO#5: Apply graphical method, Simplex method and Dual Simplex method to solve Linear Programming Problems and also solving Transportation problems

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1		-	1
CO#2		-	1
CO#3		-	1
CO#4	1	-	
CO#5	1	-	-

3 – High; 2 – Medium; 1- Low

MATRIX THEORY

Matrix Norms - Jordan Canonical form – Generalized Eigen vectors - Pseudo Inverse – QRdecomposition – QR Algorithm.

PROBABILITY AND RANDOM VARIABLES

Probability – conditional probability - Random variables – Mathematical Expectation – Moments - Moment Generating function - Binomial, Poisson, Geometric, Uniform, Exponential and Normal Distributions – Function of a random variable.

QUEUEING MODELS

Markovian Queues - Single and multi server models – Little's formula - Steady state analysis – Queuing applications.

CLASSICAL OPTIMIZATION TECHNIQUES

Classification – optimization technique - Unconstrained Optimization – Equality constraints – Inequality constraints – Lagrange Multiplier method – Kuhn-Tucker Condition - Indirect search methods – Gradient of a function – Steepest descent method – Conjugate gradient method – Newton's method.

LINEAR PROGRAMMING

Standard form of Linear programming problem – formation – graphical method - Simplex method – Dual simplex method – Transportation problem - Applications.

References

1. Bronson.R. Matrix operations, Second Edn., Schaum's Outline series, McGraw Hill Education, 2011.
2. Gupta S.C. and Kapoor V.K. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2014.
3. Taha H A, "Operations Research, An Introduction", 9th Edn., Pearson Education, 2016
4. Singiresu S.Rao ,Engineering Optimization: Theory and Practice, Fourth Edition, New Age International 5. (P) Ltd, 2009.
6. Sheldon M. Ross, Probability and Statistics for Engineers and Scientists, Fifth Edn., Elsevier India, 2014.

CIV18R5101	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
		4	0	0	4
Course Category : Program Core	**Course Type** : Theory				

Course Objective

This course will provide the students with state-of-the art knowledge on durable and sustainable cement and concrete, on the various mineral additions and chemical admixtures to enhance the workability, strength, durability and sustainability aspects and will empower them in the decision making process regarding the various concrete products, construction procedures and performance test methods that will improve the durability and sustainability of concrete civil infrastructure.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Demonstrate the behavior and material properties for fresh concrete

CO#2: Demonstrate the behavior and material properties for hardened concrete

CO#3: Evaluate the mechanical and durability properties of concrete

CO#4: Apply mix proportion principles to proportion a concrete mix for field applications

CO#5: Describe the salient features of special concretes.

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	2	-	2
CO#2	2	-	2
CO#3	3	2	3
CO#4	3	3	2
CO#5	2	-	2

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Core	**Course Type** : Theory				

Course Objective

The objective of this course is to provide the fundamental understanding of the structural dynamics and the problem solving ability for dynamic response in civil engineering design, analysis and research. The course is intended to provide necessary knowledge to establish the equations of motion and for the determination of structural response from dynamic loads and experience in the modeling and calculation of dynamic response for simple structural systems.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Formulate the equation of motion for SDOF

CO#2: Formulate the mathematical models for various dynamic loads.

CO#3: Formulate the equation of motion for two degrees of freedom

CO#4: Determine the dynamic analysis of MDOF

CO#5: Analyze the simple beams using energy and virtual work concept

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	3	2	1
CO#2	3	-	2
CO#3	2	2	2
CO#4	2	-	1
CO#5	2	-	2

3 – High; 2 – Medium; 1- Low

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.

TWO DEGREE OF FREEDOM SYSTEMS

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

DYNAMIC ANALYSIS CONTINUOUS SYSTEMS

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

DYNAMIC ANALYSIS OF MDOF

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

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

CIV18R5182	ADVANCED STRUCTURAL ENGINEERING LAB	L	T	P	C
		0	0	3	2
Course Category : Program Core	**Course Type** : Laboratory				

Course Objective

The student will be able to determine the requirements of the fresh and hardened concrete properties and study the behavior of structural elements through various tests. To provide a detailed account of modern experimental techniques in construction Engineering research. The student can able to prepare the technical report through validation of test results.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Examine the workability requirements of conventional concrete

CO#2: Investigate the characteristics of self compacting concrete

CO#3: Execute the mechanical and durability test on concrete

CO#4: Evaluate the strength characteristics on concrete using NDT Methods

CO#5: Prepare the report based on test results and graphical analysis to interpret the experimental data

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	3	3	2
CO#2	3	3	3
CO#3	3		3
CO#4	3		3
CO#5	3	3	3

3 – High; 2 – Medium; 1- Low

List of Experiments

(A) Basic Material Properties

(B) Concrete Mix Design

(c) Workability of Fresh Concrete
Slump cone, Compaction factor test, Vee Bee Consistometer

(d) Flow characteristics of Self Compacting Concrete
V funnel, L box, U box test

(e) Mechanical Properties of Hardened Concrete
Compressive strength of concrete, Split tensile strength of concrete, Flexural strength of concrete, Elastic modulus of concrete

(f) Durability Properties of Hardened Concrete
Rapid chloride penetration test of concrete, Acid attack, Sulphate attack, Water absorption test

(g) NDT on Hardened Concrete
UPV Method, Rebound hammer Method

(h) Testing of RC structural elements in Loading Frame

CIV18R5104	ADVANCED STEEL STRUCTURES	L	T	P	C
		3	0	0	3
Course Category : Program Core	**Course Type** : Theory				

Course Objective

This course is designed to enhance and strengthen the knowledge on detailed design methods for steel structures, in compliance with Indian and International codes. Detailed numerical modelling for preliminary analysis and design of steel members under special loads like fire, impact loads, ice loads and blast loads will be discussed.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Design the various components of steel truss members

