SGT UNIVERSITY
SHREE GURU GOBIND SINGH TRICENTENARY UNIVERSITY
GURGAON, DELHI-NCR
(Established by the Haryana Act No.8 of 2013)

Department of Civil Engineering
M. Tech
in
Structure Engineering

SGT University Gurgaon

Credit Based Scheme w.e.f. 2019-2020

Curriculum (Scheme of Examination)

M.Tech –Structural Engineering

Batch 2019-20 onwards

SEMESTER WISE COURSE STRUCTURE

First Semester

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160101	Pre-Stressed Concrete Design	3	0	0	3	60	40	100
2	13160102	Structural Dynamics	3	0	0	3	60	40	100
3	13160103	Matrix Methods of Structural Analysis	3	1	0	4	60	40	100
4	13160104	Advanced Concrete Technology	3	0	0	3	60	40	100
5	13160105	Design of Concrete Structural Systems	3	0	0	3	60	40	100
6	13160106	Matrix methods of Structural Analysis Lab (STAAD PRO)	0	0	2	1	30	20	50
7	13160107	Design of Concrete and Structural Systems Lab (STAAD PRO)	0	0	2	1	30	20	50
		Total	**15**	**1**	**4**	**18**	**360**	**240**	**600**

Second Semester

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160201	Finite Element Analysis	3	0	0	3	60	40	100
2	13160202	Theory of Elasticity and Plasticity	3	0	0	3	60	40	100
3	13160203	Limit State Design of Steel Structures	3	0	0	3	60	40	100
4		Elective – I	3	0	0	3	60	40	100
5		Elective – II	3	0	0	3	60	40	100
6		Elective – III	3	0	0	3	60	40	100
7	13160215	Structural Engineering lab (CASTING)	0	0	2	1	30	20	50
8	13160216	Finite Element Analysis Lab (STAAD PRO)	0	0	2	1	30	20	50
		Total	**18**		**4**	**20**	**420**	**280**	**700**

Third Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160301	Earthquake Resistant Design	3	0	0	3	60	40	100
2		Elective – IV	3	0	0	3	60	40	100
3		Elective – V	3	0	0	3	60	40	100
4	13160307	Seminar (or) Mini Project	- -	- -	2	1	30	20	50
5	13160308	Comprehensive Examination	-	-	-	2	30	20	50
6	13160309	Major Project (Phase I)	0	0	0	5	120	80	200
		Total	**9**	**1**	**2**	**17**	**360**	**240**	**600**

Fourth Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160401	Major Project (Phase II)	0	0	0	15	130	170	300
		Total	**0**	**0**	**0**	**15**	**130**	**170**	**300**

Semester-I

1. Name of the Department		**CIVIL ENGINEERING**				
2. Course Name	Structural Dynamics	**L**	**T**		**P**	
3. Course Code	13160102	3	0		0	
4. Type of Course		✓ **Core ()**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	✓ Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 44		**Tutorials = 00**	**Practical = 00**			

Brief Syllabus: Study of Single degree of freedom system(SDOF Systems) **,** Study of structure under Harmonic and Impulse Loading**,** Vibration Analysis**,** Study of multi degree of freedom system (MDOF Continuous Systems)

8. Learning 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.

9. Course Outcomes:

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.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: SDOF Systems**
Single Degree of Freedom System - Introduction - Alembert's principle - Mathematical models for SDOF systems - Free vibration - Damped and undamped - Critical damping - Logarithmic decrement.		
Unit - 2	**Number of lectures = 09**	**Title of the unit: Harmonic and Impulse Loading**
Response to Harmonic Loading and Impulse Loading - Analysis of undamped system - damped system - general dynamic loading.		
Unit - 3	**Number of lectures =08**	**Title of the unit: Vibration Analysis**
Vibration Analysis - Rayleigh's method - Approximate Analysis - Improved Rayleigh method.		
Unit - 4	**Number of lectures = 10**	**Title of the unit: MDOF Systems**
Multi degree of Freedom System - Evaluation of structural property matrices - Mode shape - Orthogonality conditions - Undamped and damped system - Mode superposition method		
Unit – 5	**Number of lectures = 09**	**Title of the unit: Continuous Systems**
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.		

11. Brief Description of self learning / E-learning component

1. https://swayam.gov.in/course/3697-structural-dynamics

2. https://onlinecourses.nptel.ac.in/noc16_ce08/course

3. https://www.iitk.ac.in/nicee/wcee/article/WCEE2012_3202.pdf

12. Books Recommended

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.

