Curriculum

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Syllabus

for

M.Tech - Civil Engineering
(Structural Engineering)

Batch 2017-18 onwards

Program Electives

S. No.	Course Code	Course Title	L	T	P	C	Pre-requisite/ Exposure	Category	Remarks
1		Advanced Foundation Engineering	3	0	0	3	-	Engineering	**Elective 1**
2		Design of Concrete Bridges	3	0	0	3	-	Engineering	
3		Design of Industrial Structures	3	0	0	3	-	Engineering	
4		Earthquake Resistant Design	3	0	0	3	-	Engineering	**Elective 4**
5		Design of Tall Buildings	3	0	0	3	-	Engineering	**Elective 2**
6		Energy Efficient Buildings	3	0	0	3	-	Engineering	
7		Environmental Engineering Structures	3	0	0	3	-	Engineering	
8		Experimental Stress Analysis	3	0	0	3	-	Engineering	**Elective 4**
9		Machine Foundations	3	0	0	3	-	Engineering	
10		Maintenance & Rehabilitation of Structures	3	0	0	3	-	Engineering	**Elective 3**
11		Theory and Design of Plates & Shells	3	0	0	3	-	Engineering	**Elective 5**
12		Off Shore Structures	3	0	0	3	-	Engineering	**Elective 3**
13		Prefabricated Structures	3	0	0	3	-	Engineering	
14		Pre-stressed Concrete Structures	3	0	0	3	-	Engineering	**Elective 1**
15		Soil Structure Interaction	3	0	0	3	-	Engineering	**Elective 5**
16		Stability of Structures	3	0	0	3	-	Engineering	**Elective 2**
17		Structural Optimization	3	0	0	3	-	Engineering	**Elective 3**
18		Composite Structures	3	0	0	3	-	Engineering	**Elective 2**

SEMESTER WISE COURSE STRUCTURE

First Semester

S. No.	Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
1		Professional and Communication Skills (or) Foreign Language	0 2	0 0	4 0	2	Humanities		-
2		Advanced Numerical and Statistical Methods	3	1	0	4	Science		-
3		Structural Dynamics	3	0	0	3	Engineering		-
4		Matrix Methods of Structural Analysis	3	0	0	3	Engineering		-
5		Advanced Concrete Technology	3	0	0	3	Engineering		-
6		Design of Concrete Structural Systems	3	0	0	3	Engineering		-
7		Matrix methods of Structural Analysis Lab (STAAD PRO)	0	0	2	1	Engineering		-
8		Design of Concrete and Structural Systems Lab (STAAD PRO)	0	0	2	1	Engineering		-

Total Credit = 20

Second Semester

S. No.	Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
1		Finite Element Analysis	3	0	0	3	Engineering		-
2		Theory of Elasticity and Plasticity	3	0	0	3	Engineering		-
3		Limit State Design of Steel Structures	3	0	0	3	Engineering		-
4		Elective - 1	3	0	0	3	Engineering		-
5		Elective – 2	3	0	0	3	Engineering		-
6		Elective - 3	3	0	0	3	Engineering		-
7		Structural Engineering lab (CASTING)	0	0	2	1	Engineering		-
8		Finite Element Analysis Lab (STAAD PRO)	0	0	2	1	Engineering		-

Total Credit = 20

Third Semester

S. No.	Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
1		Application of Numerical Methods in Structural Engineering	3	0	0	3	Engineering		-
2		Elective – 4	3	0	0	3	Engineering		-
3		Elective – 5	3	0	0	3	Engineering		-
4		Seminar (or) Mini Project	- -	- -	2	1	Engineering		-
5		Comprehensive Examination	-	-	-	2	Engineering		-
6		Major Project (Phase I)	0	0	0	5	Engineering		-

Total Credit = 17

Fourth Semester

S. No.	Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
1		Major Project (Phase II)	0	0	0	15	Engineering		-

Total Credit=15

Curriculum (Scheme of Examination)

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Syllabus

for

M.Tech - Civil Engineering (Semester-I)

Batch 2017-18 onwards

SGT University Gurgaon

Credit Based Scheme w.e.f. 2017-2018

	Professional and Communication Skill	L	T	P	C
Version	Date of Approval:	0	0	4	2
Pre-requisites	Nil				

COURSE OBJECTIVES

1. To develop the professional and communication skills of learners in a technical environment.
2. To enable the students to acquire functional and technical writing skills.
3. To acquire state-of-the-art presentation skills in order to present technical topics to both technical and non-technical audience.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Exhibit their language proficiency and skill in Describing, Investigating, Designing and Making and Using Technology.
2. Talk fluently and communicate well with others.

COURSE CONTENT

UNIT: 1

Functional Language	Basic structures- Tense agreement, Prepositional phrases Techno-words : Basic Concepts 62, 63 Pronunciation : sounds of syllables: Past tense & plural endings
Technical Expression	Organisational techniques in technical writing Guided writing: Paragraph Writing, Note Making
Presentation Skills	Techniques of presentation (general topics : speech without visual aids)Listening to speeches and comprehending
Graphical Skills	Flow chart : Process and Functional description

UNIT: 2

Functional Language	Basic structures- Voice, Conditionals Techno-words : Basic Concepts 64,65,67 Pronunciation : Word Stress: two syllable words
Technical Expression	Mechanics of Technical Writing and Syntax Guided writing: Letter and email
Presentation Skills	Interpersonal Communication Skills Writing techniques for Power point presentation, Group Discussion
Graphical Skills	Technical Illustrations and Instructions

UNIT: 3

Functional Language	Basic structures- Modal Verbs and Phrasal verbs Techno-words : Basic Concepts 68,69,70,71 Pronunciation : Word Stress: compound words
Technical Expression	Mechanics of Technical Writing and Syntax Guided writing: Technical Description
Presentation Skills	Career advancement: Technical Resume and Company Profile Presentation and Group Discussion
Graphical Skills	Pie chart, Bar chart, Line graphs: analysis and interpretation

UNIT: 4

Functional Language	Basic structures- Modal Verbs and Phrasal verbs Techno-words : Basic Concepts 72,73,74, Functional vocabulary 87 Pronunciation : Sentence Stress
Technical Expression	Guided and Free writing: Abstract and Technical articles
Presentation Skills	Nuances of Presentation to a Technical audience
Graphical Skills	Oral Presentation of graphical representation

TEXT BOOKS

1. English Vocabulary in Use Advanced, McCarthy & Felicity, CUP, 2003, ISBN-13: 978-0521532549.
2. Sky Pronunciation CD-ROM, ISBN-13: 978-0062072047
3. Cambridge Advanced Learner's Dictionary CD-ROM, 9781107619500, June 2013.
4. English Master: Grammar

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REFERENCE BOOKS

1. Writing, Researching, Communicating, Keith et al, Tata McGraw-Hill, 1989, ISBN 0-324-31751-4 3.
2. Advanced English Grammar, Martin, CUP, 2006, ISBN-10 0-521-53291-4.

	Advanced Numerical and Statistical Methods	L	T	P	C
Version	Date of Approval:	3	1	0	4
Pre-requisites	Nil				

COURSE OBJECTIVES

1. To introduce the applications of many advanced methods for solving a wide variety of engineering problems.
2. To understand the formulations of approximating polynomials.
3. To understand the procedures of numerical integration.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Solve any problem related to approximating problems.
2. Evaluate numerical integrations.
3. Solve any problem on probability and statistics.

COURSE CONTENT

Unit I: Solutions of System of Linear Equations 8 lecture hours

Direct Methods - Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss-Seidel and Jacobi method, ill conditioned matrix.

Solution of system of non linear equation - Newton Raphson and Modified Newton Raphson Method - Iterative methods.

Unit II: Interpolation and Approximation 8 lecture hours

Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, Least square approximation.

Unit III: Numerical Integration 8 lecture hours

Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration.

Unit IV: Numerical Solution of Differential Equations 8 lecture hours

Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2^{nd}, 3^{rd} and 4^{th} orders, Predictor- Corrector method, Solution of Laplace's and Poisson's equations by Liebmann's method, Solution of one dimensional time dependent heat flow.

Unit V: Probability and statistics 8 lecture hours

Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments.