CO#2: Design the various types of connections for a steel members

CO#3: Design the steel towers and chimneys with bracing elements

CO#4: Analyze the portal frame subjected to axial and shear force

CO#5: Design the light gauge sections for various cross sectional members

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	2		2
CO#2	3		2
CO#3		2	2
CO#4	3	2	
CO#5	2	2	2

3 – High; 2 – Medium; 1- Low

DESIGN OF TRUSS MEMBERS

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	C
		4	0	0	4
Course Category : Program Core	**Course Type** : Theory				

Course Objective

This course imparts the fundamental knowledge on the alternative design of RC elements and skill pertaining to design and detailing of the special structures such as flat slabs, grid floors, deep beams, corbel and spandrels etc. In-elastic behavior and ultimate load analysis of RC sections for various end conditions including the rotational capacity will be discussed.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Compare, contrast and apply alternative methods of design for reinforced concrete beams & slabs.

CO#2: Analyze the flexural and shear capacity of existing RC elements.

CO#3: Design and detailing of the special RC structures

CO#4: Design of slabs and grid floors as per IS provisions

CO#5: Illustrate the inelastic behaviour and ultimate load analysis for various conditions

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	3	1	1
CO#2	2		2
CO#3	3	2	3
CO#4	2	2	3
CO#5	2		2

3 – High; 2 – Medium; 1- Low

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 effects analysis 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	C
		3	0	0	3
Course Category : Program Core	**Course Type** : Theory				

Course Objective

The main objective is to expand the student knowledge of the stiffness and flexibility methods studied in the basic structural analysis courses. This course imparts the knowledge on solving planar, grid structures using matrix approach. Also covers matrix displacement analysis of space truss and space frames.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Compute static and kinematic indeterminacies for various types of structures.

CO#2: Generate the global stiffness matrix by assembling the element stiffness matrices

CO#3: Analyze the continuous beams, portal frames and trusses by matrix stiffness method

CO#4: Analyze the grid structures by using matrix flexibility method

CO#5: Calculate the displacement analysis for space truss and frames

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	2		1
CO#2			3
CO#3	2	2	2
CO#4	2	2	3
CO#5	1		2

3 – High; 2 – Medium; 1- Low

INTRODUCTION

Matrix Methods of Analysis of Skeletal Structures. Methods of Analysis. Displacement Method: Stiffness Relationships.

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 FLEXIBILITY ANALYSIS OF PLANAR & GRID

Matrix flexibility Analysis of Planar & 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

References

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

PGM18R5001	RESEARCH METHODOLOGY FOR ENGINEERS	L	T	P	C
		1	0	0	1
Course Category : Supportive Course	**Course Type** : Theory				

Course Objective

This course imparts the fundamental knowledge on the basic research process and its various types. Also this course covers the idea for doing data collection and data procession methods. To educate the students on structured way of writing a thesis report and evaluation process. Also covers ethical practice in research.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the basic concepts of research and its methodologies.

CO#2: Arrive the relative research hypothesis

CO#3: Prepare a suitable data collection methods

CO#4: Adopt the relevant data processing methods

CO#5: Formulate the structured research report

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	2		
CO#3			2
CO#4			2
CO#5		3	

3 – High; 2 – Medium; 1- Low

BASICS OF RESEARCH

Definition of Research-Objectives- Characteristics-Methods of Research- Relevance of Research in decision making in various functional areas of management

RESEARCH DESIGN

Formulation of Research problem- literature survey developing Hypothesis- Research Design and Types- Determination of sampling plan- collection of Data-Analysis of Data-Testing of Hypothesis

DATA COLLECTION

Methods- merits & demerits – Sample size determination-Collection of Data (Methods Merits and Limitations-Designing a questionnaire –Types Construction procedure – Questionnaire vs Schedule

DATA PROCESSING

Editing and Coding Data- classification and usefulness of Statistical tools- Hypothesis testing – Tabulation Significance and guidelines- types of tables and diagrams used in research

RESEARCH REPORT

Research report-Types-Mechanics in writing report precautions – Structure of a report Appendix-bibliography- Executive Summary- Briefing –Evaluation of Research report - Ethics in research

References

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction” Ranjit Kumar, 2 ndEdition, “Research Methodology: A Step by Step Guide for beginners”

CIV18R5183	COMPUTER AIDED ANALYSIS AND DESIGN LABORATORY	L	T	P	C
		0	0	3	2
Course Category : Program Core	**Course Type** : Laboratory				

Course Objective

The objective of this course is to provide practical training to students in structural analysis and design using modern software tools (STAAD pro and ANSYS). The laboratory provides an opportunity for students to learn and apply theoretical concepts to real-world engineering problems, which is essential for developing their analytical and problem-solving skills

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Understand the basic geometric models in a computer program.

CO#2: Create, design and analyze various civil engineering structures.

CO#3: Apply codal requirements in the design of buildings

CO#4: Simulate, model and analyze trusses, Steel beams, RC beams and columns.

