CURRICULUM AND SYLLABI

(I SEMESTER to IV SEMESTER)

Applicable to the students admitted to

DEPARTMENT OF CIVIL ENGINEERING

M.E- STRUCTURAL ENGINEERING

R-2021: CBCS

Academic year 2021-2022
onwards

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

#60, Avadi – Vel Tech Road, Vel Nagar,
Avadi, Tamil Nadu 600062

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R-2021: CBCS CURRICULA – I to IV

SEMESTER SYLLABI

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	**BSC**	Basic Science Courses
2	**PCC**	Professional Core Courses
3	**PEC**	Professional Elective Courses
4	**PROJ/EEC**	Project work / Employability Enhancement Courses

Category Based Credit Split-Up – Semester Wise

Semester	BSC	PCC	PEC	Project /EEC	Total Credit
1	4	10	6	-	20
2	-	14	6	1	21
3	-	3	6	8	17
4	-	-	-	13	13
Total credits	**4** (6%)	**27** (38%)	**18** (25%)	**22** (31%)	**71**

M.E. – STRUCTURAL ENGINEERING
Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21SE11T	Advanced Engineering Mathematics	BSC	40	60	100	4	0	0	4
2	21SE12T	Structural Dynamics	PCC	40	60	100	3	0	0	3
3	21SE13T	Theory of Elasticity and Plasticity	PCC	40	60	100	3	0	0	3
4	21SE14T	Advanced Reinforced Concrete Structures	PCC	40	60	100	4	0	0	4
5	-	Professional Elective I	PEC	40	60	100	3	0	0	3
6	-	Professional Elective II	PEC	40	60	100	3	0	0	3
TOTAL										**20**

SEMESTER II										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21SE21T	Advanced Design of Steel Structural Elements	PCC	40	60	100	3	0	0	3
2	21SE22T	Stability of Structures	PCC	40	60	100	3	0	0	3
3	21SE23T	Concrete Technology & Special Concretes	PCC	40	60	100	3	0	0	3
4	21SE24T	Finite Element Analysis of Structures	PCC	40	60	100	3	0	0	3
5	-	Professional Elective III	PEC	40	60	100	3	0	0	3
6	-	Professional Elective IV	PEC	40	60	100	3	0	0	3
PRACTICAL										
7	21SE27P	Structural Engineering Laboratory	PCC	40	60	100	0	0	4	2
8	21SE28P	Internship I	EEC	100	-	100	0	0	0	1
TOTAL										**21**

SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21SE31T	Earthquake Analysis and Design of Structures	PCC	40	60	100	3	0	0	3
2	-	Professional Elective V	PEC	40	60	100	3	0	0	3
3	-	Professional Elective VI	PEC	40	60	100	3	0	0	3
PRACTICAL										
4	21SE34P	Internship II	EEC	100	-	100	0	0	0	1
5	21SE35P	Technical Seminar	EEC	100	-	100	0	0	2	1
6	21SE36P	Project Work - Phase I	PROJ	40	60	100	0	0	12	6
TOTAL										**17**

SEMESTER IV										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
PRACTICAL										
1	21SE41P	Internship III (4 weeks)	EEC	-	-	100	0	0	0	1
2	21SE42P	Project work phase II	EEC	40	60	100	0	0	24	12
TOTAL										**13**

List of Professional Elective Courses

S. No.	Elective course code	Elective course title	Semester
1.	21SE151PT	Prefabricated Structures	I
2.	21SE152PT	Nonlinear Analysis of Structures	I
3.	21SE153PT	Matrix Methods for Structural Analysis	I
4.	21SE161PT	Maintenance and Rehabilitation of Structures	I
5.	21SE162PT	Wind and Cyclone Effects on Structures	I
6.	21SE163PT	Offshore Structures	I
7.	21SE251PT	Structural Optimization	II
8.	21SE252PT	Urban Planning and Sustainability	II
9.	21SE253PT	Experimental Techniques and Instrumentation	II
10.	21SE261PT	Industrial Structures	II
11.	21SE262PT	Prestressed Concrete Structures	II
12.	21SE263PT	Design of Bridges	II
13.	21SE321PT	Design of Steel Concrete Composite Structures	III
14.	21SE322PT	Theory of Plates and Shells	III
15.	21SE323PT	Environmental Impact Assessment of Civil Engineering	III
16.	21SE331PT	Tall Buildings	III
17.	21SE332PT	Energy Efficient Buildings	III
18.	21SE333PT	Design of Sub Structures	III

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Course code	21SE21T	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	ADVANCED DESIGN OF STEEL STRUCTURAL ELEMENTS		3	0	0	3

COURSE OBJECTIVES:

- To study the behavior of steel members. Design of Industrial buildings and roofs, chimneys.
- To design members subjected to torsion and understand plastic analysis of structures.
- To get familiarized with cold formed steel sections and different types of connections.

PREREQUISITE:

- Design of Steel Structures

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C201.1	***Acquire*** knowledge on wind analysis in designing purlins	K2
C201.2	***Select*** the **s**uitable connections for joints	K3
C201.3	**Design** industrial buildings	K4
C201.4	***Understand*** the concepts of cold-formed steel structures	K2
C201.5	**Design** the web of beams	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C201.1	3	1	-	-	-	-	-	-	-	-	-	-
C201.2	3	1	-	-	-	-	-	-	-	-	-	-
C201.3	3	2	1	-	-	-	-	-	-	-	-	-
C201.4	3	1	1	-	-	-	-	-	-	-	-	-
C201.5	3	1	-	-	-	-	-	-	-	-	-	-
C201	3	1	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I GENERAL 9

Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder – Design of simple bases, Gusseted bases and Moment Resisting Base Plates- Local Buckling of thin plate elements.

UNIT II DESIGN OF CONNECTIONS 9

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections – Framed Connections HSFG bolted connections–Connections for force and moment transmission –tee stub and End plate connections – principles of semi rigid connections.

UNIT III ANALYSIS AND DESIGN OFINDUSTRIALBUILDINGS 9

Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non-sway frames – Aseismic design of steel buildings - Review of loads on structures- Dead, Live, wind and Seismic loads as per National standards.

UNIT IV ANALYSIS AND DESIGN OF COLD-FORMED STEEL STRUCTURES 9

Types of cross sections-concepts of local buckling, and Effective width-Design of compression and tension members- concepts of lateral buckling –Design of Beams, deflections of beams and design of beam webs- Combined stresses and connections – Empirical design of Z-purlins with lips and wall studs.