TEXT BOOKS

1. Numerical Method: E. Balagurusamy, Tata McGraw Hill Publication. ISBN 10: 0074633112, Edition -2001.
2. Applied Numerical Analysis: Curtis F. Gerald and Patrick O. Wheatley – Pearson Education Ltd. ISBN-13: 978-0321133045, Edition: 7

REFERENCE BOOKS

1. Numerical Methods for Scientific and Engineering computation: M.K Jain, S.R.K Iyengar and R K Jain, New age International Publishers. (Jul 30, 1996) ISBN-13: 978-8122414615.
2. Statistical Methods: S.P. Gupta, Sultan Chand and Sons 16th rev. ed. reprint, 2012(2013) 978-81-8054-909-0.
3. Introduction to Mathematical Statistics: A.M. Mood, F. Graybil and D.C.Boes, Mc Graw Hill Publication, edt.1974 ... ISBN-13: 9780070854659

	Structural Dynamics	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Structural Analysis				

COURSE OBJECTIVES

1. To find the behaviour of structures subjected to dynamic loads such as wind, earthquake and blast loads.
2. To study different dynamic analysis procedures for calculating response of structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Solve the problems on single degree of freedom system.
2. Understanding concepts of harmonic loading and impulse loading and related analysis.
3. Understanding the concepts of multi degree of freedom system.
4. Evaluate the mode shapes for different structures.

COURSE CONTENT

Unit I: SDOF Systems 8 lecture hours

Single Degree of Freedom System - Introduction - Alembert's principle - Mathematical models for SDOF systems - Free vibration - Damped and undamped - Critical damping - Logarithmic decrement.

Unit II: Harmonic and Impulse Loading 8 lecture hours

Response to Harmonic Loading and Impulse Loading - Analysis of undamped system - damped system - general dynamic loading.

Unit III: Vibration Analysis 8 lecture hours

Vibration Analysis - Rayleigh's method - Approximate Analysis - Improved Rayleigh method.

Unit IV: MDOF Systems 8 lecture hours

Multi degree of Freedom System - Evaluation of structural property matrices - Mode shape - Orthogonality conditions - Undamped and damped system - Mode superposition method

Unit V: Continuous Systems 8 lecture hours

Continuous Systems - Differential equation of motion - Transverse vibration of linearly elastic beams - Analysis of undamped free vibration of simply supported and cantilever beams - Orthogonality condition.

TEXT BOOKS

1. Mario Paz, (2004), Structural Dynamics - Theory and Computation, Second Edition, CBS Publishers, ISBN-13: 9788123909783.

REFERENCE BOOKS

1. J. Humar, (2012), Dynamics of Structures, Third Edition, CRC Press, ISBN-13: 9780415620864.
2. Anil K. Chopra, (2003), Dynamics of Structures - Theory and Applications to Earthquake Engineering, Third Edition, Pearson India, ISBN-13: 9788131713297.

	Matrix Methods of Structural Analysis	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Structural Analysis				

COURSE OBJECTIVES

1. The course is intended to teach the basic concepts of indeterminate structures, static indeterminacy and kinematic indeterminacy.
2. Different matrix methods will be taught and their uses will be explained in the class.

COURSE OUTCOMES

On completion of this course, the students will be able to
1. Solve different structures by flexibility matrix method and stiffness matrix method.
2. Visualize and analyze space trusses and space frames.
3. Understand the effect of settlement of supports.

COURSE CONTENT

Unit I: Introduction to flexibility matrix and stiffness matrix 8 lecture hours

Concept of static indeterminacy and kinematic indeterminacy - concept of flexibility matrix and stiffness matrix - properties of matrices - coordinate system - solution of simple problems - derivation of stiffness matrix of beam element from strain energy.

Unit II: Analysis of plane structures by flexibility matrix method 8 lecture hours

Analysis of continuous beam, plane truss and plane frame by flexibility matrix method - Internal forces due to thermal expansion and lack of fit – effect of settlement of supports.

Unit III: Analysis of plane structures by stiffness matrix method 8 lecture hours

Analysis of continuous beam, plane truss and plane frame by stiffness matrix method - Internal forces due to thermal expansion and lack of fit – effect of settlement of supports

Unit IV: Space truss 8 lecture hours

Analysis of space truss by flexibility matrix method and stiffness matrix method.

Unit V: Analysis of space structures by stiffness matrix method 8 lecture hours

Analysis of space frame and grid structures by stiffness matrix method

TEXT BOOKS

1. Pundit G.S. & Gupta S.P., (2008), Structural Analysis (A matrix approach), Second Edition, Tata McGraw Hill Education, ISBN-13: 9780070667358.

REFERENCE BOOKS

1. J. S. Przemieniecki, (1985), Theory of Matrix Structural Analysis, New Edition, Dover Publication, ISBN-13: 97804866494.
2. Richard B. Nelson, Lewis P. Felton, (1997), Matrix Structural Analysis, John Wiley & Sons, Imported Edition, ISBN-13: 9780471123248.

	Advanced Concrete Technology	L	T	P	C
Version	Date of Approval :	3	0	0	3
Pre-requisites	Concrete Technology				

COURSE OBJECTIVES

1. This course mainly aims to develop the knowledge about properties of cement concrete and importance of admixtures in concrete.
2. To make the students to understand Mix Design Method.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Know the various materials used in concrete and admixtures.
2. Do the Mix design by different methods.
3. Get a thorough knowledge of various types of cement, aggregates and special concrete.
4. Know the different procedures for testing concrete.

COURSE CONTENT

Unit I: Material, reinforcement and admixtures 8 lecture hours

Materials - Concrete materials - Reinforcements and admixtures.

Unit II: Mix design 8 lecture hours

Mix Design – Specifications - Design of concrete mixes by IS code method - ACI method - Road Note No: 4 methods – High strength concrete.

Unit III: Modern trends in concrete 8 lecture hours

Behaviour of Concrete - Modern trends in concrete manufacture and placement techniques - Behaviour of fresh concrete and hardened concrete - Resistance to static and dynamic loads.

Unit IV: Concrete testing 8 lecture hours

Testing of Concrete - Non-destructive testing and quality control – Durability - Corrosion protection and fire resistant.

Unit V: Special concrete 8 lecture hours

Special Concrete - Pre-cast concrete - Light weight concrete - Under water concrete – Pump concrete - Polymer concrete - Composites and fibre reinforced concrete.

TEXT BOOKS

1. Shetty. M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd. ISBN-13: 9788121900034.

REFERENCE BOOKS

1. M. L. Gambhir, (2013), Concrete Technology, Fifth Edition, McGraw Hill Education India Pvt. Ltd., ISBN-13: 9781259062551.
2. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

	Design of Concrete Structural Systems	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Concrete Technology				

COURSE OBJECTIVES

1. This subject is intended to teach the concept of advanced concrete design.
2. The practical aspects of various designs of structure will be explained in the classes

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Analyse and design the deep beams.
2. Design shears wall buildings and flat slabs.
3. Design slender columns.

COURSE CONTENT

Unit I: Limit state design of beams 8 lecture hours

Limit state analysis and design of beams in flexure - Behaviour of reinforced concrete members in bending - Plastic hinge – Rotation capacity – Factors affecting rotation capacity of a section – Plastic moment – Moment curvature relationship – Redistribution of moments.

Unit II: Deep beams 8 lecture hours

Limit state design of deep beams

Unit III: Flat Slabs 8 lecture hours

Design of Flat Slabs using BIS 456

Unit IV: Columns and shear wall buildings 8 lecture hours

Design of slender column subjected to combined bending moment & axial force using SP: 16

Unit V: Shear wall framed building 8 lecture hours

Analysis and Design of shear wall framed buildings.

TEXT BOOKS

1. Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, ISBN-13: 9788123912257.

REFERENCE BOOKS

1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
2. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
3. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.
4. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

	Matrix Methods of Structural Analysis Lab	L	T	P	C
Version	Date of Approval:	0	0	2	1
Pre-requisites	Structural Analysis				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on Matrix Methods of Structural Analysis using STAAD-PRO software package.
2. The practical application of the STAAD-PRO software package will be taught.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Use STAAD PRO software package for analysis of different types of structures.
2. Use STAAD PRO software package for drawing shear force diagram and bending moment diagram.
3. Understand the behaviour of different types of structures.
4. Understand the deflected shape of different types of structures.

COURSE CONTENT

List of experiments:

1. Analysis of propped cantilever beam
2. Analysis of two span continuous beams
3. Analysis of statically determinate plane truss
4. Analysis of statically indeterminate plane truss
5. Analysis of kinematically indeterminate plane truss
6. Analysis of one bay – one storey plane frame
7. Analysis of multi bay – multi storied plane frame
8. Analysis of space truss
9. Analysis of grid
10. Analysis of space frame

TEXT BOOKS

1. Pundit G.S. & Gupta S.P., (2008), Structural Analysis (A matrix approach), Second Edition, Tata McGraw Hill Education, ISBN-13: 9780070667358.