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1. Name of the Department		**CIVIL ENGINEERING**				
2. Course Name	**Matrix Methods of Structural Analysis**	**L**	**T**		**P**	
3. Course Code	13160103	3	0		2	
4. Type of Course (use tick mark)		✓ **Core ()**	**PE()**		**OE()**	
5. Pre-requisite (if any)	Structural Analysis	**6. Frequency (use tick marks)**	Even ()	✓ Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)

Lectures = 40	**Tutorials = 00**	**Practical = 10**

Brief Syllabus:

8. Learning 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

9. Course Outcomes:

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.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Introduction to flexibility matrix and stiffness matrix**

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 - 2	**Number of lectures = 08**	**Title of the unit: Analysis of plane structures by flexibility matrix method**

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 - 3	**Number of lectures = 08**	**Title of the unit: Analysis of plane structures by stiffness matrix method**

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 - 4	**Number of lectures = 08**	**Title of the unit: Space truss**

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

Unit - 5	**Number of lectures = 08**	**Title of the unit: Analysis of space structures by stiffness matrix method**

Analysis of space frame and grid structures by stiffness matrix method

11. Books Recommended

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.

12. Lab component components

Sr. No.	Title	CO covered
1	Analysis of propped cantilever beam	1
2	Analysis of two span continuous beams	1
3	Analysis of statically determinate plane truss	2
4	Analysis of statically indeterminate plane truss	2
5	Analysis of kinematically indeterminate plane truss	2
6	Analysis of one bay – one storey plane frame	1
7	Analysis of multi bay – multi storied plane frame	1
8	Analysis of space truss	3
9	Analysis of grid	2
10	Analysis of space frame	3

1. Name of the Department		**CIVIL ENGINEERING**				
2. Course Name	**Advanced Concrete Technology**	**L**	**T**		**P**	
3. Course Code	13160104	3	0		0	
4. Type of Course (use tick mark)		✓ **Core ()**	**PE()**		**OE()**	
5. Pre-requisite (if any)	**Concrete Technology**	**6. Frequency (use tick marks)**	Even ()	✓ Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 43		**Tutorials = 00**	**Practical = 08**			

8. Brief Syllabus

Study of different types of material .and admixture. Learning of different mix design and the process of mix design study of latest technique for concrete behavior, experimental study of different test on concrete and different types of concrete.

9. Learning 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.

10. Course Outcomes:

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.

11. Unit wise detailed content

Unit-1	**Number of lectures = 07**	**Title of the unit: Material, reinforcement and admixtures**
Materials - Concrete materials - Reinforcements and admixtures.		
Unit - 2	**Number of lectures = 09**	**Title of the unit: Mix design**
Mix Design – Specifications - Design of concrete mixes by IS code method - ACI method - Road Note No: 4 methods – High strength concrete.		
Unit - 3	**Number of lectures = 10**	**Title of the unit: Modern trends in concrete**
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 - 4	**Number of lectures = 09**	**Title of the unit: Concrete testing**
Testing of Concrete - Non-destructive testing and quality control – Durability - Corrosion protection and fire resistant.		
Unit - 5	**Number of lectures = 08**	**Title of the unit: Special concrete**
Special Concrete - Pre-cast concrete - Light weight concrete - Under water concrete – Pump concrete - Polymer concrete - Composites and fibre reinforced concrete.		

12. Books Recommended

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.

1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Pre-stressed Concrete Structures	L	T		P	
3.Course Code	13160101	3	0		0	
4.Type of Course (use tick mark)		Core (√)	PE-()		OE()	
5.Pre-requisite (if any)	Fluid Mechanics	**6.Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about Pre-stressed concrete. Its advantages, different methods and its application. Different types of losses in pre-stressed concrete structure and design.

9.Learning objectives:

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

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 10	Materials and losses in pre stress
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 - 2	Number of lectures = 11	Design of pre-stressed concrete beams
Design of prismatic pre-stressed concrete members for bending at service load.		
Unit - 3	Number of lectures = 10	Deflections
Simple cable profiles – Calculation of deflections – Design of beams for shear and torsion at working and ultimate loads.		
Unit - 4	Number of lectures = 05	Anchorage design
Design of Anchorage zone by Guyon's method – Concept of Magnel's method – IS:1343 recommendations.		
Unit - 5	Number of lectures = 05	Composite prestressed concrete beams
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.		

13.Books Recommended

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.