UNIT V DESIGN OF LIGHT GAUGESTEELSTRUCTURES 9

Introduction to Direct Strength Method - Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling – Design of Compression Members – Wall Studs.

Total: 45 Periods

LEARNING RESOURCES:

REFERENCES:

1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2008.
2. Bhavikatti, S.S., Design of Steel Structures, I.K. International Publishing House Pvt. Ltd., New Delhi, 2010.
3. Punmia B.C., Comprehensive Design of Steel Structures, Lakshmi Publications, New Delhi, 2000.
4. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.
5. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, New York, 1996.
6. Gregory J. Hancock, Thomas Murray, Duane S. Ellifrit, “Cold-Formed Steel Structures to the AISI Specification”, CRC Press, 2001.

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Course code	21SE22T	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	STABILITY OF STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

- To study the concept of buckling and analysis of structural elements.

PREREQUISITE:

- Knowledge on Strength of materials

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C202.1	***Know*** the Concept and characteristics of stability problems	K2
C202.2	***Determine*** Buckling of columns with remotes end conditions	K2
C202.3	***Know*** the Importance of torsional and lateral buckling	K2
C202.4	***Evaluate*** the structural stability of columns, frames	K3
C202.5	***Study*** the stability of plates and shells	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C202.1	3	2	-	-	-	-	-	-	-	-	-	-
C202.2	3	2	-	-	-	-	-	-	-	-	-	-
C202.3	3	2	-	-	-	-	-	-	-	-	-	-
C202.4	2	2	-	-	-	-	-	-	-	-	-	-
C202.5	2	2	-	-	-	-	-	-	-	-	-	-
C202	2	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I BUCKLING OF COLUMNS 9

States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear on buckling.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 9

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load, Effect of Axial Load on Bending Stiffness

UNIT III TORSIONAL AND LATERAL BUCKLING 9

Torsional Load, Torsional buckling – Combined Torsional and flexural buckling – Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported and cantilever beams, Strain energy of Torsion

UNIT IV BUCKLING OF PLATES 9

Governing differential equation - Buckling of thin plates, various edge conditions -Analysis by equilibrium and energy approach, – Finite difference method.

UNIT V INELASTIC BUCKLING 9

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling Behaviour of plates, Strain energy of bending in a plate

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Gambhir.M.L, "Stability Analysis and Design of Structures", springer, New York, 2013.
2. Allen.H.G, and Bulson.P.S, "Background to Buckling", McGraw Hill Book Company, 1980.

REFERENCES:

1. Brush and Almorth, *"Buckling of Bars, Plates and Shells"*, McGraw Hill book Company, 1975.
2. Seely, F.B, and Smith, J.O, *"Advanced Mechanics of Materials"*, 2nd Edition, John Wiley and Sons, Inc., New York. 1952.
3. Timoshenko.S, and Woinowsby - Krieger.S, *"Theory of Plates and Shells"*, 2nd Ed. Mc Graw - Hill Book Co., New York 1959.
4. Ashwini Kumar, *"Stability Theory of Structures"*, Tata Mc Graw Hill Co., New Delhi, 1985.

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Course Code	21SE23T	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CONCRETE TECHNOLOGY AND SPECIAL CONCRETES		3	0	0	3

COURSE OBJECTIVES:

- This course aims at giving adequate exposure to students in the technology of construction
- The course will enable the students to use the basic materials
- Student should be able to differentiate the materials that can be effectively used for preparing concrete. Student should be able to design, prepare and work with the concrete.

PREREQUISITE:

- Knowledge on construction materials, concrete technology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C203.1	***Acquire knowledge*** in the manufacturing process of concrete and cement types	K3
C203.2	***Experiment*** with the destructive testing methods	K3
C203.3	**Study** of different concrete ***techniques*** and methods of concrete	K3
C203.4	***Identify*** the use and types of polymers and fiber reinforced concrete	K3
C203.5	***Distinguish*** the properties and uses of special concretes	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C203.1	2	1	-	-	-	-	-	-	-	-	-	-
C203.2	2	1	-	-	-	-	-	-	-	-	-	-
C203.3	1	3	-	-	-	-	-	-	-	-	-	-
C203.4	3	1	-	-	-	-	-	-	-	-	-	-
C203.5	3	2	-	-	-	-	-	-	-	-	-	-
C 203	3	2	-	-	-	-	-	-	-	-	-	-

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SYLLABUS **No of Credits: 3**

UNIT I CONCRETE MAKING MATERIALS AND PROPERTIES 9

Introduction to concrete – Mineral and chemical admixtures – Structure of hydrated cement paste – Calcium Aluminate Cement – Cement Production quality control -Transition zone in concrete – measurement of workability by quantitative empirical methods – Methods to reduce CO_2 emission from cement manufacturing industry, IS Codes for Concrete Materials – specifications of IS 383, IS 4082 and methods of IS 2430

UNIT II TESTING METHODS AND SUSTAINABILITY OF CONCRETE 9

Non-Destructive testing methods - Semi-destructive testing methods. Concreting under special circumstances – Special materials in construction – Concreting machinery and equipment – Sustainability of concrete - Future trends in concrete technology, IS Codes for Testing methods - IS 13311-1 & IS 13311-2 and IS 516

UNIT III RETROFITTING OF CONCRETE 9

Maintenance – Importance, Principles, quality assurance, Preventive; Importance of repair, rehabilitation and retrofitting, causes of distress, evaluation methods for condition assessment, Dealing with cracks; Repair materials – Characteristic, repair techniques, quality control methods for repair of concrete. Corrosion damage - Reinforced concrete and its repair, prevention measures; Retrofit techniques for concrete and Masonry as per codal provision.