REFERENCE BOOKS

1. J. S. Przemieniecki, (1985), Theory of Matrix Structural Analysis, New Edition, Dover Publication, ISBN-13: 97804866494.
2. Richard B. Nelson, Lewis P. Felton, (1997), Matrix Structural Analysis, John Wiley & Sons, Imported Edition, ISBN-13: 9780471123248.

	Design of Concrete Structural Systems lab	L	T	P	C
Version	Date of Approval:	0	0	2	1
Pre-requisites	Design of Concrete and Structural system				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on design of concrete structures using STAAD-PRO software package.
2. The practical application of the STAAD-PRO software package will be taught.

COURSE OUTCOMES

On completion of this course, the students will know the use of STAAD PRO software package and will be able to

1. Design continuous beams
2. Design deep beams
3. Design columns
4. Design shear walls.

COURSE CONTENT

List of experiments:

1. Design of Continuous beams
2. Design of Deep beams
3. Design of Columns
4. Design of Shear walls

TEXT BOOKS

1. Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, ISBN-13: 9788123912257.

REFERENCE BOOKS

1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
2. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
3. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.
4. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

Curriculum (Scheme of Examination)

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Syllabus

for

M.Tech-Civil Engineering (Semester-II)

Batch 2017-18 onwards

SGT University Gurgaon

Credit Based Scheme w.e.f. 2017-2018

	Finite Element Analysis	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Matrix Methods of Structural Analysis				

COURSE OBJECTIVES

1. The course is intended to teach the basic concepts of finite element analysis.
2. The practical application of finite element method and their advantages and disadvantages will be explained in the class.

COURSE OUTCOMES

On completion of this course, the students will be able to
1. Calculate strain-displacement matrix and stress-strain matrix.
2. Know the analysis procedure and the matrix operations.
3. Know the concepts of isoparametric elements.

COURSE CONTENT

Unit I: Introduction to FEM 8 lecture hours

Introduction - Background - General description of the method – Analysis procedure - Stress and strain vectors – Stain displacement equations – Linear constitutive equations – Overall stiffness matrix – Overall load matrix - Analysis of beams.

Unit II: Displacement models 8 lecture hours

Theory of Finite Element - Concept of an element - Various elements shapes - Displacement polynomials - Convergence requirements - Shape functions - Element strains and stresses - Direct formulation of element stiffness matrix for beam element and plane truss element.

Unit III: Analysis of structures by FEM 8 lecture hours

Overall Problems - Discretization of a body or structure - Minimization of band width - Construction of stiffness matrix and loads for the assemblage - Boundary conditions - Analysis of plane truss, space truss, plane frame and grid.

Unit IV: Plane stress and plane strain 8 lecture hours

Plane stress - Plane strain - CST, LST & QST elements – Rectangular element - solutions of problems.

Unit V: Iso-parametric elements 8 lecture hours

Natural Coordinate - Isoparametric Formulation - Natural coordinates (area and volume) - Isoparametric Bar element - Plane bilinear isoparametric element - Plane stress element - Quadratic plane stress elements - Application of Gauss Quadrature formulation.

TEXT BOOKS

1. C. S. Krishnamoorthy, (2008), Finite Element Analysis, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 978007462100.

REFERENCE BOOKS

1. Cook R. D., Malkas D. S. & Plesha M. E, (2008), Concepts and applications of Finite element analysis, Fourth Edition, Wiley India Pvt. Ltd., ISBN-13: 9788126513369.
2. Reddy, (2005), An Intro. To The Finite Element Methods, Third Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070607415.
3. Singiresu S. Rao, (2010), The Finite Element Method in Engineering, Fifth Edition, Elsevier Science, ISBN-13: 9780080952048.

	Theory of Elasticity and Plasticity	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Strength of Material				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on theory of elasticity and plasticity.

COURSE OUTCOMES

On completion of this course, the students will be able to
1. Analyse the stresses and strains for two dimensional and three dimensional elements.
2. Understand the equilibrium and compatibility conditions.
3. Solve the problems on Torsion for different shaped bars.
4. Understand the concept of plasticity.

COURSE CONTENT

Unit I: Stresses and strains 8 lecture hours

Analysis of Stress and Strain - Elasticity approach – Definition and notation of stress – Components of stress and strain – Generalized Hooke's law -Two dimensional Problems in Cartesian Coordinates - Plane stress and plain strain problems with practical examples - Equations of equilibrium and compatibility conditions in Cartesian coordinates – Airy's stress function - Bending of simply supported beams..

Unit II: Axi-symmetric problems 8 lecture hours

Two dimensional Problems in Polar Coordinates - Equations of equilibrium and compatibility conditions in polar coordinates – Axi-symmetrical problems - Thick cylinder under uniform pressure - Circular arc beams subjected to pure bending

Unit III: Prandle's membrane analogy 8 lecture hours

Principal stresses and strains for three dimensional element – Equations of equilibrium and compatibility conditions for 3D problems in Cartesian co-ordinates - Transformation of stresses and strains.

Unit IV: Torsion 8 lecture hours

Torsion - Torsion of various shaped bars - Pure torsion of prismatic bars - Prandtle's membrane analogy - Torsion of thin walled tubes and hollow shafts.

Unit V: Introduction to plasticity 8 lecture hours

Introduction to plasticity – Stress – Strain diagram – Plastic analysis – Yield criteria – St. Venant's theory – Von Mises criterion – Plastic work – Strain hardening.

TEXT BOOKS

1. Timoshenko and Goodier, (1970), Theory of Elasticity, Third Edition, McGraw Hill Professional, ISBN-13: 9780070858053.

REFERENCE BOOKS

1. Srinath, (2002), Advanced Mechanics of Solids, Third Edition, Tata McGraw Hill Pvt. Ltd., ISBN-13: 9780070139886.
2. D. Peric, E. A. de Souza Neto & D. R. J. Owen, (2011), Computational Methods for Plasticity, Wiley, ISBN-13: 9781119964544.

	Limit State Design of Steel Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Design of Steel Structures				

COURSE OBJECTIVES

1. To know how to design and use the different types of steel structural elements.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Design compression members.
2. Design light gauge steel structures.
3. Analyse the beams and portal frames.
4. Design joints and connections using riveted and welded connections

COURSE CONTENT

Unit I: Joints and connections 8 lecture hours

Design of joints and connections – Riveted – Bolted – Welded – Semi rigid connection.

Unit II: Compression members 8 lecture hours

Design of compression members – Axially – Uniaxial and biaxial bending - Design of base slab.

Unit III: Plastic Analysis 8 lecture hours

Plastic Analysis of Structures – Introduction - Shape factors – Mechanisms - Plastic hinge - Analysis of beams and portal frames - Design of continuous beams.

Unit IV: Light gauge sections 8 lecture hours

Design of Light Gauge Steel Structures - Types of cross sections - Local buckling and lateral buckling - Design of compression and tension members – Beams - Deflection of beams.

Unit V: Chimney 8 lecture hours

Design of Chimney, Design of foundation of chimney.

TEXT BOOKS

1. Dayarathnam. P., (1996), Design of Steel Structures, Second Edition, S. Chand and Publishers, ISBN-13: 0788121923200.

REFERENCE BOOKS

1. Duggal S. K., (2014), Limit State Design of Steel Structures, Second Edition, McGraw Hill, ISBN-13: 9789351343509.
2. Ramchandra, Virendra Gehlot, (2010), Limit State Design of Steel Structures: Based on IS: 800-2007 IN S. I. Units, Scientific Publishers, ISBN-13: 9788172336141.

	Structural Engineering Laboratory	L	T	P	C
Version	Date of Approval:	0	0	2	1
Pre-requisites	Design of Concrete Structures				

COURSE OBJECTIVES

1. To teach students different types of testing of concrete structures.
2. To enable the students to know the behaviour of RCC structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Design concrete mix for particular grade of concrete
2. Test concrete beams for various loading conditions
3. Perform non-destructive testing

COURSE CONTENT

List of experiments:

1. To determine the compressive strength of fibre reinforced concrete by testing cubes specimen.
2. Casting and testing of simply supported RCC beams for flexural failure.
3. Casting and testing of simply supported RCC beams for shear failure.
4. To determine tensile strength on a steel reinforcement bar.
5. To determine shear strength of steel bar under double shear.
6. To conduct bending test of I-section steel beam.
7. To conduct bending test of steel channel section.
8. To study rebound hammer test on concrete blocks.
9. To study ultra sonic pulse velocity test

TEXT BOOKS

1. Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, ISBN-13: 9788123912257.