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1. Name of the Department		**Civil Engineering**				
2. Course Name	**Design of Concrete Structural Systems**	**L**	**T**		**P**	
3. Course Code	13160105/07	3	0		2	
4. Type of Course (use tick mark)		**Core (✓)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 28**			

8. Brief Syllabus : Student will study about limit state design method, Deep Beams, Flat Slab, Columns and shear walls and framed buildings

9. Learning 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

10. Course Outcomes (COs): On completion of this course, the students will be able to

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.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Title of the unit: Limit state design of beams**

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 – 2	**Number of lectures = 8**	**Title of the unit: Deep Beams**

Limit state design of deep beams

Unit – 3	**Number of lectures = 9**	**Title of the unit: Flat Slab**

Design of Flat Slabs using BIS 456

Unit – 4	**Number of lectures = 8**	**Title of the unit: Columns and shear wall buildings**

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

Unit – 5	**Number of lectures = 8**	**Title of the unit: Shear wall framed building**

Analysis and Design of shear wall framed buildings. Introduction of Design of experiments.

12. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/
Journal papers; Patents in the respective field.

13. Books Recommended

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.

13. Lab component components

Sr. No.	Title	CO covered
1	Design of Continuous beams	1
2	Design of Deep beams	2
3	Design of Columns	2
4	Design of Shear walls	2

Semester - II

1. Name of the Department – Civil Engineering						
2. Course Name	**Finite Element Analysis**	**L -** 3	**T – 0**		**P -2**	
3. Course Code	**13160201**					
4. Type of Course (use tick mark)		**Core (√)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 28		**Tutorials =**	**Practical = 28**			

8. Brief Syllabus

Basics of finite element analysis, study of different methods linear equations and matrix method, study by displacement models, analysis of structure such as frame and truss by finite element analysis, Basic study of Iso-parametric elements

9. Learning 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.

10. Course Outcomes (COs):

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.

11. Unit wise detailed content

Unit-1	**Number of lectures = 8**	**Introduction to FEM**
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 – 2	**Number of lectures = 8**	**Displacement models**
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 – 3	**Number of lectures = 4**	**Analysis of structures by FEM**
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 – 4	**Number of lectures = 4**	**Plane stress and plane strain**
Plane stress - Plane strain - CST, LST & QST elements – Rectangular element - solutions of problems		
Unit – 5	**Number of lectures = 4**	**Iso-parametric elements**
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.

12. Brief Description of self learning / E-learning component

13. Books Recommended

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., I***SBN***-13: 9780070607415.
3. Singiresu S. Rao, (2010), The Finite Element Method in Engineering, Fifth Edition, Elsevier Science, ISBN-13: 9780080952048.

14. Lab component components

Sr. No.	Title	CO covered
1	Analysis of three span continuous beams.	(1), (2)
2	Analysis of propped cantilever beam.	(2)
3	Analysis of statically determinate plane truss.	(2), (3)
4	Analysis of statically indeterminate plane truss.	(3), (4)
5	Analysis of one bay – one storey plane frame.	(5)

1. Name of the Department		**CIVIL ENGINEERING**				
2. Course Name	**Theory of Elasticity and Plasticity**	**L**	**T**		**P**	
3. Course Code	**13160202**	3	0		0	
4. Type of Course		✓ **Core ()**	**PE()**		**OE()**	
5. Pre-requisite (if any)	Strength of Materials, Engg. Mechanics	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 46		**Tutorials = 00**	**Practical =09**			

8. Brief Syllabus: Structural analysis is the determination of the effects of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads, such as buildings, bridges, vehicles, machinery, furniture, attire, soil strata, prostheses and biological tissue. Structural analysis incorporates the fields of applied mechanics, materials science and applied mathematics to compute a structure's deformations, internal forces, stresses, support reactions, accelerations, and stability. The results of the analysis are used to verify a structure's fitness for use, often saving physical tests. Structural analysis is thus a key part of the engineering design of structures

Learning 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.

9. Unit wise detailed content

Unit-1	**Number of lectures = 8**	**Stresses and strains**

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 - 2	**Number of lectures = 08**	**Axi-symmetric problems**

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 - 3	**Number of lectures = 08**	**Prandle's membrane analogy**

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 - 4	**Number of lectures = 10**	**Torsion**

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

Unit - 5	**Number of lectures = 10**	**Introduction to plasticity**

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

10. Books Recommended

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.

1. Name of the Department		**CIVIL ENGINEERING**				
2. Course Name	**Limit State Design of Steel Structures**	**L**	**T**		**P**	
3. Course Code	**13160203**	3	0		2	
4. Type of Course		✓ **Core ()**	**PE()**		**OE()**	
5. Pre-requisite (if any)	Engineering Mechanics	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 44	**Tutorials = 00**	**Practical = 08**

8. Learning 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

9. Unit wise detailed content

Unit-1	**Number of lectures = 06**	**Joints and connections**

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

Unit – 2	**Number of lectures = 08**	**Compression members**

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

Unit – 3	**Number of lectures = 12**	**Plastic Analysis**

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

Unit – 4	**Number of lectures = 08**	**Light gauge sections**

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 – 5	**Number of lectures = 10**	**Chimney**

Design of Chimney, Design of foundation of chimney.