UNIT IV POLYMER AND FIBER CONCRETES 9

Polymer concrete-Types, Properties and Applications - Blended cement concretes- Fibre-reinforced Concrete-Different types of metallic and non-metallic fibres - Types, Properties and Applications, Slurry-infiltrated fibre reinforced concrete - Born again concrete (Recycled Aggregate concrete)

UNIT V SPECIAL CONCRETES 9

Light weight concrete, Fiber and Hybrid Fiber reinforced concrete, Polymer Concrete, Super plasticized concrete, Epoxy resins and screeds for rehabilitation Fly ash and High volume fly ash concrete, -High performance concrete - Self compacting concrete - Self curing concrete – Recycled aggregate concrete - Bacterial concrete – Nano concrete - vacuum dewatering - under water technology-special form work

TOTAL PERIODS: 45

LEARNING RESOURCES:

TEXT BOOKS:

1. Shetty M.S., "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003.
2. Neville. A.M., "Properties of Concrete", Tata McGraw Hill publishers, 2003 Properties of concrete / A.M.Neville / Pearson 5th edition

REFERENCES:

1. Santhakumar, A.R., "Concrete Technology", Oxford University Press, New Delhi, 2007.

2. Ghambir, "Concrete Technology", Tata MC Graw Hill, 2002.

3. Kumar Mehta P and Monteiro "Concrete –Micro structure, properties and materials" Indian concrete institute- First edition-2005.

4. Rafatsiddique "Special structural concrete" Galgotia Publication, I Edition-2000.5.Neville. A.M., "Concrete Technology", 2003.

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Course code	21SE24T	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	FINITE ELEMENT ANALYSIS OF STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

- To study the basics of the finite element technique, a numerical tool for the solution of different classes of problem

PREREQUISITE:

- Knowledge on Structural Analysis

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C204.1	***Provide*** students basics of the Finite Element Technique	K2
C204.2	***Identify*** the information requirements and sources for analysis, design and evaluation.	K2
C204.3	***Analyze*** the framed structure	K4
C204.4	***Understand*** Plate and Shells and modify using recent software	K2
C204.5	***Understand*** the techniques	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C204.1	3	1	-	-	-	-	-	-	-	-	-	-
C204.2	3	1	-	-	-	-	-	-	-	-	-	-
C204.3	3	2	-	-	-	-	-	-	-	-	-	-
C204.4	3	1	1	-	-	-	-	-	-	-	-	-
C204.5	3	1	-	-	-	-	-	-	-	-	-	-
C204	3	1	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION 9

Approximate solutions of boundary value problems - Methods of weighted residuals, approximate solution using variation method, Boundary conditions and general comments-continuity, compatibility, convergence aspects. Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin's method- Principle of Stationary Potential energy

UNIT II APPLICATION AXIAL DEFORMATION OF BARS, AXIAL SPRING ELEMENT. 9

Natural Coordinates - Triangular Elements -Rectangular Elements - Lagrange and Serendipity Elements -Solid Elements – Iso parametric Formulation - Stiffness Matrix of Iso parametric Elements – Four Noded Quadrilateral Element – Gauss elimination and LDLT decomposition

UNIT III ANALYSIS OF FRAMED STRUCTURES 9

Stiffness of Truss Member - Analysis of Truss -Stiffness of Beam Member-Finite Element Analysis of Continuous Beam -Plane Frame Analysis -Analysis of Grid and Space Frame – Two Dimensional Solids - Constant Strain Triangle -Linear Strain Triangle -Rectangular Elements - Numerical Evaluation of Element Stiffness -Finite Element Formulation for 3 Dimensional Elements – 2D Truss element Analysis

UNIT IV PLATES AND SHELLS 9

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate -Finite Element Analysis of Thick Plate -Finite Element Analysis of Skew Plate -Finite Element Analysis of Shell-3d Brick Elements- Mindlin's Plate theory.

UNIT V APPLICATIONS 9

Finite Elements for Elastic Stability - Dynamic Analysis - Nonlinear, Vibration and Thermal Problems - Meshing and Solution Problems - Modelling and analysis using recent softwares-Torsion

TOTAL PERIODS: 45

LEARNING RESOURCES:

REFERENCES:

1. Bhavikatti.S.S, "Finite Element Analysis", New Age International Publishers, 2007.
2. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007.
3. Rao.S.S, "Finite Element Method in Engineering", Butterworth – Heinmann, UK, 2008
4. Logan D. L., A First Course in the Finite Element Method, Thomson Learning, 2007.
5. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons.
6. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

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Course code	21SE251PT	Semester	II			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	STRUCTURAL OPTIMIZATION		3	0	0	3

COURSE OBJECTIVES:

- The objective of this course is to introduce the concepts of design optimization and review major conventional and modern optimization methods used in structural optimization applications.
- To impart knowledge on cost effective designs, conventional and non-conventional optimization techniques for engineering applications

PREREQUISITE:

Design of Steel Structures

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C2501.1	***Understand*** structural optimization problems	K2
C2501.2	***Apply various*** classical techniques for optimization	K3
C2501.3	***Understand*** geometric and Dynamic Programming	K3
C2501.4	***Identify problem*** formulation, analytical method and basic feasible solution	K2
C2501.5	***Understand*** optimization techniques for steel and RC members.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C2501.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C2501.2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C2501.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C2501.4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
C2501.5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C2501	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I OPTIMIZATION FUNDAMENTALS 9

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behaviour and other constraints - Design space - Feasible and infeasible- Convex and Concave - Active constraint - Local and global optima. Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints(Lagrange Multiplier method) - with inequality constraints (Khun - Tucker Criteria).

UNIT II LINEAR AND NON-LINEAR PROGRAMMING 9

LINEAR PROGRAMMING: Formulation of problems - Graphical solution - Analytical methods - Standard form - Slack, surplus and artificial variables - Canonical form - Basic feasiblesolution - simplex method - Two phase method - Penalty method - Duality theory - Primal - Dualalgorithm. **NON LINEAR PROGRAMMING:** One Dimensional minimization methods: Uni dimensional - Unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimizationTechniques. Methods of feasible direction- Interior Penality function – External Penalty function method.

UNIT III GEOMETRIC PROGRAMMING 9

Posynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty- Representation of a multistage decision problem

UNIT IV DYNAMIC PROGRAMMING 9

Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods- Truss optimization.

UNIT V STRUCTURAL APPLICATIONS 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multi storied buildings, water tanks and bridges- Structural optimization for transient (dynamic) problems.

TOTAL: 45 PERIODS

LEARNING RESOURCES:

REFERENCES:

1. Rao. S.S., " Optimisation Theory and Applications" , New Age International Private Limited Publisher, New Delhi , 2009
2. 2. Belegundu, A.D.and Chandrapatla,T.R., "Optimisation Concepts and Applications in Engineering", Pearson Education, 2011.
3. 3. K.Deb, "Optimisation for Engineering Design : Algorithms and examples", Prentice Hall, New Delhi, 2012.
4. J.S.Arora, "Introduction to Optimum Design", McGraw –Hill Book Company , 2011.
5. Taha, H.A., " Operations Research – An Introduction ", Prentice Hall of India,2008.