REFERENCE BOOKS

1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
2. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
3. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.
4. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

	Finite Element Analysis Lab	L	T	P	C
Version	Date of Approval:	0	0	2	1
Pre-requisites	Matrix Methods of Structural Analysis Lab				

COURSE OBJECTIVES

1. To teach the students to understand the finite element analysis of different types of structures.
2. To enable the students to know the details of the STAAD-PRO software package.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the use of STAAD-PRO software package for finite element analysis of different types of structures.
2. Use STAAD-PRO software package for drawing shear force diagram and bending moment diagram.
3. Understand the behaviour of different types of structures.
4. Understand the deflected shape of different types of structures.

COURSE CONTENT

List of experiments:

1. Analysis of three span continuous beams.
2. Analysis of propped cantilever beam.
3. Analysis of statically determinate plane truss.
4. Analysis of statically indeterminate plane truss.
5. Analysis of one bay – one storey plane frame.
6. Analysis of two bays – one storey plane frame.

TEXT BOOKS

1. Pundit G.S. & Gupta S.P., (2008), Structural Analysis (A matrix approach), Second Edition, Tata McGraw Hill Education, ISBN-13: 9780070667358.

REFERENCE BOOKS

1. J. S. Przemieniecki, (1985), Theory of Matrix Structural Analysis, New Edition, Dover Publication, ISBN-13: 97804866494.
2. Richard B. Nelson, Lewis P. Felton, (1997), Matrix Structural Analysis, John Wiley & Sons, Imported Edition, ISBN-13: 9780471123248.
3. Analysis of a 2-D building frame subjected to dead load, live load and seismic load.
4. Analysis of grid.

Curriculum (Scheme of Examination)

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Syllabus

for

M.Tech-Civil Engineering (Semester-III)

Batch 2017-18 onwards

SGT University Gurgaon

Credit Based Scheme w.e.f. 2017-2018

	Application of Numerical Methods in Structural Engineering	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Finite Element Analysis				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on numerical methods in structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Solve the linear simultaneous equations.
2. Use the Finite difference method.
3. Calculate bending moment, slope and deflection for beams using Simpson's rule and Gauss Quadrature method.
4. Evaluate the eigen values and eigen vectors for stability problems.

COURSE CONTENT

Unit I: Simultaneous equations 8 lecture hours

Solution of linear simultaneous equations – Gauss elimination method, Gauss-Jordan method, Gauss-Siedal method - Banded - Semi-banded matrix– Skyline technique.

Unit II: Finite difference method 8 lecture hours

Finite difference method – Solution of simultaneous equations – Bending moment - Slope and deflection in beams - Membrane analogy using finite difference method for slabs-slope and deflection of slabs.

Unit III: Numerical methods 8 lecture hours

Numerical Methods – Numerical integration (Trapezoidal and Simpson's rule) for determining shear, moment and deflection in beams– Gauss Quadrature formula.

Unit IV: Finite Strip method for analysis of plates 8 lecture hours

Finite Strip Method – Shape Functions – Strain - Displacement Relationship – Strip Stiffness Matrix – Load Matrix – Solution of Problems.

Unit V: Eigen values and Eigen Vectors 8 lecture hours

Mass Matrix - Stiffness matrix - Dynamic Analysis - Eigen values & Eigen Vectors.

TEXT BOOKS

1. N. Krishnaraju & K. U. Muthu, (2008), Numerical Methods for Engineering problems, Second Edition, Macmillan India Ltd., ISBN-13: 9780333924242.

REFERENCE BOOKS

1. Jain M. K., Iyengar, R. K. & Jain R. K. (2004), Numerical Methods: Problems and Solutions, Second Edition, New Age International (P) Ltd., ISBN-13: 9788122415346.
2. Klaus-Jsrgan Bathe, (2008), Finite Element Procedures, First Edition, Prentice Hall of India, ISBN-13: 9788120310759.

	Seminar	L	T	P	C
Version	Date of Approval:	0	0	2	1
Pre-requisites	Nil				

COURSE OBJECTIVES

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analyze the various topologies for the selected topic of interest.
4. To conclude the advantages, drawbacks and future scopes of the technique.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Get familiarity with the recently advanced techniques.
2. Get detailed information about the topic of interest.
3. Know how to do literature survey.
4. Develop the interest in different research areas of Structures.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

	Mini Project	L	T	P	C
Version	Date of Approval:	0	0	2	1
Pre-requisites	Nil				

COURSE OBJECTIVES

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analyze the various topologies for the selected topic of interest.
4. To conclude the advantages, drawbacks and future scopes of the technique.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Get familiarity with the recently advanced techniques.
2. Get detailed information about the topic of interest.
3. Know how to do literature survey.
4. Develop the interest in different research areas of Structures.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

	Major Project (Phase I)	L	T	P	C
Version	Date of Approval:	0	0	0	5
Pre-requisites	Nil				

COURSE OBJECTIVES:

It will provide a strong fundamental scientific and technical knowledge related to topics of Civil engineering. They will get the concept of theories and methodologies needed to plan, design, analyse, develop, organise and manage Civil engineering topics / fields.

They will get the expertise in the major areas of Civil engineering, structural analysis, design and reliability, transportation system engineering, water resources and environmental engineering etc. with the knowledge of their projects and presentation. It will inculcate a deep understanding of engineering principles. It will also develop the capacity for independent studies and thinking.

COURSE OUTCOMES:

Students will possess the ability to apply the basic mathematical and scientific concepts that underlie the modern field of Civil Engineering. They will be able to design, analyse and interpret experimental data. They will be capable of designing major Civil Engineering projects. They will possess the problem solving abilities and familiarity with the computational procedures essential to the field. They will have the skills and motivations for their professional growth. They will get the indepth of knowledge of their selected topic or subjects of their project. The presentation of their project will enhance communication skills and confidence about their knowledge in that subject topic. They will have the strong fundamental scientific and technical knowledge.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

Curriculum (Scheme of Examination)

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Syllabus

for

M.Tech-Civil Engineering (Semester-IV)

Batch 2017-18 onwards

SGT University Gurgaon

Credit Based Scheme w.e.f. 2017-2018

	Major Project (Phase II)	L	T	P	C
Version	Date of Approval:	0	0	0	15
Pre-requisites	Nil				

COURSE OBJECTIVES:

It will provide a strong fundamental scientific and technical knowledge related to topics of Civil engineering. They will get the concept of theories and methodologies needed to plan, design, analyse, develop, organise and manage Civil engineering topics / fields.

They will get the expertise in the major areas of Civil engineering, structural analysis, design and reliability, transportation system engineering, water resources and environmental engineering etc. with the knowledge of their projects and presentation. It will inculcate a deep understanding of engineering principles. It will also develop the capacity for independent studies and thinking.

COURSE OUTCOMES:

Students will possess the ability to apply the basic mathematical and scientific concepts that underlie the modern field of Civil Engineering. They will be able to design, analyse and interpret experimental data. They will be capable of designing major Civil Engineering projects. They will possess the problem solving abilities and familiarity with the computational procedures essential to the field. They will have the skills and motivations for their professional growth. They will get the indepth of knowledge of their selected topic or subjects of their project. The presentation of their project will enhance communication skills and confidence about their knowledge in that subject topic. They will have the strong fundamental scientific and technical knowledge.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

PROGRAM ELECTIVES

	Advanced Foundation Engineering	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Geotechnical Engineering –II (Foundation Engg.)				

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of analysis and design of foundations and earth retaining structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the concepts of shallow foundations.
2. Design the retaining walls and sheet piles.
3. Know the types well foundations.
4. Design pile foundation

COURSE CONTENT

Unit I: Shallow foundation 8 lecture hours

Shallow Foundations - Spread footings – Contact pressure – Structural design of individual footings – Pedestals - Combined footings (Rectangular and trapezoidal) – Eccentrically loaded footings – Mat foundations

Unit II: Deep foundation 8 lecture hours

Retaining Structures - Stability of walls – Design of cantilever and counter fort walls – Design of gravity walls – Coffer dams – Braced coffer dams – Stability of bottom excavation – Anchorage – Walls and tie rods

Unit III: Retaining structures 8 lecture hours

Pile Foundations - Types of piles – Static and dynamic pile formula – Pile groups – Efficiency of pile group

Unit IV: Pile foundations 8 lecture hours

Settlement of piles – Batter piles – Analysis of pile groups – Structural design of piles and pile caps

Unit V: Well foundations 8 lecture hours

Well Foundations - Types of wells or caissons – Components – Shapes of wells – Forces acting – Construction– Design of drilled caissons

TEXT BOOKS

1. Gopal Ranjan and A S R Rao (2000), Basic and Applied Soil Mechanics, Second Edition, New Age International, ISBN-13: 9788122412239.