10. Brief Description of self learning / E-learning component

11. Books Recommended

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.

1. Name of the Department		**CIVIL ENGINEERING**				
2. Course Name	**Structural Engineering Laboratory**	**L**	**T**		**P**	
3. Course Code	**13160215**	0	0		2	
4. Type of Course		✓ **Core ()**	**PE()**		**OE()**	
5. Pre-requisite (if any)	None	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 00		**Tutorials = 00**	**Practical = 10**			

Brief Syllabus:

Learning 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

8. Books Recommended (3 Text Books + 2-3 Reference Books)

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.

9. **Lab component components**

Sr. No.	Title	CO covered
1	To determine the compressive strength of fibre reinforced concrete by testing cubes specimen.	1,2,3
2	Casting and testing of simply supported RCC beams for flexural failure.	2
3	Casting and testing of simply supported RCC beams for shear failure.	2
4	To determine tensile strength on a steel reinforcement bar.	2
5	To determine shear strength of steel bar under double shear.	2,4

6	To conduct bending test of I-section steel beam.	4
7	To conduct bending test of steel channel section.	3
8	To study rebound hammer test on concrete blocks.	2,4
9	To study ultra sonic pulse velocity test	2

Semester-III

1. Name of the Department	CIVIL ENGINEERING					
2. Course Name	Earthquake Resistant Design	L	T		P	
3. Course Code	13160301	3	0		0	
4. Type of Course (use tick mark)		Core (√)	PE-()		OE()	
5. Pre-requisite (if any)	Concrete Technology	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutorials = 00	Practical = 10			

8.Brief Syllabus:

The aim of the course is to present to the students fundamental concepts of current seismic codes and technical seismology as well as the technical skills for the seismic design of structures and the evaluation of their seismic response.

9Learning 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 behavior

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Basic of Seismology

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

Unit - 2	Number of lectures = 08	Title of the unit: Theory of vibrations

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 - 3	Number of lectures = 08	Title of the unit: Earthquake resistant design

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

Unit - 4	Number of lectures = 08	Title of the unit: Capacity design method

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 - 5	Number of lectures = 08	Title of the unit:Multi storey building analysis

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

12.Brief Description of self learning / E-learning component

http://retrofit.teipir.gr/?course=earthquakeresistant-design-of-structures&lang=en

13.Books Recommended

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. PankajAgarwal 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.

1. Name of the Department	CIVIL ENGINEERING					
2. Course Name	Seminar	L	T		P	
3. Course Code	13160307	0	0		2	
4. Type of Course		✓ Core ()	PE()		OE()	
5. Pre-requisite (if any)	Nil	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		Tutorials = 00	Practical = 28			

8. Brief Syllabus:

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

9. Learning 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.

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10. 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.

11. Unit wise detailed content

Unit	Number of lectures =28	Title of the unit: Seminar

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

12. Brief Description of self learning / E-learning component:

i. https://www.sciencedirect.com/
ii. https://www.elsevier.com/en-in

13. Books Recommended

i. https://onlinecourses.nptel.ac.in/noc16_ge01/preview
ii. https://www.che.iitb.ac.in/online/resources/academic-resources/technical-guides-and-tools/report-writing/guidelines-presentation-semin

1. Name of the Department	CIVIL ENGINEERING					
2. Course Name	Mini Project	L	T		P	
3. Course Code	13160308	0	0		2	
4. Type of Course (use tick mark)		✓ Core ()	PE		OE()	
5. Pre-requisite (if any)	Nil	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 0		Tutorials = 00	Practical =28			

8. Brief Syllabus:

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

9. Learning 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.

10. 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.

11. CourseCoursecontent

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

12. Brief Description of self learning / E-learning component:

i. https://www.che.iitb.ac.in/online/resources/academic-resources/technical-guides-and-tools/report-writing/guidelines-presentation-semin

ii. https://www.elsevier.com/en-in

13. Books Recommended

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.

1. Name of the Department	CIVIL ENGINEERING					
2. Course Name	Major Project (Phase I)	L	T		P	
3. Course Code	13160309	0	0		0	
4. Type of Course (use tick mark)		Core (√)	PE-I()		OE()	
5. Pre-requisite (if any)	Nil	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical :						
Lectures = 00		Tutorials = 00	Practical = 00			

8. Brief Syllabus

The course describes the basics of demand and demand forecasting. It explains cost functions, cost control, cost reduction and pricing techniques.

9. Learning 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.

10. 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.