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Course code	21SE252PT	Semester	II			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	URBAN PLANNING AND SUSTAINABILITY		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the student will be able

- The course aims to give an overall understanding of urban planning, infrastructure planning, Industrialization and various aspects involved in the planning and development of smart cities

PREREQUISITE:

Urban Planning and Development

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C2502. 1	***Understand*** the concept of Industrial planning.	K2
C2502. 2	***Get a knowledge*** about various types of plans and techniques for sustainable smart city infrastructure development	K2
C2502.3	***Get an idea*** of recent technologies in urban planning and development	K2
C2502. 4	***Get a knowledge*** about various types sustainable infrastructural planning	K2
C2502. 5	***Able to develop*** Human development and sustainability	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C2502. 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2502. 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2502.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2502. 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2502. 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2502	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - Planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.- Different components of industrial structures

UNIT II INTRODUCTION TO CITY PLANNING 9

Overview of planning from prehistory to current - Industrialization and the transformation of Urban Space - Detailed case studies of planned cities - Introduction of Remote sensing, GIS and GPS in urban planning. Smart City Planning.

UNIT III PLANNING THEORIES 9

Theory of city form: normative models –cosmic, machine, organic; Concentric Zone Theory, Sector Theory, Multiple Nuclei Theory - Modes of planning -Land use and land value -Emerging Concepts and Environmental Planning.

UNIT IV INFRASTRUCTURE PLANNING 9

Critical issues in sustainable infrastructural planning- Concepts of basic needs, formation of objectives and standards - Data requirements for planning of urban networks and service - feasibility planning studies for structure, infrastructure systems. Technology for Sustainable Smart City Infrastructure. Recycling Technologies and Renewable energy.

UNIT V SMART CITIES AND SUSTAINABLE DEVELOPMENT 9

Human development and sustainability - Rights of future generations -Climate Change and development - Leveraging recent technologies in enhancing urban living: internet of things (IoT) – Concept of smart cities.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Peter Hall, Mark Tewdwr-Jones. (2010), Urban and Regional Planning, Taylor & Francis.

REFERENCES:

1. Peter Hall (2014), Cities of Tomorrow, An Intellectual History of Urban Planning and Design Since 1880. 4th Edition, Wiley-Blackwell.
2. Randall Crane and Rachel Weber (2012), The Oxford Handbook of Urban Planning, Oxford University Press.

3. Ian Bracken (2009), Urban Planning Methods, Research and Policy Analysis, Routledge, Taylor & Francis.
4. Harry T. Dimitriou, Ralph Gakenheimer (2011), Urban Transport in the Developing World, A Handbook of Policy and Practice. Edward Elger, USA.
5. Joy Sen (2013), Sustainable Urban Planning, The Energy and Resources Institute, New Delhi, India.
6. Russ Lopez. (2012). The Built Environment and Public Health. John Wiley & Sons.
7. Eddie N. Laboy-Nieves, Fred C. Schaffner, Ahmed Abdelhadi, Mattheus F.A. Goosen (2008), Environmental Management, Sustainable Development and Human Health, CRC Press, Taylor & Francis.
8. Carol L. Stimmel. (2015), Building Smart Cities: Analytics, ICT, and Design Thinking, CRC Press, Taylor & Francis.
9. DurganandBalsavar (2012) Mahindra World City, Public Private Partnerships in Urban Planning, Mapin Publishers.

VEL TECH HIGH TECH

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Course code	21SE253PT	Semester	II			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION		3	0	0	3

COURSE OBJECTIVES:

- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results
- To understand the techniques for experimentation
- To know the model analysis

PREREQUISITE:

- Knowledge on construction techniques and equipment practice

COURSE OUTCOMES:

CO. No.	Course Outcomes	Bloom's level
On successful completion of this Course, students will be able to		
C2503.1	***Understand*** the working principle of strain gauges and deformeters.	K2
C2503.2	***Understand*** the measurements of strains and the concepts of two-dimensional photo elasticity	K2
C2503.3	***Summarize*** the concepts of photo elasticity and its applications	K2
C2503.4	***Analyze*** the structure by non-destructive testing methods	K4
C2503.5	***Apply*** the model analysis using different theorems	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C2503.1	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C2503.2	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C2503.3	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C2503.4	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C2503.5	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C2503	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I FORCES AND STRAIN MEASUREMENT 9

Choice of Experimental stress analysis methods, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications -Two-dimensional photo elasticity - Stress optic law. Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long- term monitoring – vibrating wire sensors– Fibre optic sensors.

UNIT II MEASUREMENT OF VIBRATION AND WIND FLOW 9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter - chart plotter – wind tunnels – Flow meters – Venturi meter – Digital data Acquisition systems.

UNIT III DISTRESS MEASUREMENTS AND CONTROL 9

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring.

UNIT IV NON-DESTRUCTIVE TESTING METHODS 9

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR, Ground penetrating radar (GPR) - X-ray method, Gamma ray method - Moire fringe method.

UNIT V MODEL ANALYSIS 9

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems –Usage of influence lines in model studies. Begg Eny's deformeter - Moment indicators

Total: 45 Periods

LEARNING RESOURCES:

REFERENCES:

1. Dalley .J. W and Riley. W. F, "Experimental Stress Analysis", McGraw Hill Book Company,N.Y. 1991
2. Ganesan.T.P, "Model Analysis of Structures", University Press, India, 2000.
3. Ravisankar.K.and Chellappan.A., "Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures", SERC, Chennai, 2007.
4. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 2006.
5. Sirohi.R.S., Radhakrishna.H.C, "Mechanical Measurements", New Age

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Course code	21SE261PT	Semester	II			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	INDUSTRIAL STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the student will be able

- To design various structures such as Bunkers, Silos, Cooling Towers, Chimneys, and Transmission Towers with required foundations.