CO#5: Prepare the report and interpret the results based on the analysis

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			3
CO#2	3		
CO#3			3
CO#4	3		3
CO#5		3	

3 – High; 2 – Medium; 1- Low

List of Experiments

I. STAAD Pro Software

(A) Design and analysis of continuous beam for various loads

(B) Design and analysis of trusses

(C) Design and analysis of single storey building subjected to various loadings

(D) Design and analysis of multi storey building subjected to various loadings

(E) Design and analysis of water tank subjected to various loadings

II. ANSYS Software

(F) Finite Element Analysis of Beams

(G) Finite Element Analysis of Plates

III. Modelling

(H) Regression

(I) ANN

CIV18R5020	LIFE CYCLE ASSESSMENT FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

To expose the students to impart the fundamental techniques to perform LCA for environmental sustainability. To make the students in understanding the LCA methodologies and its impact assessment. Also, this course teaches life cycle design and management, evaluation and its assessment on the case studies of treatment plants.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Categorize the LEED ratings in buildings

CO#2: Apply LCA concepts for industry's production issues

CO#3: Express the suitable life cycle impact assessment

CO#4: Illustrate the LCA designs strategies based on the needs

CO#5: Investigate the suitable approaches for adopting LCA in various case studies

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2	2		1
CO#3			1
CO#4	2	2	
CO#5		3	1

3 – High; 2 – Medium; 1- Low

INTRODUCTION

Introduction to sustainability concept and life cycle analysis - material flow and waste management - environmental risk assessment - characteristics of environmental problems - measuring energy use in buildings - rating system selection - LEED

LCA METHODOLOGY

Environmental data collection issues - statistical analysis of environmental data - common analytical instruments - overview of LCA methodology - material production phase - manufacturing phase - operation and maintenance phase

LIFE CYCLE IMPACT ASSESSMENT

Classification - characterization - valuation - impact potentials - human and ecosystem health - critical volume approach - environmental defence

LIFE CYCLE DESIGN AND MANAGEMENT

Life cycle management - multi-stakeholders - internal elements - external factors - life cycle design process - need analysis - selection and synthesis of design strategies - design evaluation

LIFE CYCLE ASSESSMENT – CASE STUDIES

Odour removal for organics treatment plant - comparison of hand drying methods - biofuels for transportation etc – Case studies

References

1. Jeroen B. Guinee, Handbook on Life Cycle Assessment, Kluwer Academic Publishers, 2002
2. Reinout Hejungs and Sangwon Suh, The Computational Structure of Life Cycle Assessment, Kluwer Academic Publishers, 2002
3. U.S. EPA , Life Cycle Assessment: Principles and Practice (EPA 600/R-06/060).Cincinnati, OH: 2006.
4. U.S. EPA, Life Cycle Assessment:Inventory Guidelines and Principles (EPA 600/R92/245).Cincinnati, OH:Office of Research and Development, Risk Reduction Engineering Laboratory, February 1993.

CIV18R5103	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

By using the fundamental elasticity equations, the students may comprehend the concepts of elasticity. to familiarise students with polar and cartesian two-dimensional issues. To make students to familiar in understanding the principle of torsion of prismatic bars principal stresses and strains. Also this course improves the analytical abilities for the real world's problem-solving nature under ordinary stress and strain.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Apply the concepts of equilibrium and compatibility equations in stress-strain problems

CO#2: Solve the simple two dimensional problems using Cartesian and Polar co-ordinates.

CO#3: Compare the suitable approach for sections subjected to torsion

CO#4: Apply strain energy principle in solving elasticity problems.

CO#5: Discuss the plasticity behavior subjected to torsion and bending

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2			1
CO#3	1		2
CO#4	2		
CO#5			1

3 – High; 2 – Medium; 1- Low

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 – Energy theorems – 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.

CIV18R5107	COMPUTER AIDED DESIGN	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

The main goals of this course are to provide students with a conceptual understanding and practice on modeling commands on the drafting softwares, performing analyze of structures, read and interpret the detailed drawing and preparing bill of materials quantity. Also this course imparts knowledge on the optimization techniques in the construction management sectors. Also helps in practicing various AI softwares.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Perform basic commands on the modeling aspects in the drafting softwares

CO#2: Analyze the structural performance through structural analysis softwares

CO#3: Estimate the bill of materials with the help of detailed drawings

CO#4: Apply suitable optimization technique in project scheduling aspects

CO#5: Practice the working approach in various AI softwares

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2	2		2
CO#3		3	2
CO#4	2		
CO#5			2

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

The main aim of this course is to enable students to choose the appropriate bridge type for a given project, and to analyses and design the main components of the chosen bridge. Also the students understood other bridge design objectives which include inspect ability, deformation, and aesthetics etc. Acquire knowledge in designing prestressing bridges and steel girder brisges and its associated components.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Identify the fundamental concepts on design considerations of bridges

CO#2: Apply the principles in analysis and design of short span bridges

CO#3: Apply the principles in analysis and design of long span bridges

CO#4: Design prestressed bridges with suitable safety checks against stress and deflection

CO#5: Design steel and masonry bridges including its foundations

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2	1		
CO#3	1		
CO#4		2	2
CO#5		2	2

3 – High; 2 – Medium; 1- Low

DESIGN CONSIDERATIONS

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.

CIV18R5109	DESIGN OF SHELL AND SPATIAL STRUCTURES	L	T	P	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

This course's primary goal is to empower students to understand the classifications and design considerations for various shells folded plates structures w.r.t the codal provisions. Also this course facilitates to gain basic knowledge and understanding on the design and analysis of space frame using some special methods such as formex algebra, formian configuration and software packages.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Identify the types and classifications various shells

CO#2: Describe the structural behavior of folded plates

CO#3: Restate the general design principles and behavior of space frames

CO#4: Perform analysis and detailed design of space frames using softwares

CO#5: Adopt the special methods for performing the analysis of shells and space frames

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2	1		2
CO#3		2	
CO#4	1	3	
CO#5			1

3 – High; 2 – Medium; 1- Low

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

CIV18R5110	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

This course intends to provide basic comprehensive knowledge on steel concrete composite construction Also this course provides the adequate knowledge in designing the various components of composite members and its connections. Also the students get an understanding skill in analyzing the facts through the case studies on steel-composite constructions in Indian buildings about its general and seismic performance.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the salient features of steel concrete composite construction

CO#2: Apply the principles and concepts in designing the components of composite members

CO#3: Perform the design of connections in the composite structures

CO#4: Discuss the behavior of composite box girder bridges

CO#5: Illustrates the facts on the performance of steel concrete composite construction through some case studies.