11. Course content

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

12. Books Recommended

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

Semester - IV

1. Name of the Department: Civil Engineering						
2. Course Name	Major Project(Phase II)	L 0	T 0		P 0	
3. Course Code	13160401					
4. Type of Course (use tick mark)		Core (√)	PE()		OE()	
5. Pre-requisite (if any)	Nil	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 00		Tutorials = 00	Practical = 00			

8. Brief Syllabus

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

9. Learning 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.

10. Course Outcomes (COs):

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.

11. Course content

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

12. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal:
https://elearning.sgtuniversity.ac.in/course-category/general/

13. Books Recommended

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 Elective

1. Name of the Department	CIVIL ENGINEERING					
2. Course Name	Advanced Foundation Engineering	L	T		P	
3. Course Code	13160204	3	0		0	
4. Type of Course		Core ()	PE(√)		OE()	
5. Pre-requisite (if any)	Foundation Engineering	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 42	Tutorials = 00	Practical = 00

Brief Syllabus:

The course "Advanced Foundation Engineering" will cover various aspects of foundation engineering including soil exploration, details of shallow and deep foundations, retaining walls.The soil-foundation interaction will also be discussed along with the numerical solution techniques of beams and plates resting on elastic foundation bed.The behavior and design methods of foundation on reinforced earth will be discussed.The advanced theories and design of various foundation components will be discussed in logical way.The earth pressure theories for designing the retaining walls will be discussed.Thecodal provisions of the design of various types of foundation will also be discussed.The number of chosen problems will be solved in this course.The advanced course material will be very useful to undergraduate and post-graduate students, teachers and practitioners.

8. Learning objectives:

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

9. 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

10. Unit wise detailed content

Unit-1	Number of lectures =08	Title of the unit: Shallow foundation
Shallow Foundations - Spread footings – Contact pressure – Structural design of individual footings – Pedestals - Combined footings (Rectangular and trapezoidal) – Eccentrically loaded footings – Mat foundations		
Unit – 2	Number of lectures = 08	Title of the unit: Deep foundation
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 – 3	Number of lectures =08	Title of the unit: Retaining structures
Pile Foundations - Types of piles – Static and dynamic pile formula – Pile groups – Efficiency of pile group		
Unit – 4	Number of lectures = 08	Title of the unit:Pile Foundations
Settlement of piles – Batter piles – Analysis of pile groups – Structural design of piles and pile caps		

Unit-5	Number of lectures=08	Title of unit:Well Foundations
Well Foundations - Types of wells or caissons – Components – Shapes of wells – Forces acting – Construction– Design of drilled caissons		

11. Brief Description of self learning / E-learning component:

i. https://nptel.ac.in/courses/105108069/

12. Books Recommended

TEXT BOOKS

1. GopalRanjan 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.

1. **Name of the Department**		CIVIL ENGINEERING				
2. Course Name	Design of Concrete Bridges	L	T		P	
3. Course Code	13160205	3	0		0	
4. Type of Course		Core ()	PE(√)		OE()	
5. Pre-requisite (if any)	Reinforced Concrete Structures	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 42		Tutorials =00	Practical = 00			

8. Brief Syllabus:

Design of reinforced concrete bridges is normally done on the basis of a structural analysis. The purpose of the analysis is to find a distribution of sectional forces which fulfils equilibrium and is suitable for design.

9. Learning objectives:

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

10.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

11.Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: IRC loading and other methods

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 – 2	Number of lectures = 08	Title of the unit: Slab bridges

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

Unit – 3	Number of lectures = 08	Title of the unit: Arch bridges

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

Unit – 4	Number of lectures = 08	Title of the unit: Miscellaneous bridges

.

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) Design of slab base and gusset base and grillage foundation along with its connection with column.

Unit – 5	Number of lectures = 08	Title of the unit: Substructures

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

joints

12.Brief Description of self learning / E-learning component

https://onlinecourses.nptel.ac.in/noc17_ce24/preview

13.Books Recommended

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.

1. Name of the Department		CIVIL ENGINEERING				
2. Course Name	Design of Industrial Structures	L	T		P	
3. Course Code	13160206	3	0		0	
4. Type of Course :		Core ()	PE(√)		OE()	
5. Pre-requisite (if any)	Construction Technology	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 42	Tutorials = 00	Practical = 00

8.Brief Syllabus

The purpose of this course is to develop an in-depth knowledge in the area of design of industrial structure with thelatest code of practice as per the Indian Standard. On completion of this course student gain good confidence in designing majorindustrial structures like bridge plate girders, industrial structures like gantry girders, water tanks, support structures, high risechimneys and pre-engineered thin walled structures.