PREREQUISITE:

- Knowledge on Strength of materials
- Knowledge on Structural analysis

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C2601. 1	***Understand*** the concept of planning & functional requirement of industrial standards.	K2
C2601. 2	***Design*** the girder, corbels and staircase.	K3
C2601.3	***Analyze*** the cooling towers, bunker and silos.	K3
C2601. 4	***Analyze and Design*** of Steel transmission line towers and chimneys	K3
C2601. 5	***Design*** foundations for cooling tower, chimneys and turbo generator.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C2601. 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2601. 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2601.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2601. 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2601. 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C2601	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - Planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.- Different components of industrial structures

UNIT II INDUSTRIAL BUILDINGS 9

Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase- Industrial floors

UNIT III POWER PLANT STRUCTURES 9

Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures- Design of Conveyers

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS 9

Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations, Methods of tower testing – Design of self-supporting and guyed chimney, Design of Chimney bases

UNIT V FOUNDATION 9

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation- Design Principles

Total: 45 Periods

LEARNING RESOURCES:

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings:
2. A Design Manual, Birkhauser Publishers, 2004.
3. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
4. Swami saran, Analysis & Design of substructures, Limit state Design second Edition.
5. D, N. Subramaniyan, Design of Steel Structures 2016
6. N. Krishna Raju, Advanced Reinforced concrete Design, 3rd edition 2016.

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Course code	21SE262PT	Semester	II			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	PRESTRESSED CONCRETE STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

- To learn The Principles of prestressing, analysis and design of prestressed concrete structures.
- To identify the different types of losses
- To study the design of pre-stressed concrete pipes and tanks.
- To study the analysis of PSC flexural members

PREREQUISITE:

- Knowledge on Reinforced Concrete Structures

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C2602.1	Acquire Sufficient ***Knowledge*** on Various Methods of Prestressing and The Concepts of Partial Pre-Stressing.	K3
C2602.2	***Analyze*** Prestressed concrete flexural members	K4
C2602.3	***Design*** Concept of Tension and Compression Members in Prestressed Concrete Structures	K4
C2602.4	***Design*** of Composite Members in Prestressed Concrete Structures	K4
C2602.5	***Design*** Members of Continuous and Cantilever Beams in Prestressed Concrete Structures	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C2602.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C2602.2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C2602.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C2602.4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
C2602.5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION AND LOSSES IN PRE-STRESS 9

Introduction – Development of Pre-stressed Concrete, General Principles of Pre-stressed Concrete, Classification and types of pre-stressing, Stages of loading, Materials – Concrete and Steel - stress, strain characteristics-short and long term deflections – Cable layouts.

UNIT II ANALYSIS OF PRESTRESSED FLEXURAL MEMBERS 9

Basic Concepts, Stresses at transfer and service loads, ultimate strength in flexure - code provisions in – deflection- Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Transfer of prestress

UNIT III DESIGN OF TENSION MEMBERS 9

Design for shear, bond and torsion - Design of End blocks - Stress distribution in end block- Design of Tension embers - Design of prestressed concrete cylindrical water tanks - Design of prestressed concrete pipes- Connections for pre-stressed concrete elements– design of anchorage zone reinforcement

UNIT IV SPECIAL TOPICS AND COMPOSITE BEAMS 9

Design of piles, flag masts and similar structures- Design of prestressed concrete sleepers and poles-Analysis and Design - Ultimate Strength - their applications - Special Structures like folded plates, prestressed cylindrical shells, spherical shells-Design of Prestress Metro rail elements-Precast post tensioned segmental box girder-Pretensioned Twin-U girders Span.

UNIT V STATICALLY INDETERMINATESTRUCTURES 9

Concept of concordant cable and profile and cap cables – sketching of pressure lines for continuous beams - Analysis and design of continuous beams and cantilever beams - Concept of linear transformation.

Total: 45 Periods

LEARNING RESOURCES:

REFERENCES:

1. Antonnie. E. Naaman, Prestressed Concrete Analysis and Design, Technopress, 3 rd Edition, 2012.
2. Edward. G .Nawy, Prestressed Concrete, Prentice Hall, 5 th Edition, 2010.
3. Arthur. H. Nilson, Design of Prestressed Concrete, John Wiley and sons, 2 nd Edition, 1987.
4. Raja Gopalan N. Prestressed Concrete, Alpha Science International, 2 nd Edition, 2005.
5. Krishna Raju, Prestressed Concrete, Tata McGraw Hill Publishing Co, 2000.

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Course code	21SE263PT	Semester	II			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	DESIGN OF BRIDGES		3	0	0	3

COURSE OBJECTIVES:

- To study the loads, forces on bridges and design of several types of bridges.

PREREQUISITE:

- Design of RCC, prestressed concrete and steel structures.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C2603.1	***Choose*** the type of bridge and its basic requirements for particular location.	K3
C2603.2	***Design*** the slab culverts, the beam and slab bridges	K6
C2603.3	***Design*** the various types of bridges	K6
C2603.4	***Design*** the prestressed concrete bridges	K6
C2603.5	***Design*** the steel bridges	K6
C2603.6	***Analyze*** and design the bridge bearings, piers and abutments	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C2603.1	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
C2603.2	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
C2603.3	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
C2603.4	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
C2603.5	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
C2603.6	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
C2603	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits:3**

UNIT I GENERAL INTRODUCTION AND SHORT SPAN RC BRIDGE 9

Types of bridges and loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges - analysis and design of slab culverts , Tee beam and slab Bridges, Pigeaud's theory.

UNIT II LONG SPAN RC BRIDGES 9

Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges- Analysis and design principles of cable stayed bridges -Analysis and design principles of suspension bridges.

UNIT III PRESTRESSED CONCRETE BRIDGES 9

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

UNIT IV STEEL BRIDGES 9

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

UNIT V BEARINGS AND SUBSTRUCTURES 9

Different types of bearings – Design of bearings – Design of piers and abutments of different types– Types of bridge foundations – Design of foundations.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Co., New Delhi, 2009.
2. Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2013

REFERENCES:

1. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.
2. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi,

3. 1991.

4. N Krishna Raju ,Design of Bridges, Oxford &IBH, 2010
5. N.Rajagopalan, Bridge Super Structure, Narasa Publishing House Pvt. Ltd, First Edition, 2006.
6. Taylor. F.W, Thomson S.E, and Smulski .E. "Reinforced Concrete Bridges", John Wiley & Sons, New York 1955.