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2	2		2
CO#3	2		
CO#4			1
CO#5		1	2

3 – High; 2 – Medium; 1- Low

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

CIV18R5111	DESIGN OF TALL BUILDINGS	L	T	P	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

The objective of this course is to develop thorough understanding of structural systems of Tall Structures. It also aim to expose students to analysis and design of high rise structures using software. The exposure of this course provides a detailed conceptual design, approximate methods of stability analysis, preliminary design and optimization, to safely carry over the gravity and lateral load configurations.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Express the design principles and various loading on tall buildings

CO#2: Describe the behavior of various structural systems of tall buildings

CO#3: Perform the analysis and design techniques on the tall structures

CO#4: Discuss the behavior of various structural elements in tall buildings

CO#5: Determine the stability analysis using various approximate methods

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	1		2
CO#3	2	2	
CO#4			1
CO#5		2	2

3 – High; 2 – Medium; 1- Low

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 shrinkage effects, 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	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

This course deals with the nonlinear elastic and in-elastic of flexural members subjected to varying dimensions, support and loading conditions. Also the student gets knowledge on vibrational analysis on the flexural members and plates under cyclic loading. The students can also get the basic understanding skills about the instability conditions of the elastically supported beams.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the nonlinear elastic analysis of the flexural members on various conditions

CO#2: Describe the nonlinear inelastic analysis of the flexural members on various conditions

CO#3: Illustrate the behavior of flexural members under cyclic loadings

CO#4: Applying the various conditions for analyzing elastic and inelastic nature of plates

CO#5: Identify the suitable parameters for the instability conditions of beams

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			2
CO#2			2
CO#3	2		
CO#4	1		1
CO#5		1	2

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

The aim of the course is to provide for the basic knowledge on wave generation process, wave theories and various forces acts on the offshore structures. The students will gets an exposure on different types of offshore structures and various modeling aspects related to foundation, structural and other loading aspects. The course provides a broad idea related to the design of the other components of the offshore structures.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the wave generation process and wave theories

CO#2: Illustrate the wind and wave forces acting on the offshore structures

CO#3: Illustrate the modeling aspects of offshore structures

CO#4: Applying the concept of static method of analysis to the offshore structures

CO#5: Design the various types of offshore structures

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2			1
CO#3	2		2
CO#4		1	2
CO#5	2		

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

On completion of this course the students will gain good confidence in planning the layout requirements addressing lighting, ventilation and fire safety etc. The students performs better design skills in designing the major industrial structural components such as roofs, gantry girders, corbels, nibs and machine foundation etc. as well as power transmission structures and auxiliary structures.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the planning requirements in considering lighting, ventilation and fire safety

CO#2: Design the components of industrial buildings

CO#3: Design the foundation elements for power plant structures

CO#4: Design the components of power transmission structures

CO#5: Design the auxiliary structures with respect to the conditional requirements

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	1	2	
CO#3	2	2	
CO#4		2	2
CO#5	2	2	2

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

The students will be able to understand the need, process and principles of prefabrication units. The course covers specification, production, transportation, erection and safety measures of the residential building components such as floors, slabs, walls, beams, columns, stairs etc. and industrial building components such as crane gantry girder, roof truss, roof panels, corbels, bracing units, folded plates, shells etc.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Identify the specific requirement for planning and layout of prefabrication units.

CO#2: Describe the components and connections of framed RC buildings

CO#3: Calculate the deflections control and ultimate strength of floor, stairs and roofs

CO#4: Perform the quality check against leak preventions of prefabricated units

CO#5: Design the components of single storey sheds with crane gantry systems

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1		1	
CO#2			1
CO#3			2
CO#4	2		2
CO#5	2	2	

3 – High; 2 – Medium; 1- Low

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.

CIV18R5116	FINITE ELEMENT METHODS	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

This subject will provide the fundamental concepts in the theory of finite element analysis and analyse problems related to bar, truss, beam and plane elements using finite element approach. To introduce the concepts of finite element analysis in problems related to mesh generation techniques and associated with non linear thermal analysis. This course also covers the application of FEA softwares.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Apply the boundary value conditions, displacement and shape functions for FE problems.

CO#2: Compute the stress analysis for the two dimensional FE problems

CO#3: Adopt the various mesh generation techniques for attempting the FEA solutions.

CO#4: Perform the non linear vibrational thermal analysis

CO#5: Practice the modeling and analysis functions using FEA softwares

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	1		
CO#3			2
CO#4	2		2
CO#5	2		2

3 – High; 2 – Medium; 1- Low

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

Modelling 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. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Prentice Hall of India, 2007.

CIV18R6101	ADVANCED PRESTRESSED CONCRETE	L	T	P	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

This course will provide a detailed coverage on behaviour of prestressed concrete, analysis and design for strength and serviceability of prestressed concrete members, such as beams and slabs including continuous members, and anchorage design and losses in prestress. Moreover the course will address the detailed design skills of continuous beams, temsion and compression members.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the types and principles of prestressing techniques

CO#2: Design the prestressed members against flexure, shear, bond and torsion

CO#3: Analyze and design of continuous beam using the concept of linear transformations

CO#4: Design of tension and compression members of a prestressed pipes and tanks

CO#5: Design of composite beams for its ultimate strength

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2		2	
CO#3	1		2
CO#4		2	2
CO#5		2	2

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory Course			

Course Objective

This course imparts knowledge on the basics of wind parameters such as speed, height, shape factor and aspect ratio etc and wind tunnel studies. Wind effects on flexible and rigid structures are covered in this course. The students can able to design the building structures, chimneys, roof, shelters, cladding and windows using Indian standards to withstand wind and cyclone effects.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Express the basic wind parameters required in designing the buildings

CO#2: Identifying the modeling requirements of aero-elastic models

CO#3: Illustrate the static and dynamic wind effects on rigid and flexible structures

CO#4: Design of buildings, chimneys, roofs and shelters as per the codal requirements

CO#5: Describe the cyclone effects on the cladding and window glass design.