9. **Learning objectives**:

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

10. 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

11. Unit wise detailed content

Unit-1	Number of lectures =08	Title of the unit: Industrial requirements
General - Specific requirements for industries like textile, sugar, cement, chemical, etc - Site layout and external facilities.		
Unit – 2	Number of lectures = 08	Title of the unit: Planning of building works
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 – 3	Number of lectures = 08	Title of the unit: Construction techniques
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 – 4	Number of lectures = 08	Title of the unit: Circulation
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 – 5	Number of	Title of the unit: Functional Requirements

	lectures =08	

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.

12. Brief Description of self learning / E-learning component:
https://nptel.ac.in/courses/105106113/3

13. Books Recommended

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 RizwanHussain, (2011), Pre-Cast Concrete for Multi-Storey Structures, Createspace Publisher, ISBN: 9781467918220.

1. Name of the Department		CIVIL ENGINEERING				
2. Course Name	Design of Tall Buildings	L	T		P	
3. Course Code	13160207	3	0		0	
4. Type of Course		Core ()	PE(√)		OE()	
5. Pre-requisite (if any)	Design of Steel Structures, Structural analysis	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 42		Tutorials = 00	Practical =00			

8. Brief Syllabus:

Classification of buildings, Three dimensional analysis, Shear wall system ,In-filled frame system, Plane frame systems

9.Learning 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.

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Classification of buildings
Introduction - Classification of buildings according to NBC – Types of loads – wind load – Seismic load – Quasi static approach		
Unit – 2	Number of lectures = 08	Title of the unit:Plane frame systems
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 – 3	Number of lectures = 08	Title of the unit: Shear wall system
Shear Wall System - Rosman's analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method		
Unit - 4	Number of lectures = 08	Title of the unit: In-filled frame system
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 - 5	Number of lectures = 10	Title of the unit: Three dimensional analysis
Three Dimensional Analysis - Basic principles – Centre of rotation of a rigid floor – Force displacement method.		

12.Books Recommended

TEXT BOOKS

1. Bryan Stafford Smith and Alex Coull, (2011), Tall Building Structures: Analysis and Design,

Wiley India, ISBN-13: 9788126529896.

REFERENCE BOOKS

1. SarwarAlamRaz, (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.

1. **Name of the Department**		CIVIL ENGINEERING				
2. Course Name	Energy Efficient Buildings	L	T		P	
3. Course Code	13160208	3	0		0	
4. Type of Course		Core ()	PE(√)		OE()	
5. Pre-requisite (if any)	Nil	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 42		Tutorials =00	Practical = 07			

8. Brief Syllabus:

Green Buildings, Energy and Environment ,Renewable Energy, Site and Climate ,Building Form and Fabric ,Energy Awareness, Infiltration, Ventilation, Lighting, Cooling and Water Conservation

9. Learning objectives:

i. This course aims to highlight importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.

ii. To familiarize students with the concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings

iii. To give a full understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.

iv. To highlight the importance of Environmental Management as well as Environmental impact Assessment methods in Energy efficient buildings.

10.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, Photovoltaic, 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.

11.Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Green Buildings, Energy and Environment
Green Buildings within the Indian Context - Types of Energy - Energy Efficiency and Pollution - Better Buildings - Reducing energy consumption - Low energy design.		
Unit - 2	Number of lectures = 08	Title of the unit: Renewable Energy, Site and Climate
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 - 3	Number of lectures = 08	Title of the unit: Building Form and Fabric
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 - 4	Number of lectures = 08	Title of the unit:Infiltration, Ventilation, Lighting, Cooling and Water Conservation
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 – 5	Number of lectures = 08	Title of the unit: : Energy Awaeness
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.		

12.Brief Description of self learning / E-learning component

https://www.concretesociety.co.za/images/stories/conferences/Brochure%20-%20Buildings%20&%20Bridges.pdf

13.Books Recommended

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.

1. Name of the Department	CIVIL ENGINEERING					
2. Course Name	Environmental Engineering Structures	L	T		P	
3. Course Code	13160209	3	0		2	
4. Type of Course		Core ()	PE(√)		OE()	
5. Pre-requisite (if any)	Design of Concrete Structures	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 30	Tutorials = 00	Practical = 00

8.Brief Syllabus:
Pipe Design, Water Tank Design, Economic Analysis, Swimming Pools, Mixing Tank

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

10.Course Outcomes: On completion of this course, the students will be able to
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.

11.Unit wise detailed content

Unit-1	Number of lectures =08	Title of the unit: Pipe design

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 – 2	Number of lectures = 08	Title of the unit:Water tank design

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 – 3	Number of lectures =0 8	Title of the unit: Economic analysis

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

Unit – 4	Number of lectures = 08	Title of the unit: Swimming pools

.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 – 5	Number of	Title of the unit: Mixing tank

	lectures =08	

Design of filter walls and clarifiers - Mixing tanks.