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Course code	21SE27P	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	STRUCTURAL ENGINEERING LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To provides a thorough knowledge of material selection through the material testing based on specification

PREREQUISITE:

- Knowledge on Concrete Technology, Construction materials laboratory, Strength of materials laboratory.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C207. 1	***Find*** the properties of concrete	K2
C207. 2	***Learn*** the method of concrete mix design as per ACI and IS code and to get exposure to special concrete	K2
C207. 3	***Identify*** non-destructive tests on concrete	K3
C207. 4	***Examine*** the structural behavior of RC beams and measure strain.	K4
C207. 5	***Examine*** the deflection behavior of structural components	K4
C207.6	***Know*** the methodology for protecting reinforcement from weathering actions.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C207. 1	3	1	-	-	-	-	-	-	-	-	-	-
C207. 2	3	2	-	-	-	-	-	-	-	-	-	-
C207. 3	3	2	1	-	-	-	-	-	-	-	-	-
C207. 4	3	2	1	-	-	-	-	-	-	-	-	-
C207. 5	3	2	1	-	-	-	-	-	-	-	-	-
C207	3	2	1	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits: 2**

LIST OF EXPERIMENTS:

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Non-Destructive Test on concrete Rebound hammer
5. Non-Destructive Test on concrete Ultrasonic Pulse Velocity Tester
6. Design of Special Concrete like FRC (fibre reinforced concrete), SCC (self compacting concrete) and HPC (high performance concrete)
7. Concrete cover thickness test by common midpoint method.
8. Rebar locators test
9. Elongation of material by extensometer.
10. Vertical pull test (VPT).

TOTAL: 60 PERIODS

LEARNING RESOURCES:

REFERENCES:

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

Course code	21SE28P	Semester	II			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	INTERNSHIP I (4 WEEKS)		0	0	0	1

COURSE OBJECTIVES:

- To create knowledge for the students in the field work so as to have a preliminary knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in various types of difficulties facing and solving the field problems.
- To provide practical exposure in structural Engineering related organizations.

COURSE OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
- The students able to aware of the practical applications of theoretical concepts studied in the class rooms.

SYLLABUS:

- The students individually undertake training in reputed Industries during the summer vacation for a specified period of four weeks.
- At the end of training, a detailed report on the work done should be submitted within one month from the commencement of the semester.
- The students will be evaluated through a viva-voce examination by a team of internal staff.

DEPARTMENT OF CIVIL ENGINEERING

M.E- STRUCTURAL ENGINEERING

R-2021: CBCS

III SEMESTER SYLLABI

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Course code	21SE31T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

- To understand the causes and effects of earthquake and the structural systems subjected to earthquake forces as per the recommendations of IS code of practice.

PREREQUISITE:

- Structural Dynamics, Basic Mathematics Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C301. 1	**Understand** the causes of earthquake and its measurement.	K2
C301. 2	**Analyze** the seismic behavior of structures.	K3
C303. 3	**Acquire** knowledge on codal provisions for earthquake resistant design.	K3
C304. 4	**Understand** the concepts of earthquake resistant design and detailing.	K4
C305. 5	**Gain** knowledge on effects of earthquake and retrofitting of structures.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C301. 1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C301. 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C303. 3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C304. 4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
C305. 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C305	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS **No. of Credits:3**

UNIT I INTRODUCTION 9

Elements of engineering seismology – causes of earthquakes, seismic waves, magnitude, intensity and energy release – Indian seismology –Earthquake history – Seismic zone Map of India – seismographs – seismogram – accelerograph – strong motion characteristics- initiation into vibration of structures

UNIT II SEISMIC DESIGN OF BUILDINGS 9

Introduction to methods of seismic analysis – Equivalent static analysis IS 1893 provisions – Design horizontal seismic coefficient – design base shear – distribution – idealization of building frames - seismic analysis and modeling – determination of lateral forces – equivalent static lateral force method – response spectrum method – time history method – push over analysis - mathematical modeling of multistorey RC Building.

UNIT III "IS, ASCE AND EN" CODAL PROVISIONS 9

Modal response contribution – modal participation factor – response history – spectral analysis – approximate methods for lateral load analysis – IS 4326 provisions – behavior and design of masonry structures – discussion of codes IS 13827,13828, ASCE-7:2002 and EN 1998-1:2004.

UNIT IV SEISMIC DESIGN CONCEPTS 9

Concept of earthquake resistant design – concept of ductility – lateral force resisting systems – strong column weak beam concept - guidelines for seismic resistant construction - beam column joints –effect of structural irregularities – seismic-resistant building architecture – cyclic load behavior of RC, steel and prestressed concrete elements – Earthquake Resistant Design for multi storied RC frames, shear wall, braced frames and their combinations – capacity based design - Ductile detailing of reinforcement in RC Buildings as per IS 13920.

UNIT V SPECIAL PROBLEMS AND MODERN CONCEPTS 9

Soil performance - Liquefaction -Modern concepts – base isolation – adaptive system – seismic evaluation- retrofitting and strengthening of structures – seismic retrofitting strategies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Chopra A K, "Dynamics of Structures- Theory and Applications to Earthquake Engineering", Prentice- Hall of India Pvt. Ltd., New Delhi, 2002.
2. PankajAgarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice – Hall of India Pvt. Ltd., NewDelhi – 110 001, 2006.

REFERENCES:

1. Clough R W and Penzien J, " Dynamics of Structures", McGraw Hill, INC, 1993
2. Taranath B S, "Wind and Earthquake Resistant Buildings - structural Analysis & Design" ,Marcell Decker, NewYork, 2005.
3. Chen WF &Scawthorn, "Earthquake Engineering Hand book",CRC Press, 2003.

Course code	21SE321PT	SEMESTER	III			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

- To impart Knowledge on fundamentals of steel concrete composite structures
- To design of composite beams, columns
- To study on trusses and box girder bridges including the related connections.

PREREQUISITE:

- Design of steel structures
- Advanced steel structural elements

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C3201.1	***Understand*** the concepts of Composite action, Serviceability and Construction issues in design.	K2
C3201.2	***Design*** of composite beams, slabs	K4
C3201.3	***Design*** of connections in composite structures and columns	K4
C3201.4	***Understanding*** behaviour of box girder bridges and Composite Trusses	K2
C3201.5	***Study*** on case studies seismic behavior of composite structures. seismic behavior of composite structures.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C3201.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C3201.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3201.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3201.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C3201.5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3201	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I FUNDAMENTALS **9**

Introduction to Steel - Concrete Composite Construction - Theory of Composite Structures - Sandwich Construction- Design Philosophy- Advantages – Types of composite construction– Basic concepts of composite structures- Composite action – Serviceability and Construction issues in design.