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2			1
CO#3			2
CO#4		2	
CO#5		2	

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective	**Course Type:** Theory				

Course Objective

This course covers fundamental knowledge on the analysis of different types of plates and shells under subjected to boundary conditions. To impart knowledge on the behaviour of plates and shell elements, their places of utility and of course the design procedure of such elements in practical applications. This course provides in-depth knowledge in analysis and design of various types of shell structures.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Applying navier's and levy's solution for analyzing the rectangular plates

CO#2: Identifying the modeling requirements of aero-elastic models

CO#3: Illustrate the static and dynamic wind effects on rigid and flexible structures

CO#4: Design of buildings, chimneys, roofs and shelters as per the codal requirements

CO#5: Describe the cyclone effects on the various glass designs.

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2			1
CO#3			2
CO#4		2	
CO#5		2	

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory Course				

Course Objective

The course provides the learning skills on understanding the various distress and damages to concrete and masonry structures. The course also addresses the various conditions of the serviceability and durability aspects of concrete structures. Materials and various techniques to be adopted for repair, rehabilitation and retrofitting of structures under normal and marine conditions will be discussed.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Identify the suitable assessment procedure for evaluating a damaged structure

CO#2: Recognize the importance of serviceability and durability aspects of concrete structure

CO#3: Categorize the different repair materials subjected to the requirements

CO#4: Describe the various techniques for repair and demolition of concrete structures

CO#5: Adopting repair, rehabilitation and retrofitting of structures under marine exposure

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	2	2	
CO#2			2
CO#3	2		
CO#4	2		2
CO#5	1		2

3 – High; 2 – Medium; 1- Low

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	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory Course			

Course Objective

The course brings the learning ability skills to measure the stress and Strains using different sources. The course also provides the detailed guidelines on using electrical resistance strain gauges with correction factor and non destructive testing methods. The basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity will be covered.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Perform suitable dimensional analysis to verify the model and prototypes

CO#2: Discuss the characteristics study on electrical resistance strain gauges

CO#3: Demonstrate the various non destructive testing methods on concrete specimens

CO#4: Describe the theory of photo elasticity for suitable arrangements

CO#5: Apply suitable methods to examine the two dimensional photo elasticity property

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1			1
CO#2	1		2
CO#3	3	2	2
CO#4			2
CO#5	2	1	2

3 – High; 2 – Medium; 1- Low

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”, McGraw Hill Publishing Company, New York.1989

CIV18R6106	STABILITY OF STRUCTURES	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory Course				

Course Objective

This course explains how and under what loading condition, a structure passes from a stable state to unstable state. Different structural members and systems are analysed for their stability conditions. This covers also includes the behavioral aspects of structural elements against lateral and torsional buckling conditions. Knowledge on finite element approach with various boundary conditions under critical loads will be discussed.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Formulate the equations for beam-column for various loading conditions.

CO#2: Evaluate the elastic buckling of bars and frames.

CO#3: Evaluate the in-elastic and torsion buckling of various sections.

CO#4: Derive the equation of simply supported beam subjected to lateral buckling.

CO#5: Analyze the stability conditions by finite element approach.

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1		2	
CO#2			2
CO#3			2
CO#4		2	
CO#5	1		1

3 – High; 2 – Medium; 1- Low

BEAM COLUMNS

Differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load – application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

ELASTIC BUCKLING OF BARS AND FRAMES

Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns- Buckling of frames-large deflections of buckled bars-Energy methods- Buckling of bars on elastic foundations- Buckle line of bar with intermediate compressive forces – Buckling of bars with change in cross-section – Effect of shear force on critical load- built up columns.

IN ELASTIC & TORSION BUCKLING

Buckle line of straight bar- Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling – Critical stress diagram various end conditions - Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section- Torsional buckling – Buckling by torsion and flexure.

LATERAL BUCKLING OF SIMPLY SUPPORTED BEAMS

Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

STABILITY ANALYSIS BY FINITE ELEMENT APPROACH

Deviation of shape function for a two nodded Bernoulli – Euler beam element – element stiffness and element geometric stiffness matrices – assembled stiffness and geometric stiffness matrices for a discretized column with different boundary condition – calculation of critical loads - Buckling of pin jointed frames.

References

1.Stability of Structures by Kumar, Ashwini: Allied Publishers, New Delhi.
2.Principles of Structural Stability Theory by Chajes, A. Prentice-Hall.
3.Structural Stability by Chen, W.F. &Lui, E.M.: Elsevier.
4. Elastic Stability of Structural Elements by Iyengar, N.G.R.: Macmillan India.
5. Stability Analysis and Design of Structures by Gambhir, M.L.: Springer-Verlag.
6. Theory of Elastic Stability by Timoshenko & Gere, McGraw Hill.

CIV18R6107	CHARACTERIZATION OF CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

The objective of the course is to provide students with an understanding of the behaviour and characterization of construction materials, particularly cement and concrete. By exploring the physics of these techniques and their application to cement science, students will develop a deeper comprehension of the mechanisms governing the performance of construction materials.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Perform the characterization study on the cement materials using calorimetry

CO#2: Identify the crystallographic structure of a cement material with X-ray diffraction method

CO#3: Differentiate the SEM image analysis in a cementitious materials

CO#4: Describe the working principles of NMR spectroscopy

CO#5: Identify the pore size distribution of a construction materials

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	2	2	2
CO#2	2		2
CO#3	1		3
CO#4			1
CO#5			2

3 – High; 2 – Medium; 1- Low

CALORIMETRY

Introduction – characterization of construction materials- structure of construction materials- introduction to calorimetry and types- sample preparation, practical note and heat of hydration- applications

X- RAY DIFFRACTION AND THERMAL ANALYSIS

Introduction to X-ray & crystallography- crystal systems and history of XRD- diffractogram- calculations-qualitative phase analysis-sample preparation and applications in study of cements, thermal analysis – applications in construction materials.