REFERENCE BOOKS

1. J. E. Bowles, (2000), Foundation Analysis and Design, Fifth Edition, McGraw Hill Education India Pvt. Ltd., ISBN-13: 9781259061035.
2. P. C. Verghese, (2009), Design of Reinforced Concrete Foundations, First Edition, PHI Learning Pvt. Ltd., ISBN-13: 9788120336155.

	Design of Concrete Bridges	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Reinforced Concrete Structures				

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the analysis and design of concrete bridges.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the load distribution and IRC standards
2. Design the slab bridges
3. Design the Arch bridges
4. Design the bridge bearings, hinges and expansion joints

COURSE CONTENT

Unit I: IRC loading and other methods 8 lecture hours

Load Distribution Theory - I.R.C. loading standards – Bridge slabs – Effective width method as per I.R.C. – Pigeaud's method – Bridge girders – Courbon's method – Assumptions and analysis of a typical bridge floor – Hendry-Jaeger method – Morice – Little version of Guyon and Massonet method (principles only) .

Unit II: Slab bridges 8 lecture hours

Slab Bridges - Straight and skew slab bridges – T beam bridges – Balanced cantilever bridges – Design of articulation – Continuous girder bridges.

Unit III: Arch bridges 8 lecture hours

Arch Bridges - Single span closed and open spandrel symmetrical type (structural arrangements and functions only) – Design of bow string girder bridges.

Unit IV: Miscellaneous bridges 8 lecture hours

Other Bridges - Box culvert (Single vent only) – Single span rigid frame bridges (Barrel of solid slab type only) – Pre-stressed composite T beam bridges (structural arrangements only)

Unit V: Substructures 8 lecture hours

Substructures - Design principles of Piers and abutments – Bridge bearings - Hinges and expansion joints

TEXT BOOKS

1. Johnson Victor, (2007), Essentials of Bridge Engineering, Sixth Edition, Oxford & IBH Publishing Co. Ltd., ISBN-13: 9788120417175.

REFERENCE BOOKS

1. Wilbur Jay Watson, (2910), General Specifications for Concrete Bridges, Nabu Press, ISBN-13: 9781177206587.
2. Portland Cement Association, (2010), Continuous Concrete Bridges, Cambridge Scholars Publishing, ISBN-13: 978115337241.

	Design of Industrial Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Construction Technology				

COURSE OBJECTIVES

1. This subject is taught to impart a broad knowledge in the area of industrial structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Know the requirements of various industries.
2. Get an idea about the materials used and planning.
3. Know the construction techniques.
4. Understand the functional requirements.

COURSE CONTENT

Unit I: Industrial requirements 8 lecture hours

General - Specific requirements for industries like textile, sugar, cement, chemical, etc - Site layout and external facilities.

Unit II: Planning of building works 8 lecture hours

Planning of Building Work – Standards - Structural materials including plastics – Polymers - Fibre glass - Pressed card boards, etc - Multi-storey buildings - Steel skeletal structures - Reinforced concrete frames – Workshops - Ware houses - Single storey buildings - Sheds in steel and reinforced concrete - North-lights - Single span spherical and other special constructions - Cooling towers and chimneys - Bunkers and silos' prefabrication - Construction.

Unit III: Construction techniques 8 lecture hours

Construction Techniques - Expansion joints - Machine foundations - Other foundations - Water proofing - Roofs and roofing - Roof drainage - Floors and flooring joists - Curtain walling - Outer wall facing - Sound and shock proof mountings - Use of modern hoisting and other construction equipments.

Unit IV: Circulation 8 lecture hours

Circulation - Communication and Transport - Fixed points (central cores) – Staircases - Grid floor sections - Lifts refuse disposals - Utilization of waste materials – Cranes - Continuous conveyors - Mobile cranes – Transporters – Doors - Sliding gates.

Unit V: Functional Requirements 8 lecture hours

Functional Requirements – Lighting: Natural lighting - Protection from the sun - sly lights - window cleaning installations -Services: Layout – wiring – fixtures - cable and pipe bridges - electrical installations - lighting substation - Effluent. Ventilation and fire protection: Ventilation - Air-conditioning - Fire escapes and chutes - Fire alarms - Hydrants.

TEXT BOOKS

1. El Reedy, (2010), Construction Management and Design of Industrial Concrete and Steel Structures, Taylor & Francis Group, ISBN-13: 9781439815991.

REFERENCE BOOKS

1. Nelson G. L., (1988), Light Agricultural and Industrial Structures: Analysis and Design Kluwer Academic Publisher, ISBN-13: 9780442267773.
2. Dr. Raja Rizwan Hussain, (2011), Pre-Cast Concrete for Multi-Storey Structures, Createspace Publisher, ISBN: 9781467918220.

	Earthquake Resistant Design	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Concrete Technology				

COURSE OBJECTIVES

1. To impart the knowledge about the earthquake and its occurrence.
2. To know about the mathematical modeling of structures subjected to earthquakes and their behaviour

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Evaluate the behaviour of structures under dynamic loadings.
2. Know methodology for earthquake resistant design.
3. Design the buildings using capacity design concept.
4. Design the multi storied building using computer.

COURSE CONTENT

Unit I: Basic of Seismology 8 lecture hours

Elements of Seismology - Definitions of magnitude – Intensity - Epicenter etc - General features of tectonics of seismic regions - Seismographs.

Unit II: Theory of vibrations 8 lecture hours

Theory of Vibrations - Free vibrations of single degree - Two degree and multiple degree freedom systems - Computations of dynamic response to time dependent forces - Vibrations isolation – Vibration absorbers - Brief introduction to instruments - Accelerograms

Unit III: Earthquake resistant design 8 lecture hours

Principles of earthquake resistant design - Response spectrum theory - Application of response spectrum theory to seismic design of structures.

Unit IV: Capacity design method 8 lecture hours

Capacity - Design Principles - Design criteria for strength - Stiffness and ductility - Earthquake Analysis and Design - Characteristics of earthquake – Earthquake response of structures – Concept of earthquake resistance design – Code provisions for design of building – IS 1893 and IS 4326 – Energy absorption capacity. Behaviour and design of masonry buildings subjects to earthquake ground motion - Seismic retrofitting strategies for RC and masonry buildings.

Unit V: Multi storey building analysis 8 lecture hours

Seismic analysis and design of a multi storied building using Computer.

TEXT BOOKS

1. Anil K. Chopra, (2011), Dynamics of Structures - Theory and Applications to Earthquake Engineering, Second Edition, Ingram International Inc., ISBN-13: 9780132858038.

REFERENCE BOOKS

1. Pankaj Agarwal and Manish Shrikhande, (2007), Earthquake Resistant Design of Structures, First Edition, Prentice-Hall India Pvt Ltd, ISBN-13: 9788120328921.
2. Gupta B. L., (2010), Principles of Earthquake Resistant Design of Structures & Tsunami, Standard Publishers & Distributors, ISBN-13: 9788180141485.

	Design of Tall Buildings	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Design of Steel Structures, Structural analysis				

COURSE OBJECTIVES

1. This course is intended to teach the concept of tall structures.
2. Various methods to analyse the tall structure will be explained in the classes.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Know the types of tall buildings.
2. Analyze the plane frame systems by different methods.
3. Design the shear wall systems and in filled frame systems.
4. Do the three dimensional analysis.

COURSE CONTENT

Unit I: Classification of buildings 8 lecture hours

Introduction - Classification of buildings according to NBC – Types of loads – wind load – Seismic load – Quasi static approach

Unit II: Plane frame systems 8 lecture hours

Plane Frame System - Calculation of wind load – Approximate method – Portal - Cantilever and factor methods – Kani's method – Substitute frame method for dead load and live loads.

Unit III: Shear wall system 8 lecture hours

Shear Wall System - Rosman's analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method

Unit IV: In-filled frame system 8 lecture hours

In-filled Frame Systems - Importance – Methods of analysis – Equivalent truss and frame method – Force-displacement method – Effect of perforation in the in-filled frame.

Unit V: Three dimensional analysis 8 lecture hours

Three Dimensional Analysis - Basic principles – Centre of rotation of a rigid floor – Force displacement method.

TEXT BOOKS

1. Bryan Stafford Smith and Alex Coull, (2011), Tall Building Structures: Analysis and Design, Wiley India, ISBN-13: 9788126529896.

REFERENCE BOOKS

1. Sarwar Alam Raz, (2002), Structural Design in Steel, Second Edition, New Age International, ISBN-13: 9788122432282.
2. Ghali. A., Neville. A. M and Brown T. G, (2009), Structural Analysis - A unified classical and Matrix Approach, Sixth Edition, Span press, ISBN-13: 9780415774338.