UNIT II COMPOSITE SLABS AND BEAMS **9**

Design of composite beam – Propped condition – Un-propped condition – Deflection of Composite beams – Beam with profile sheeted deck slab – Design of partial shear connection- Composite floor slabs - Conventional composite beams - Resistance to sagging bending, Longitudinal shear and vertical shear.

UNIT III COMPOSITE COLUMNS **9**

Types of Composite columns – Design of encased columns – Design of in-filled columns – Axial, Uni-axial and bi-axially loaded columns– Concrete filled steel tubes – Resistance to axial Compression –. Composite column and frames- Design of beam-Column joints and rigid joint.

UNIT IV COMPOSITE TRUSSES and COMPOSITE GIRDER BRIDGES **9**

Composite Trusses – Behaviour and Design - Design of connections- Case studies on steel concrete composite construction in buildings - Behaviour of girder bridges - Design concepts.

UNIT V CASE STUDIES **9**

Seismic Behaviour Different codal provisions - Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction- Case Studies on steel - concrete composite construction structures in buildings.

Total: 45 Periods

LEARNING RESOURCES:

REFERENCES:

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Pergamon press, Oxford, 1995.
3. Owens.G.W and Knowles.P, ”Steel Designers Manual”, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.

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Course code	21SE322PT	Semester	III			
Category	PROFESSIONAL ELECTIVE COURSES (PEC)		L	T	P	C
Course Title	THEORY OF PLATES AND SHELLS		3	0	0	3

COURSE OBJECTIVES:

- To study engineering design approach to plates
- To impart knowledge on structural behaviour and analysis of different types of plates and shells under different boundary conditions.
- To know the structural behaviour of folded plates
- To obtain knowledge on the behaviour of shells
- To understand the analysis techniques of different types of shells

PREREQUISITE:

- Theory of Elasticity and Plasticity

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C3202.1	***Develop*** and solve differential equation of thin plates subjected to flexure	K2
C3202.2	***Analyze*** rectangular plates using Navier's and Levy's method	K4
C3202.3	***Analyze*** the plates under lateral load	K4
C3202.4	***Understand*** the behavior of behavior of plates and shells	K2
C3202.5	***Differentiate*** various types of shells based on structural behavior	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C3202.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3202.2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
C3202.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3202.4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
C3202.5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
C3202	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO PLATES THEORY 9

Thin plates with small deflection; assumptions, governing differential equations and various boundary conditions. Bending of plates Laterally loaded thin plates

UNIT II RECTANGULAR PLATES 9

Simply supported rectangular plates - Navier solution with various types of loads, rectangular plates with various boundary conditions - Levy's method, Axi-symmetric circular plates- Plates with Various Edge Conditions Plates on Elastic Foundation.

UNIT III ANALYSIS OF CIRCULAR PLATES AND FOLDED PLATES 9

Symmetrical bending of circular plates- Introduction of folded plate structures – Structural behavior – Various types

UNIT IV INTRODUCTION OF SHELLS 9

Introduction - Beam method of analysis. Analysis and design of doubly curved shells – Elliptic paraboloid- Design of cylindrical shell with edge beam using theory for long shells

UNIT V CLASSIFICATION OF SHELLS 9

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells. Application to design of shell roofs of water tanks (membrane analyses) Membrane theory of shells

Total: 45 Periods

LEARNING RESOURCES:

1. Timoshenko. S., (2010), Theory of Plates and Shells, McGraw Hill Education (India) Private Limited, 2 edition, New York.
2. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010.

REFERENCE BOOKS:

1. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, 1982.
2. Ramasamy, G.S., "Design and Construction of Concrete Shells Roofs", CBS Publishers, 1986.
3. Bhavikatti. S.S., (2012), Theory of Plates and Shells, New Age International Publisher, First edition, New Delhi.
4. Reddy. J.N., (2006), Theory and Analysis of Elastic Plates and Shells: Solutions Manual, CRC Press Inc, 2nd Revised edition, London.

Course code	21SE323PT	Semester	III			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	ENVIRONMENTAL IMPACT ASSESSMENT OF CIVIL ENGINEERING		3	0	0	3

COURSE OBJECTIVES:

- To understand the impacts of Civil Engineering Projects on the components of environment.
- To assess the impacts and apply mitigating measures.
- To apply the safety practices as per the CPCB Norms.

PREREQUISITE:

- Knowledge on Environmental Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C3203.1	***Interpret*** the Impacts of Civil Engineering Projects on Environment.	K2
C3203.2	***Illustrate*** risk assessment on hazard and exposure extent.	K2
C3203.3	***Choose*** effective methodologies in environmental management plan.	K3
C3203.4	***Develop*** the safety measurements based on the identified environmental impacts	K3
C3203.5	***Create*** environmental impact assessment report for Civil Engineering Projects.	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C3203.1	2	1	-	-	-	-	-	-	-	-	-	-
C3203.2	2	1	-	-	-	-	-	-	-	-	-	-
C3203.3	2	1	-	-	-	-	-	-	-	-	-	-
C3203.4	3	1	-	-	-	-	-	-	-	-	-	-
C3203.5	3	2	1	-	-	-	-	-	-	-	-	-
C3203	3	2	1	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION 9

Impacts of civil engineering projects on environment - Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA– Environmental issues and management - Environmental monitoring – CRZ rules (offshore projects) – Revised classification of industrial sectors (Red, Orange, Green & White Categories).

UNIT II ENVIRONMENTAL ASSESMENT AND SUSTAINABILITY 9

Engineering and sustainable development - Population and urbanization - Toxic chemicals and finite resources - Water scarcity and conflict - Environmental risk - Risk assessment and characterization - Hazard assessment - Exposure assessment.

UNIT III ENVIRONMENTAL MANAGEMENT PLAN AND METHODOLOGIES 9

Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People - Methods of EIA –Check lists – Matrices – Networks – Cost-Benefit analysis

UNIT IV PREDICTION AND SAFETY MEASUREMENT 9

Assessment of Impact on land, water and air, noise, social, cultural flora and fauna; Mathematical models; public participation – Rapid EIA - Safety measures in design and process operations - Inerting, explosion, fire prevention, sprinkler systems.

UNIT V CASE STUDIES 9

EIA for infrastructure projects – Bridges – Stadium – Highways – Dams – Multi-storied Buildings– Water Supply and Drainage Projects – Waste water treatment plants.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Canter, R.L., "Environmental Impact Assessment", McGraw-Hill Inc., New Delhi, 1996.
2. Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common
3. Wealth Publishers, New Delhi, 1992.