13.Books Recommended

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.

1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Experimental Stress Analysis	L	T		P	
3.Course Code	13160302	3	0		0	
4.Type of Course (use tick mark)		Core ()	✓ PE-II		OE()	
5.Pre-requisite (if any)	Nil	**6.Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =00	Practical =10			

8.Brief Syllabus:

Student will study about Strain gauges, Model Analysis Interior, Two dimensional photo elasticity, Three dimensional photo elasticity, Non-destructive testing.

9.Learning objectives:

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

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Strain gauges

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 - 2	Number of lectures = 08	Title of the unit: Model Analysis Interior

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'sdeformeters – Moment indicators – Design of models for direct and indirect analysis.

Unit - 3	Number of lectures = 08	Title of the unit: Two dimensional photo elasticity

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 - 4	Number of lectures = 08	Title of the unit: Three dimensional photo elasticity

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

Unit - 5	Number of lectures = 08	Title of the unit:Non-destructive testing

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

13.<u>Books Recommended:</u>

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.

1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Machine Foundations	L	T		P	
3.Course Code	13160303	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE(√)		OE()	
5.Pre-requisite (if any)	Nil	**6.Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutorials =	Practical			
8.Brief Syllabus: Student will learn about basics of soil dynamics, effect of different process on soil properties and effects of dynamic loads and the various design methods and different types of block foundation and its methods						
9.Learning objectives: 1. This subject is taught to impart the knowledge of dynamic behaviour of soils, effects of dynamic loads and the various design methods. .						
10.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.						
11.Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Introduction				
Introduction: Elements of soil dynamics – Basic definitions – Importance of dynamics analysis – general requirements of machine foundations – types of machine foundation						
Unit – 2	Number of lectures = 08	Title of the unit: Properties of Soil				
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 – 3	Number of lectures = 08	Title of the unit: Design Parameters				
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 – 4	Number of lectures = 08	Title of the unit: Block foundation				
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 – 5	Number of lectures = 08	Title of the unit :Vibration isolation
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		

13.Books Recommended

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&IndrajitChowdhury, (2009), Dynamics of Structures and Foundations: A Unified Approach: Fundamentals (Volume 1), First Edition, Taylor & Francis Publishers, ISBN-13: 9780415471459.

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1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Theory and Design of Plates & Shells	L	T		P	
3.Course Code	13160305	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)	Fluid Mechanics	**6.Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about Thin plates its equation and boundary condition, Plate bending and design of shells, curve shell etc. design and detailing of folded plate struture.

9.Learning objectives:

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

10.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

11.Unit wise detailed content

Unit-1	Number of lectures = 10	Title of the unit: Thin plates
Laterally loaded thin plates – Differential equation – Boundary conditions.		
Unit - 2	Number of lectures = 11	Title of the unit: Plate bending
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 - 3	Number of lectures = 10	Title of the unit:Design of shells
Types of shells – Structural action – Membrane theory – Limitations – Beam method of analysis.		
Unit - 4	Number of lectures = 05	Title of the unit: Curved shell
Analysis and design of doubly curved shells – Elliptic paraboloid - Conoid and hyperbolic paraboloid roofs.		
Unit - 5	Number of lectures = 05	Title of the unit:Folded plate structures
Folded plate structures – Structural behaviour – Various types – Design of folded plates - Reinforced detailing.		

13.Books Recommended

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.

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1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Stability of Structures	L	T		P	
3.Course Code	13160210	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about Static equilibrium and different equation for columns, analysis of columns. Analysis of frame and different methods for frame stability.

9.Learning objectives:

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

10.Course Outcomes

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

1. Understand the behaviour of eccentric column.
2. Analysis the beam columns
3. Analysis the frames stability.
4. Understand the concept of buckling of shells.

11.Unit wise detailed content

Unit-1	Number of lectures = 8	Introduction
Introduction - Static equilibrium – Governing equation for columns – Analysis for various boundary conditions - Analysis of Eccentrically loaded column.		
Unit - 2	Number of lectures = 11	Column analysis
Beam Columns – Theory of Beam column – Stability analysis of beam column with different types of loads – Failure of beam columns.		
Unit - 3	Number of lectures = 10	Frame analysis
Analysis and stability of frames		
Unit - 4	Number of lectures = 05	Frames stability
Plates subjected to inplane forces - Differential equation – Analysis – Approximate techniques - Analysis for various boundary conditions – Wood and Armour equation for analysis and design.		
Unit - 5	Number of lectures = 05	Plates and shells
Buckling of shells – Differential equation – Analysis – Application		

13.Books Recommended

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.