	Energy Efficient Buildings	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	--				

COURSE OBJECTIVES

1. This course aims to highlight importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
2. To familiarize students with the concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
3. To give a full understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
4. To highlight the importance of Environmental Management as well as Environmental impact Assessment methods in Energy efficient buildings.

COURSE OUTCOMES

On completion of this course, the students will be able to
1. Understand to make buildings energy efficient.
2. Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, Photovoltaics, and Ground source heat pumps, and their adaption to green building concepts.
3. Understand the concepts of Site and Climate, Building Form, Building Fabric, Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.
4. Have the necessary skills to undertake an Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies too.

COURSE CONTENT

Unit I: Green Buildings, Energy and Environment 8 lecture hours

Green Buildings within the Indian Context - Types of Energy - Energy Efficiency and Pollution - Better Buildings - Reducing energy consumption - Low energy design.

Unit II: Renewable Energy, Site and Climate 8 lecture hours

Renewable Energy sources that can be used in Green Buildings - Solar energy - Passive Solar Heating - Passive Solar collection - Wind and other renewable - A passive solar strategy - Photovoltaics - Climate and Energy - Macro and Microclimate - Indian Examples.

Unit III: Building Form and Fabric 8 lecture hours

Building Form - Surface area and Fabric Heat Loss - utilizing natural energy - Internal Planning - Grouping of buildings - Building Fabrics - Windows and doors - Floors - Walls - Masonry - Ecological walling systems - Thermal Properties of Construction Material.

Unit IV: Infiltration, Ventilation, Lighting, Cooling and Water Conservation 8 lecture hours

Infiltration and ventilation - Natural ventilation in commercial buildings - passive cooling - modelling air flow and ventilation - Concepts of daylight factors and day lighting - daylight assessment - artificial lighting - New light sources - Cooling buildings - passive cooling -

mechanical cooling - Water conservation- taps, toilets and urinals, novel systems - collection and utilization of rain water.

Unit V: Energy Awareness 8 lecture hours

Energy awareness - monitoring energy consumption - Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED) – Ecohomes - Sustainable architecture and urban design - principles of environmental architecture - Benefits of green buildings - Energy Conservation Building code – NBC.

TEXT BOOKS

1. William T. Meyer, (2007), Energy Economics and Building Design, McGraw - Hill, ISBN: 9780070417519.

REFERENCE BOOKS

1. Sim Van Der Ryn and Stuart Cowan, “Ecological Design”, Annotated Edition, Island Press ISBN-13: 9781597261418.
2. Richard D. Rush, (1991), The Building System Integration Handbook., Butterworth – Heinemann Ltd, ISBN-13: 9780750691987.

	Environmental Engineering Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Design of Concrete Structures				

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of analysis and design of pipes and sewage structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the concepts of pipe network and design.
2. Design the water tanks and concrete roofing systems.
3. Design the special purpose structures.
4. Understand the concepts of filter walls and clarifiers.

COURSE CONTENT

Unit I: Pipe design 8 lecture hours

Design of Pipes - Structural design of concrete - Pre-stressed concrete steel and cast iron piping mains - Sewerage tanks design - Anchorage for pipe – Massive outfalls – Structural design and laying – Hydrodynamic considerations.

Unit II: Water tank design 8 lecture hours

Analysis and design of water tanks - Design of concrete roofing systems using cylindrical, spherical and conical shapes using membrane theory and design of various types of folded plates for roofing using concrete - IS Codes for the design of water retaining structures.

Unit III: Economic analysis 8 lecture hours

Design of circular, rectangular, spherical and Intze type of tanks using concrete - Design of pre-stressed concrete cylindrical tanks – Economic analysis.

Unit IV: Swimming pools 8 lecture hours

Design of Special Purpose Structures - Underground reservoirs and swimming pools - Intake towers - Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. – Effect of earth pressure and uplift considerations – Selection of materials of construction.

Unit V: Mixing tank 8 lecture hours

Design of filter walls and clarifiers - Mixing tanks.

TEXT BOOKS

1. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.

REFERENCE BOOKS

1. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
2. Krishna Raju, (2004), Pre-stressed Concrete (Problems and Solutions), Second Edition, CBS Publishers & Distributors, ISBN-13: 9788123902174.

	Experimental Stress Analysis	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	--				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge about the instruments and its applications.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Know the working principle of strain gauges.
2. Do the model analysis using different theorems.
3. Know the concepts of photo elasticity and its applications.
4. Use the various Non-destructive testing methods.

COURSE CONTENT

Unit I: Strain gauges 8 lecture hours

Strain Gauges - Mechanical and optical strain gauges – Description and operation – Electrical resistance- Inductance and capacitance gauges – Detailed treatment on resistant gauges – Measurement of static and dynamic strains – Strain rosettes – Effect of transverse strains – Use of strain recorders and load cells.

Unit II: Model Analysis 8 lecture hours

Model Analysis - Structural similitude – Use of models – Structural and dimensional analysis – Buckingham Pi Theorem – Muller Breslau's principle for indirect model analysis – Use of Begg's and Eney's deformeters – Moment indicators – Design of models for direct and indirect analysis.

Unit III: Two dimensional photo elasticity 8 lecture hours

Two dimensional photo elasticity - Stress optic law – Introduction to polariscope – Plane and circular polariscope – Compensators and model materials – Material and model fringe value – Calibration of photo elastic materials – Isochromatic and isoclinic fringes – Time edge effects.

Unit IV: Three dimensional photo elasticity 8 lecture hours

Three dimensional photo elasticity - Introduction – Stress freezing techniques – Stress separation techniques – Scattered light photo elasticity – Reflection polariscope

Unit V: Non-destructive testing 8 lecture hours

Miscellaneous Methods - Brittle coating method – Birefringence techniques – Moire fringe method – Non-destructive testing – Ultrasonic pulse velocity technique – Rebound hammer method – X-ray method – Gamma-ray method.

TEXT BOOKS

1. Jindal, (2012), Experimental Stress Analysis, Pearson India, ISBN-13: 9788131759103.

REFERENCE BOOKS

1. J. Srinivas, (2012), Stress Analysis and Experimental Techniques: An Introduction, Alpha Science International Ltd, ISBN-13: 9781842657232.
2. Sadhu Singh, (2009), Experimental Stress Analysis, Khanna Publishers, ISBN-13: 9788174091826.

	Machine Foundations	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	--				

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge of dynamic behaviour of soils, effects of dynamic loads and the various design methods.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the basic principles of soil dynamics.
2. Understand the mathematical models and DOF.
3. Understand the concepts of stiffness, damping, inertia, guide lines for design.

COURSE CONTENT

Unit I: Introduction 8 lecture hours

Introduction: Elements of soil dynamics – Basic definitions – Importance of dynamics analysis – general requirements of machine foundations – types of machine foundation

Unit II: Properties of soil 8 lecture hours

Elastic properties of soils – Elastic deformation of soils and elastic constants - co-efficient of elastic uniform compression of soils - co-efficient of elastic non-uniform compression of soil, co-efficient of elastic uniform shear of soil, effect of vibration on the dissipatice properties of soil, effect of vibration on the porosity and hydraulic properties of soils, elements of the theory of residual settlements of decrease the residual dynamic settlement of foundations

Unit III: Design parameters 8 lecture hours

Theory of massive machine foundation – theory of single and multi degree freedom, system – Evaluation of Design parameters – vertical vibrations of foundations, rocking, vibration of foundations, vibration of pure shear, vibration of foundations accompanied by simultaneous rotations

Unit IV: Block foundation 8 lecture hours

Analysis and Design of foundation - models of vibration of block foundation – method of analysis for block foundation, design procedure from block foundations – relevant code for design of foundation, foundations for impact load and cyclic load – design data – Barker's Empirical procedures, analog models for dynamic analysis of single pile. Dynamic bearing capacity, earth pressure, dynamic soil structure interaction

Unit V: Vibration isolation 8 lecture hours

Vibration isolation – active and passive types of isolation – methods of isolation in machine foundation – properties of isolating materials – guide lanes for design and construction details of machine foundation

TEXT BOOKS

1. K. G. Bhatia, (2007), Foundations for Industrial Machines: Handbook for Practicing Engineers, D-Cad Publishers, ISBN-13: 9788190603201.

REFERENCE BOOKS

1. Srinivasulu P. and Vaidyanathan C. V., (2004), Hand Book of Machine Foundations, First Edition, Tata Education Pvt. Ltd., ISBN-13: 9780070966116.
2. Shambhu P. Dasgupta & Indrajit Chowdhury, (2009), Dynamics of Structures and Foundations: A Unified Approach: Fundamentals (Volume 1), First Edition, Taylor & Francis Publishers, ISBN-13: 9780415471459.