SURFACE AREA MEASUREMENT AND OPTICAL MICROSCOPY

Surface area measurement- sampling and particle size distribution- different techniques- calculation and applications- optical and scanning microscopy- specimen preparation- features and functions- types of optical microscopy-SEM- parts and functioning-working principles- analysis of cementitious system- application of characterization techniques.

IMAGE ANALYSIS AND SPECTROSCOPY

Image analysis- basic operation and image mapping- spectroscopy techniques- AAS, AES, UV &IR, FTIR, And NMR- principles of NMR spectroscopy.

MERCURY INTRUSION AND IMPEDANCE ANALYSIS

Porosity and pore structure- introduction, significance of pore distribution- working of mercury intrusion porosimeter- electrical impedance analysis- principles and different methods- deliverables and interpretations- electro chemical testing using EIS.

References

1. Karen Scrivener, Ruben Snellings, Barbara Lothenbach, A Practical Guide to Microstructural Analysis of Cementitious Materials, CRC Press, 2015.
2. William D. Callister, Materials Science and Engineering: An Introduction, Sixth Edition, John Wiley and Sons, 2003. .
3. J. M. Illston and P. L. J. Domone, Construction Materials – Their Nature and Behaviour, Third Edition, Spon Press, 2001.
4. J.F. Young, S. Mindess, R.J. Gray and A. Bentur, The Science and Technology of Civil Engineering Materials, Prentice Hall, 1998.
5. Jan Skalny, Editor, Materials Science of Concrete, Volumes I – VII, American Ceramic Society, 1989 – 2005.

CIV18R6108	SUSTAINABLE BUILDING MATERIALS	L	T	P	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

The aim of this course is to familiarize students with sustainability concepts related to building and conventional engineered building materials. The course will cover achieving sustainability through the use of lower carbon cements, light weight aggregates, and recycled aggregate to reduce natural resource consumption, including water. The course will also explore topics such as indoor air quality, embodied, operational, and life cycle energy, and energy consumption reduction through optimal design.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Describe the role of cement towards sustainable energy calculation

CO#2: Utilize the waste materials in producing sustainable concrete

CO#3: Performing energy efficient design of building towards leed energy rating metrics

CO#4: Arriving the embodied energy calculation for the materials used in the buildings

CO#5: Achieving optimal design of buildings through operation energy calculation

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	3		3
CO#3	1	2	
CO#4	2		2
CO#5	2	2	2

3 – High; 2 – Medium; 1- Low

ROLE OF CEMENT AND SUSTAINABILITY

Role of Cement in Sustainability and Calculation of Chemical Energy- Fuel for Cement-Cementitious/ Supplementary Cementitious Materials and Their Characterization- Strength of Concrete With Supplementary Cementitious Materials and Composite Cements- Types of Composite Cements-Alternative Fuel for cement and Embodied Energy.

PROPERTIES OF SUSTAINABLE MATERIALS

Role of agro and industrial waste in concrete- types – their influence on physical and mechanical properties and durability of concrete–role of municipal solid waste in concrete- types- their influence on physical and mechanical properties and durability of concrete-fibers and polymers in concrete- types – properties – application- lightweight aggregates- types- influence on physical and mechanical, durability properties.

ENERGY RATING SYSTEM

Concept of green building-principles of green building-components of green building-environmental, economical, health and social benefits-ecofriendly materials / green materials-Major Energy efficient areas for buildings- energy efficient design of buildings-design strategies and green design process-green building rating system- GRIHA,LEED- Embodied Energy in Green Materials.

EMBODIED ENERGY AND CONCRETE SUSTAINABILITY

Introduction and definition of sustainability- fundamentals of sustainability-basics of carbon cycle- factors affecting carbon cycle- role of construction materials in emission of CO_2 –concept of embodied energy- embodied energy for material and building components- energy for production of building materials- transportation energy for building materials- total energy needed for building- calculation of embodied energy- case study for energy in building.

OPERATIONAL ENERGY IN BUILDING MATERIALS

Operational Energy- Bond's Law + Operational Energy: U-Value -Operational energy reduction and net zero building, Optimization for design of building for energy efficiency and example of optimization through use of Evolutionary genetic algorithm.

References

1. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Processes, 1st Edition, Elsevier, 2003

2.Indian Building Congress, Practical Handbook on Energy Conservation in Buildings, 1st ed. Nabhi Publication, 2008.

3. Clarke, J.A., Energy Simulation in Building Design, Adam Hilger Ltd. 1985.

4. Leadership in Energy and Environmental Design (www.usgbc.org/LEED).

CIV18R6109	FRACTURE MECHANICS OF CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3
Course Category : Program Elective		**Course Type** : Theory			

Course Objective

The course covers the basic aspects of the Fracture Mechanics on concrete elements. A thorough understanding on the fracture mechanics of brittle and ductile materials. Exposure on the basics of linear-elastic fracture mechanics (LEFM) and elastic-plastic fracture mechanics (EPFM) and the role of photo-elasticity on the development of stress field equations in fracture mechanics. Focus on Modeling plastic zone at the crack-tip, crack models, time dependent fracture including creep and fatigue crack growth, fracture damage control mechanism.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Comprehend the fundamentals of fracture mechanics

CO#2: Categories the structural crack

CO#3: Identify the fracture mechanism in concrete structures

CO#4: Apply fracture mechanics models to structural models.