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1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Composite Structures	L	T		P	
3.Course Code	13160211	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about open channel hydraulics: Pipe Flow and Free Surface Flow, Continuity Equation, Energy in Free Surface Flow, Basic Momentum Equation, Velocity Distribution, Occurrence, Critical Depth in Trapezoidal & Circular Channels, Hydraulic Exponent for Critical Flow, Critical Flow Depth Computations, Derivation of Uniform Flow Equations, Resistance in Open Channel Hydraulics, History of Uniform Flow Velocity and Resistance Factor, Integration of Differential Equation, Improved Euler Method.

9.Learning 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.

10.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

11.Unit wise detailed content

Unit-1	Number of lectures = 8	Stress Strain Relationship
Introduction - advantages and application of composite materials, reinforcements and matrices - Generalised Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials.		
Unit - 2	Number of lectures = 11	Finite Element Analysis of Plates
Introduction - concept of mesh - Displacement function - Stress-Strain Matrix – Stiffness matrix of plate element – Solution of problem		
Unit - 3	Number of lectures = 10	Methods of Analysis
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 - 4	Number of lectures = 05	Laminated Plates
Governing differential equation for a general laminate, angle ply and cross ply laminates - Failure criteria for composites.		

Unit - 5	Number of lectures = 05	Sandwich Constructions, Fabrication Process
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.		

13.Books Recommended

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.

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1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Maintenance & Rehabilitation of Structures	L	T		P	
3.Course Code	13160212	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn Maintenance & Rehabilitation of Structures by learning different properties of concrete, repairing materials and different repairing techniques.

9.Learning objectives:

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

10.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

11.Unit wise detailed content

Unit-1	Number of lectures = 8	Properties of concrete

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 - 2	Number of lectures = 11	Repairing materials

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

Unit - 3	Number of lectures = 10	Repairing techniques

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 - 4	Number of lectures = 05	Repairs to structures

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 - 5	Number of lectures = 05	Example of Repairs to Structures

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

13.Books Recommended

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.

1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Prefabricated Structures	L	T		P	
3.Course Code	13160213	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about types of foundation, Prefabrication systems and structural schemes, Handling and erection stresses, Dimensioning and detailing of joints, Design of pre fabricated Modules

9.Learning objectives:

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

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 8	Introduction
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 structure		
Unit - 2	Number of lectures = 11	Handling and erection stresses
Handling and erection stresses - Application of pre stressing of roof members - Floor systems - Two way load bearing slabs - Wall panels		
Unit - 3	Number of lectures = 10	Dimensioning and detailing of joints
Dimensioning and detailing of joints for different structural connections - Construction and expansion joints.		
Unit - 4	Number of lectures = 05	Erection of structures
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 - 5	Number of lectures = 05	Design of pre fabricated Modules
Prefabricated Modules for Industrial structures - Multi-storied buildings and Water tanks - Application of pre stressed concrete in prefabrication		

13.Books Recommended

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.

1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Structural Optimization	L	T		P	
3.Course Code	13160214	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about Formulation of Structural Optimization problem, Linear Programming techniques, Stochastic Optimization Methods , Genetic Algorithm based Optimization Methods.

9.Learning objectives:

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

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 8	Formulation of Structural Optimization problems
Formulation of Structural Optimization problems: Design variables - Objective function - constraints. Fully stressed design.		
Unit - 2	Number of lectures = 11	Linear Programming techniques
Review of Linear Algebra: Vector spaces, basis and dimension, canonical forms.		
Unit - 3	Number of lectures = 10	Non-Linear Programming techniques
Linear Programming: Revised Simplex method, Application to structural Optimization		
Unit - 4	Number of lectures = 05	Stochastic Optimization Methods
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 - 5	Number of lectures = 05	Genetic Algorithm based Optimization Methods
Genetic Algorithm based Optimization Methods		

13.Books Recommended

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.

1.Name of the Department		CIVIL ENGINEERING				
2.Course Name	Soil Structure Interaction	L	T		P	
3.Course Code	13160306	3	0		0	
4.Type of Course (use tick mark)		Core ()	PE-(√)		OE()	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 41		Tutorials =	Practical			

8.Brief Syllabus:

In this course, student will learn about open Mathematical model, Winkler model, Two parameter model, Modulus of sub grade reaction, Analysis of piles & Pile displacement.

9.Learning objectives:

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

10.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.

11.Unit wise detailed content

Unit-1	Number of lectures = 8	Mathematical model, Winkler model, Two parameter model
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 - 2	Number of lectures = 11	Modulus of subgrade, reaction
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 - 3	Number of lectures = 10	Beams and slabs
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 - 4	Number of lectures = 05	Analysis of piles
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 - 5	Number of lectures = 05	Pile displacement
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		

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13.Books Recommended

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