	Maintenance & Rehabilitation of Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Concrete Technology				

COURSE OBJECTIVES

1. This subject imparts a broad knowledge in the area of repair and rehabilitation of structures

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the properties of fresh and hardened concrete.
2. Know the strategies of maintenance and repairing.
3. Get an idea of repairing techniques.
4. Understand the properties of repairing materials

COURSE CONTENT

Unit I: Properties of concrete 8 lecture hours

Serviceability and Durability of Structures - Quality Assurance for concrete construction - Fresh concrete properties – Strength – Permeability - Cracking - Effects due to climate – Temperature – chemicals - Wear and erosion - Design and construction errors - Corrosion mechanism - Effects of cover thickness and cracking - Methods of corrosion protection – Inhibitors - Resistant steels – Coatings - Cathodic protection

Unit II: Repairing materials 8 lecture hours

Diagnosis and Assessment of Distress - Visual inspection – Non destructive tests –Ultrasonic pulse velocity method – Rebound hammer technique – ASTM classifications – Pullout tests – Core test

Unit III: Repairing techniques 8 lecture hours

Materials for Repairing - Special concretes and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement - Polymer concrete – Ferro cement, Fibre reinforced concrete - Fibre reinforced plastics.

Unit IV: Repairs to structures 8 lecture hours

Techniques for Repair - Rust eliminators and polymers coatings for rebars during repair - Foamed concrete - Mortar and dry pack - Vacuum concrete - GModulee and shotcrete - Epoxy injection - Mortar repair for cracks - Shoring and underpinning.

Unit V: Example of Repairs to Structures 8 lecture hours

Example of Repairs to Structures - Repairs to overcome low member strength – Deflection – Cracking - Chemical disruption - Weathering wear - Fire leakage - Marine exposure

TEXT BOOKS

1. Shetty M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd. ISBN-13: 9788121900034.

REFERENCE BOOKS

1. Ravindra K. Dhir, M. Roderick Jones & Li Zheng, (2005), Repair and Renovation of Concrete Structures, American Society of Civil Engineers, ISBN-13: 9780727734051.
2. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

	Theory and Design of Plates & Shells	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	--				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge about the behavior of plates and shells.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Analyse the plates using Navier's and Levy's method.
2. Analyse the circular, rectangular and square plates by finite difference method.
3. Design the curved shells and roofs.
4. Design the various folded plate structures

COURSE CONTENT

Unit I: Thin plates 8 lecture hours

Laterally loaded thin plates – Differential equation – Boundary conditions.

Unit II: Plate bending 8 lecture hours

Bending of plates – Simply supported rectangular plates – Navier's solution and Levy's method – Rectangular plates with various edge conditions - Symmetrical bending of circular plates – Finite difference method for analysis of square and rectangular plates.

Unit III: Design of shells 8 lecture hours

Types of shells – Structural action – Membrane theory – Limitations – Beam method of analysis.

Unit IV: Curved shell 8 lecture hours

Analysis and design of doubly curved shells – Elliptic paraboloid - Conoid and hyperbolic paraboloid roofs.

Unit V: Folded plate structures 8 lecture hours

Folded plate structures – Structural behaviour – Various types – Design of folded plates - Reinforced detailing.

TEXT BOOKS

1. G. S. Ramaswamy, (1996), Design and Construction of Concrete Shell Roofs, First Edition, CBS Publishers and distributors. ISBN-13: 9780812390995.

REFERENCE BOOKS

1. Timoshenko and Krieger, (2010), Theory of Plates and Shells, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070701250.
2. K. Bhaskar, (2013), Plates: Theories and Applications, First Edition, Ane Books Pvt. Ltd., ISBN-13: 9789382127024.

	Offshore Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Nil				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge about analysis and design of offshore structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the effect of wind on structures.
2. Get an idea about modelling and analysis.
3. Design plat forms, derrick, jacket towers.

COURSE CONTENT

Unit I: Rigid and flexible structures 8 lecture hours

Wind on structures - Rigid structures - Flexible structures - Static and Dynamic effects.

Unit II: Wave generation 8 lecture hours

Wave generation and Propagation - Small and finite amplitude wave theories - Wave energy and pressure distribution.

Unit III: Wave forces 8 lecture hours

Wave forces on structures - Environmental loading - Use of Morrison equation.

Unit IV: Types of structures 8 lecture hours

Loads - Design of platforms – Derricks – Helipads – Design - Principles and examples of Jacket towers - Mooring cables

Unit V: Design of platform, helipad etc 8 lecture hours

Loads - Design of platforms – Derricks – Helipads – Design - Principles and examples of Jacket towers - Mooring cables.

TEXT BOOKS

1. Gerwick, (1999), Construction of Marine and Offshore Structure, Second Edition, CRC Press, ISBN-13: 9780849374852.

REFERENCE BOOKS

1. Lymon C. Reese, Bruce J. Muga & James F. Wilson, Offshore Structures, Second Edition, John Wiley & Sons, ISBN-13: 978047121264675.
2. Templetion J. S., (2007), Offshore Technology in Civil Engineering, Hall of Fame, Papers from the Early Years, Volume-2, American Society of Civil Engineers, ISBN-13: 9780784409251.

	Pre-fabricated Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Construction Technology				

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of prefabricated structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Know the types of prefabrication systems.
2. Understand the behaviour of shell structures.
3. Design pre fabricated Modules.
4. Do the detailing of pre fabricated Modules.

COURSE CONTENT

Unit I: Introduction 8 lecture hours

Types of foundation - Modular co-ordination – Components - Prefabrication systems and structural schemes - Design considerations - Economy of prefabrication - Prefabrication of load-carrying members - DisModuleing of structures - Structural behaviour of pre cast structures.

Unit II: Handling and erection stresses 8 lecture hours

Handling and erection stresses - Application of pre stressing of roof members - Floor systems - Two way load bearing slabs - Wall panels

Unit III: Dimensioning and detailing of joints 8 lecture hours

Dimensioning and detailing of joints for different structural connections - Construction and expansion joints.

Unit IV: Erection of structures 8 lecture hours

Production - Transportation and Erection - Organising of production - Storing and erection equipment - Shuttering and mould design - Dimensional tolerances, Erection of R.C. structures, Total prefabricated buildings

Unit V: Design of pre fabricated Modules 8 lecture hours

Prefabricated Modules for Industrial structures - Multi-storied buildings and Water tanks - Application of pre stressed concrete in prefabrication

TEXT BOOKS

1. Hass, A. M., Precast Concrete Design and Applications, Taylor & Francis Publishers, ISBN-13: 9780853341970.

REFERENCE BOOKS

1. A. S. G. Bruggeling & G. F. Huyghe, (1991), Prefabrications with Concrete, CRC Press, ISBN-13: 9789061911838.
2. Levitt Maurice, (2007), Precast Concrete Materials, Manufacture Properties and Usage, Second Edition, Applied Science Publishers Ltd., ISBN-13: 9780415268462.

	Pre-stressed Concrete Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Reinforced Concrete Structures				

COURSE OBJECTIVES

1. This subject is taught to give the concepts of pre-stress.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Know the concepts, methods and materials of pre-stressing systems.
2. Design the pre-stressed concrete members.
3. Calculate the deflections in pre-stressed concrete members.
4. Design anchorage zones and composite pre-stressed concrete members.

COURSE CONTENT

Unit I: Materials and losses in pre stress 8 lecture hours

Difference between reinforced and pre-stressed concrete – Principles of pre-stressing – Methods and systems of pre-stressing – Principles of pre-stressing – Classification of pre-stressed concrete structures – Materials – High strength concrete and High strength steel – Stress-strain diagram - Losses in pre-stress.

Unit II: Design of pre-stressed concrete beams 8 lecture hours

Design of prismatic pre-stressed concrete members for bending at service load.

Unit III: Deflections 8 lecture hours

Simple cable profiles – Calculation of deflections – Design of beams for shear and torsion at working and ultimate loads.

Unit IV: Anchorage design 8 lecture hours

Design of Anchorage zone by Guyon's method – Concept of Magnel's method – IS:1343 recommendations.

Unit V: Composite prestressed concrete beams 8 lecture hours

Pre-stressed concrete beams – Design procedure – Calculation of stresses at important stages both for propped and unpropped constructions – Shrinkage stresses - Statically indeterminate structures – Concept of concordant cable and profile – Sketching of pressure lines for continuous beams.