CO#5: Compute the fracture damage

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	2		3
CO#3	1	2	
CO#4			2
CO#5		2	2

3 – High; 2 – Medium; 1- Low

BASICS OF FRACTURE MECHANICS

Fundamentals of fracture mechanics – Brittle and ductile behavior - Sources of micro and macro cracks - types of cracks – stress intensity factor- Mechanisms of fracture - Fracture criteria – service condition affecting fracture

STRUCTURAL CRACKS

Modes of loading - Crack in a structure - mechanisms of fracture in structural concrete - crack growth - cleavage fracture - ductile fracture - fatigue and stress - corrosion crack growth - environment assisted crack

CRACK TIP PLASTICITY

Stress at crack tip - linear elastic fracture mechanics (LEFM) - Elastic-Plastic Fracture Mechanics (EPFM) - Griffith's criteria – stress-intensity factors - crack tip plastic zone - Erwin's plastic zone correction - R curves – compliance - J contour integral -concept of CTOD and CMD

MATERIAL MODELS

Crack concepts – Material models - crack models - models based on continuum damage mechanics - modeling of quasi brittle materials – photoelasticity - severity of a crack – application in concrete elements

COMPUTATIONAL FRACTURE MECHANICS

Time – dependent fracture mechanics – Fracture toughness measurement - fatigue control plan Factors – quasi-brittle materials failure surfaces – closure measurements – damage tolerance - finite element model for crack tip

References

1. Anderson L, "Fracture Mechanics: Fundamentals and Applications", 4th Edition, CRC Press; 2017

2. Surendra P Shah, Stuart E Swartz, Chengsheng Ouyang, "Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock and other Quasi- brittle Materials, John Wiley & Sons, 1995.

3. Alberto Carpinteri, "Applications of Fracture Mechanics to Reinforced Concrete", CRC Press, 2014

4. Prashant Kumar, "Elements of fracture mechanics", 1st Edition McGraw Hill Education; 2017.

5. Suri C. T. and Jin Z.H., "Fracture Mechanics", 1st Edition, Elsevier Academic Press, 2012

CIV18R6110	DESIGN OF SUB STRUCTURES	L	T	P	C
		3	0	0	3
Course Category : Program Elective	**Course Type** : Theory				

Course Objective

The basic aim of this course is to provide the comprehensive skills in design and detailing the various types of shallow and deep foundations as per IS 2911 codal requirements. Also covers the design of individual components of caisson and well foundation with various loading combinations and preventive measures against sliding action. General design criteria for the foundations of transmission line towers and retaining structures will be discussed.

Course Outcomes

Upon the successful completion of the course, the students will able to

CO#1: Design the shallow foundations as per the requirements

CO#2: Design the components of pile foundations

CO#3: Design the components of well and caisson foundations

CO#4: Design the suitable foundations for transmission line towers

CO#5: Design the various components of retaining structures

CO-PO Mapping

CO / PO	**PO#1** ***An ability to independently carry out research /investigation and development work to solve practical problems***	**PO#2** ***An ability to write and present a substantial technical report/document***	**PO#3** ***Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program***
CO#1	1		
CO#2	2		2
CO#3		2	
CO#4		2	2
CO#5		2	2

3 – High; 2 – Medium; 1- Low

DESIGN OF SHALLOW FOUNDATIONS

Introduction to site investigation - Bearing capacity - Types of shallow foundations - General principles of design of reinforced concrete shallow foundations - Structural design of isolated and combined footing - Structural design of rafts by conventional method - Principles of design of buoyancy raft and basement (no design problems) - Pressure relieve valves or ground/rock anchors(no design problems) - Modulus of subgrade reactions.

DESIGN OF PILE FOUNDATION

Pile foundations - Types - General principles of design - Pile stiffness - Estimation of load capacity of piles by static and dynamic formulae - Detailing of reinforcement as per IS 2911 - Design of pile caps - Settlement analysis of pile groups - Negative skin friction - Pile load tests.

WELL AND CAISSON FOUNDATIONS

Well and caisson foundations - Structural elements of Caisson and Well foundations - Elements of well foundation - Forces acting on Caisson and well foundations - Design of individual components of Caisson and well foundation(only forces acting and design principles) - Sinking of well - Shifts and tilts in well foundations - Preventive measures.

FOUNDATIONS OF TRANSMISSION LINE TOWERS

Introduction - Necessary information - Forces on tower foundations - General design criteria - Choice and type of foundation - Design procedure - Design of foundation for transmission towers (concrete pad and chimney type only).

RETAINING STRUCTURES

Retaining walls - Retaining walls with shear keys - Types - RE walls - Gabbions - Soil nailing & Rock bolting - Sheet pile walls - Struts and anchors

References

1. Robert w. Day, “Foundation Engineering Handbook”, Tata McGraw- Hill Companies Inc., 2010

2. Winterkorn. H. F., and Fang, H. Y., “Foundation Engineering Hand Book – Van Nostrard – Reinhold -1990.

AUD18R5001	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		1	0	0	0
Course Category : Audit Course	**Course Type** : - Theory				

Course Objective

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

(4 hours)

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

(4 hours)

Unit 3

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

(4 hours)

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

(4 hours)

Unit 5

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

(4 hours)

AUD18R5002	PEDAGOGY STUDIES	L	T	P	C
		1	0	0	0
Course Category : Audit Course	**Course Type** : - Theory				

Course Objective

To enable the students to understand the concepts of pedagogy and the improvement of teaching methods

Syllabus

Unit 1

Aims and rationale, Policy background, Conceptual framework and terminology -Theories of learning, Curriculum, Teacher education. -Conceptual framework, Research questions. - Overview of methodology and Searching.

(4 hours)

Unit 2

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.- Curriculum, Teacher education.

(4 hours)

Unit 3

Methodology for the in depth stage: quality assessment of included studies - Pedagogic theory and pedagogical approaches. -Teachers' attitudes and beliefs and Pedagogic strategies

(4 hours)

Unit 4

Alignment with classroom practices and followup support - Peer support - Support from the head teacher and the community - 3 Curriculum and assessment - Barriers to learning: limited resources and large class sizes

(4 hours)

Unit 5

Research design – Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

(4 hours)

INTER DISCIPLINERY ELECTIVES

CSE18R5051 CLOUD COMPUTING	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil **Course Type** :Theory Course				

Introduction

Cloud Computing: Nutshell of cloud computing, Enabling Technology, Historical development, Vision, feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud. Ethical Issue in Cloud Computing, Evaluating the Cloud's Business Impact and economics, Future of the cloud. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things

Cloud Computing Architecture:

Cloud Reference Model, Layer and Types of Clouds, Services models, Data center Design and interconnection Network, Architectural design of Compute and Storage Clouds. Cloud Programming and Software: Fractures of cloud programming, Parallel and distributed programming paradigms-MapReduce, Hadoop, High level Language for Cloud. Programming of Google App engine,

Virtualization Technology:

Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor VMware, KVM, Xen. Virtualization: of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of data-center

Securing the Cloud:

Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, Cloud Computing Security Architecture. Legal issues in cloud Computing. Data Security in Cloud: Business Continuity and Disaster Recovery, Risk Mitigation, Understanding and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management

Cloud Platforms in Industry:

Amazon web services Google App Engine, Microsoft Azure Design, Aneka Cloud Application Platform -Integration of Private and Public Clouds Cloud applications: Protein structure prediction, Data Analysis, Satellite Image Processing, CRM and E ,Social networking . Cloud Application- Scientific Application, Business Application. Advance Topic in Cloud Computing: Federated Cloud/Inter Cloud, Third Party Cloud Services.

TEXT/REFERENCE BOOKS:

1. Distributed and Cloud Computing " By Kai Hawang , Geofrey C.Fox, Jack Dongarra Pub: Elservier

2. Cloud Computing, Principal and Paradigms, Edited By Rajkumar Buyya, Jemes Broberg, Goscinski, Pub.- Wiley
3. Kumar Saurabh, "Cloud Computing" , Wiley Pub
4. Krutz , Vines, "Cloud Security " , Wiley Pub
5. Velte, "Cloud Computing- A Practical Approach" ,TMH Pub

CSE18R5052 IOT AND APPLICATIONS	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil **Course Type** :Theory Course				

IoT & Web Technology

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

M2M to IoT

A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

IoT Architecture

State of the Art – Introduction, State of the art, Architecture Reference ModelIntroduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views

IoT Applications for Value Creations

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Internet of Things

Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoTData-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

REFERENCE BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013
3. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1- 4493- 9357-1.

MEC18R5023 Environmental Safety	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** :Theory Course				

AIR POLLUTION

Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollutionconcept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhaustschemical factory stack emissions-CFC.

WATER POLLUTION

Classification of water pollutants-health hazards-sampling and analysis of water-water treatment - different industrial effluents and their treatment and disposal -advanced wastewater treatment - effluent quality standards and laws- chemical industries, tannery, textile effluents-common treatment.

SOLID AND HAZARDOUS WASTE MANAGEMENT

Hazardous waste management in India-waste identification, characterization and classification technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-processing and energy recovery – waste minimization, health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

ENVIRONMENTAL MEASUREMENT AND CONTROL

Sampling and analysis – dust monitor – gas analyzer, particle size analyzer – lux meter-pH meter – gas chromatograph – atomic absorption spectrometer. Gravitational settling chambers-cyclone separators-scrubbers-electrostatic precipitator - bag filter – maintenance - control of gaseous emission by adsorption, absorption and combustion methods- Pollution Control Board-laws.

POLLUTION CONTROL IN PROCESS INDUSTRIES

Pollution control in process industries like cement, paper, petroleum-petroleum products-textiletanneries- thermal power plants – dying and pigment industries - eco-friendly energy.

TEXT BOOK

1. Rao, CS, Environmental pollution engineering, Wiley Eastern Limited, New Delhi, 1992.

REFERENCES

1. H. S. Peavy, D. R. Rowe, G. Tchobanoglous Environmental Engineering - McGraw- Hill Book Company, New York, 1987.
2. H.Ludwig, W.Evans, Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands, N.J., 1991.
3. Arcadio, P. Sincero and G. A. Sincero, Environmental Engineering – A Design Approach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
4. G. Masters Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt Ltd, New Delhi, 2003.
5. S.P.Mahajan, Pollution control in process industries, Tata McGraw Hill Publishing Company, New Delhi, 1993 6. Varma and Braner, Air pollution equipment, Springer Publishers, Second Edition

MEC18R6052 SAFETY IN CONSTRUCTION	**L**	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Pre-requisite: Nil **Course Type** :Theory Course				

Course Outcome(s)

CO1: Identify the basic knowledge of construction management system.

CO2: Analyze various construction hazards and control measures.

CO3: Explain the procedures and rules of height work.

CO4: Perceive the various construction machinery used in Industries.

CO5: Explain about safety in erection and demolition work.

ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction - compensation – Black Spot Identification-Recording of accidents and safety measures – Education and training

HAZARDS OF CONSTRUCTION AND PREVENTION

Excavations, basement and wide excavation, trenches, shafts – scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings.

WORKING AT HEIGHTS

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

CONSTRUCTION MACHINERY

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder's hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

SAFETY IN DEMOLITION WORK

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods – interesting experiences at the construction site against the fire accidents. Understand basic physics related to crash reconstruction

REFERENCES

1. Hudson, R., Construction hazard and Safety Hand book, Butterworth's Publication, 1985.
2. JnatheaD.Sime, Safety in the Build Environment, London, 1988.
3. V.J.Davies and K.Thomasin, Construction Safety Hand Book, Thomas Telford Ltd., London, 1990.
4. Handbook of OSHA Construction safety and health, Charles D. Reese and James V. Edison
5. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982 6. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons, 1979.