TEXT BOOKS

1. Krishna Raju.N, (2010), Problems & Solutions Pre-stressed Concrete, Second Edition, CBS Publishers, ISBN-13: 9788123907154.

REFERENCE BOOKS

1. Dayarathnam P, (1996), Pre-stressed Concrete Structures, Fifth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120400450.
2. Sinha N. C and Roy S. K., Fundamentals of Pre-stressed Concrete, Third Edition, S.Chand & Company, ISBN-13: 9788121924276.

	Soil Structure Interaction	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Geotechnical Engineering - I (Soil Mechanics) Geotechnical Engineering –II (Foundation Engg.)				

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on soil structure interaction analysis, its influences in the design parameters.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the concept of interaction, linear and non-linear behavior of soil.
2. Design beams and slabs using Winkler foundation model.
3. Do the elastic analysis of piles and pile groups.

COURSE CONTENT

Unit I: Mathematical model, Winkler model, Two parameter model 8 lecture hours

Soil models: single parameter model (Winkler), two parameter models – Filonenko - Borodich model, Pasternak model, Heteni model, visco elastic model, elastic continuum model, contact pressure distribution below the flexible and rigid footing and. raft parameter affecting conduct pressure.

Unit II: Modulus of subgrade, reaction 8 lecture hours

Contact pressure and subgrade modulus and beams on elastic foundation method - analysis of contact pressure distribution – modulus of subgrade reaction – classical solution for beam of infinite length subjected to concentrated load and moment, beams of finite length (formulation of basic equation for slabs resting on elastic foundation), Application of design of combined footing.

Unit III: Beams and slabs 8 lecture hours

Plates in elastic medium – soil structure interaction for shallow foundation – interface behaviour - Thin and thick plates – analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions, Baker's method for rafts.

Unit IV: Analysis of piles 8 lecture hours

Soil pile interaction : Introduction – elastic analysis of single pile, theoretical solutions for settlement and load distribution analysis of pile group interaction analysis – Load distribution with groups with rigid cap – elastic continuum and elasto-plastic analysis of piles and pile groups (Ultimate lateral resistance of piles by various approaches).

Unit V: Pile displacement 8 lecture hours

Laterally loaded pile and piled raft: Non-linear load – deflection response P-Y reactions, non-linear soil properties lift capacity of piles and anchors, Piles raft system – soil structure interaction in framed structures. FEM modules use of approximately software packages

TEXT BOOKS

1. Hemsley, (1997), Elastic Analysis of Raft Foundations, Telford & Thomas Ltd. Publishers, ISBN-13: 9780727725943.

REFERENCE BOOKS

1. Smith I. M., (1994), Proceedings of the Third European Conference, Manchester, 7-9 September, CRC Press, ISBN-13: 9789054105107.
2. Volkan Kaltakci, (2009), Practical Methods for the Analysis of Piled Raft Foundations: Computer Aided Analysis, Design Charts, Simplified Methods, Lambert Academic Publishing, ISBN-13: 9783838314051.

	Stability of Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Structural analysis				

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of stability of structures.

COURSE OUTCOMES

On completion of this course, the students will be able to
1. Understand the behaviour of eccentric column.
2. Analyse the beam columns
3. Analyse the frames stability.
4. Understand the concept of buckling of shells.

COURSE CONTENT

Unit I: Introduction 8 lecture hours

Introduction - Static equilibrium – Governing equation for columns – Analysis for various boundary conditions - Analysis of Eccentrically loaded column.

Unit II: Column analysis 8 lecture hours

Beam Columns – Theory of Beam column – Stability analysis of beam column with different types of loads – Failure of beam columns.

Unit III: Beam column analysis 8 lecture hours

Analysis and stability of frames

Unit IV: Frames stability 8 lecture hours

Plates subjected to inplane forces - Differential equation – Analysis – Approximate techniques - Analysis for various boundary conditions – Wood and Armour equation for analysis and design.

Unit V: Plates and shells 8 lecture hours

Buckling of shells – Differential equation – Analysis – Application

TEXT BOOKS

1. Aswini Kumar, (1985), Stability Theory of Structures, McGraw Hill Book Co. Limited, ISBN-13: 9780074515167.

REFERENCE BOOKS

1. Timoshenko S. P. & Gere J. M., (2010), Theory of Elastic Stability, Second Edition, McGraw Hill Education, ISBN-13: 9780070702417.
2. Chai H. Yoo, (2011), Stability of Structures Principles and Applications, Elsevier Publisher, ISBN-13: 9780123851222.

	Structural Optimization	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Systems Approach in Engineering Design				

COURSE OBJECTIVES

1. This course is intended to teach the importance of Optimization problems in the Structural Engineering.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the concepts of Optimization problems in the Structural Engineering.
2. Know the different methods for the Optimization problems.
3. Understand the concepts of Linear and Non-Linear Programming techniques.
4. Understand the concepts of Stochastic Optimization Methods.
5. Understand the concepts of Genetic Algorithm based Optimization Methods.

COURSE CONTENT

Unit I: Formulation of Structural Optimization problems. 8 lecture hours

Formulation of Structural Optimization problems: Design variables - Objective function - constraints. Fully stressed design.

Unit II: Linear Programming techniques 8 lecture hours

Review of Linear Algebra: Vector spaces, basis and dimension, canonical forms.

Unit III: Non-Linear Programming techniques 8 lecture hours

Linear Programming: Revised Simplex method, Application to structural Optimization.

Unit IV: Stochastic Optimization Methods 8 lecture hours

Nonlinear Programming: Deterministic Methods_ Unconstrained and constrained Optimization - Kuhn-Tucker conditions, Direct search and gradient methods - One dimensional search methods - DFP and BFGS algorithms, constrained Optimization - Direct and Indirect methods - SLP, SQP and SUMT, Application of NLP methods to optimal structural design problems. Optimality criteria based methods, Reanalysis techniques - Approximation concepts - Design sensitivity Optimization of sections, steel and concrete structures - framed structures, bridge structures.

Unit V: Genetic Algorithm based Optimization Methods 8 lecture hours

Genetic Algorithm based Optimization Methods

TEXT BOOKS

1. S.S.Rao, (2009), Engineering Optimization: Theory and Practice, Fourth Edition, John Wiley – Mehul Exclusive, ISBN-13: 9788126540440.

REFERENCE BOOKS

1. Smith D. R., Variational Methods in Optimization, New Edition, Dover Publications, ISBN-13: 9780486404554.
2. Ravindran A., Reklaitis G. V. & Ragsdell K. M., (2006), Engineering Optimization – Methods and Applications, Second Edition, John Wiley & Sons, ISBN-13: 9780471558149.

	Composite Structures	L	T	P	C
Version	Date of Approval:	3	0	0	3
Pre-requisites	Strength of Material				

COURSE OBJECTIVES

1. To know the types of composites
2. To understand the need for stress strain relation
3. To understand the fabrication methods
4. To understand the laminated plates
5. To study and understand the different methods & analysis of composite materials.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Analyze composite structures
2. Do microscopic and macroscopic analysis
3. Analyze sandwich and laminated plates
4. Understand the failure criteria for composites.
5. Know the fabrication techniques

COURSE CONTENT

Unit I: Stress Strain Relationship 8 lecture hours

Introduction - advantages and application of composite materials, reinforcements and matrices - Generalised Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials.

Unit II: Finite Element Analysis of Plates 8 lecture hours

Introduction - concept of mesh - Displacement function - Stress-Strain Matrix – Stiffness matrix of plate element – Solution of problem

Unit III: Methods of Analysis 8 lecture hours

Micro mechanics - Mechanics of materials approach, elasticity approach to determine material properties - Macro Mechanics - Stress-strain relations with respect to natural axis, arbitrary axis - Determination of material properties - Experimental characterization of lamina.

Unit IV: Laminated Plates 8 lecture hours

Governing differential equation for a general laminate, angle ply and cross ply laminates - Failure criteria for composites.

Unit V: Sandwich Constructions, Fabrication Process 8 lecture hours

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Various Open and closed mould processes - Manufacture of fibers - Types of resins and properties and applications – Netting analysis.

TEXT BOOKS

1. Madhujit Mukhopadhyay, (2010), Mechanics of Composite Materials and Structures, First Edition, Orient Blackswan Pvt. Ltd., ISBN-13: 9788173714771.

REFERENCE BOOKS

1. Jones, R.M., (1998), Mechanics of Composite Materials, Second Edition, Taylor and Francis Publisher, Isbn-13: 9781560327127.
2. Atul K. Kaw, (2005), Mechanics of Composite Materials, Second Edition, CRC Press, ISBN-13: 9780849313431.