REFERENCES:

1. John G. Rau and David C Hooten (Ed)., "Environmental Impact Analysis Handbook", McGraw-Hill Book Company, 1990.
2. "Environmental Assessment Source book", Vol. I, II & III. The World Bank, Washington,D.C., 1991.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science, 1999.
4. "Effluent Emissions Standards", by CPCB, 2016.
5. "CRZ Rules", by MoEFCC, 2018.

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Course code	21SE331PT	Semester	III			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	TALL BUILDINGS		3	0	0	3

COURSE OBJECTIVES:

- To study the behaviour, analysis and design of tall structures.

PREREQUISITE:

- Knowledge on Design of reinforced cement concrete elements
- Knowledge on Prestressed Concrete Structures

COURSE OUTCOMES:

CO. No.	Course Outcomes	Bloom's level
On successful completion of this Course, students will be able to		
C3301.1	***Understand*** the behaviour of tall buildings due to various types of loads.	K2
C3301.2	***Evaluate*** the structural systems in tall buildings	K4
C3301.3	***Analyze*** and design such buildings by approximate, accurate and simplified methods.	K4
C3301.4	***Design*** the structural elements for various parameters.	K4
C3301.5	***Understand*** the stability issues of the framed structures	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C3301.1	3	3	-	2	-	-	-	-	-	-	-	-
C3301.2	3	1	3	-	-	-	-	-	-	-	-	-
C3301.3	3	1	3	-	-	-	-	-	-	-	-	-
C3301.4	3	1	3	-	-	-	-	-	-	-	-	-
C3301.5	3	3	-	2	-	-	-	-	-	-	-	-
C3301	3	3	3	2	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I LOADING AND DESIGN PRINCIPLES 9

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth, height and structural form. behaviour of high-rise buildings, Rigid frames, braced frames, in filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN 9

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three-dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT IV STRUCTURAL ELEMENTS 9

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

UNIT V STABILITY ISSUES 9

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation. **Total: 45 Periods**

LEARNING RESOURCES:

TEXT BOOKS:

1. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.
3. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
4. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.
5. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

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Course code	21SE332PT	Semester	III			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	ENERGY EFFICIENT BUILDINGS		3	0	0	3

COURSE OBJECTIVES:

- This course aims to provide an understanding of the concept of reduction in energy consumption with energy efficient building design.
- Highlight strategies to integrate day lighting and effective energy consumption in heating/cooling of buildings.

PREREQUISITE:

- Concepts, laws and principles of physics and chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C3302. 1	***Relate*** the concept and theoretical background of energy efficient building design	K2
C3302. 2	***Experiment*** with heat transfers and cooling techniques.	K3
C3302.3	***Model*** the Natural ventilation and forced ventilation in structures.	K3
C3302. 4	***Develop*** daylight assessment Supplementary artificial lighting design	K3
C3302. 5	***Apply*** simulation tools to achieve energy efficiency in buildings	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C3302. 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C3302. 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C3302.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C3302. 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C3302. 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C303	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I GREEN BUILDINGS AND SOLAR ENERGY RESOURCES 9

Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Rebound Effect, Pollution, Better Buildings, Reducing energy consumption, Low energy design. Solar energy, Passive Solar Heating, Passive Solar collection, Wind and other renewable energy resources. A passive solar strategy: Direct gain - Trombe wall, convective air loop, Photovoltaics, Climate and Energy, Macro and Microclimate - Indian Examples.

UNIT II HEATING AND COOLING 9

Building Form Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings – Robin's Spatial Proportion – Orientation of building –Heat transmission through buildings –Thermal properties of building materials –AQI (CPCB Standards) - Thermal Comfort –Psychometrics Chart –Heat transfer – Cosine Effect - Insulation - Cooling buildings, passive cooling, and mechanical cooling – Measurement of heating and cooling loads.

UNIT III VENTILATION AND INFILTRATION 9

Natural ventilation and forced ventilation in commercial buildings, passive cooling, modelling air flow and ventilation – stack effect - ventilation calculation – Mass effect.

UNIT IV DAY LIGHTING AND ARTIFICIAL LIGHTING 9

Illumination requirements - Concepts of daylight factors and day lighting, daylight assessment, sky dome - sun path diagram, sky exposure angle, sun protection, shading coefficient, visualisingday lighting: Source-Path-Target and apparent size, illuminance calculation, penetration and spread of sky component, artificial lighting, efficacy, Radiant barriers - new light sources – luminaries - light shelves - Supplementary artificial lighting design – light distribution – electric lighting control

UNIT V DESIGN FOR CLIMATIC ZONES, ENERGY ASSESSMENT AND COMPLIANCES PROCEDURES 9

Energy efficient building strategies for various climatic zones – cold and cloudy – cold and sunny – composite – warm and humid – moderate – hot and dry – case studies. Energy awareness, monitoring energy consumption, Building Environmental Assessment- environmental criteria – embodied energy of building materials – Energy Management & Audit - assessment methods - assessment tools (e.g. GRIHA, LEED) – Eco-homes - Sustainable architecture and urban design – principles of environmental architecture.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Satyajit Ghosh and Abhinav Dhaka (2015), Green Structures: Energy Efficient Buildings, Ane Books.
2. Energy Efficiency in Buildings, by José Manuel Andújar, Sergio Gómez Melgar, 2020.

REFERENCES:

1. Charles Eley (2016), Design Professional's Guide to Zero Net Energy Buildings, Island Press.
2. Ian M. Shapiro (2016), Energy Audits and Improvements for Commercial Buildings,
3. JohnWiley & Sons.
4. MoncefKrarti (2016), Energy Audit of Building Systems: An Engineering Approach, Second Edition.
5. EngHwa Yap., (2017), Energy Efficient Building., Published by InTech.,Crotia.
6. LalJayamaha (2006), Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance, McGraw Hill Professional.
7. Energy Audit of Building Systems, An Engineering Approach, Third Edition, *By* Moncef Krarti.
8. Air Quality Index, by CPCB Standards.

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Course code	21SE333PT	Semester	III			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	DESIGN OF SUB STRUCTURES		3	0	0	3

COURSE OBJECTIVES:

- To gain familiarity with different types of foundation.
- To expose the students to the design of shallow foundations and deep foundations.
- To understand the concepts of designing well, machine and special foundations.

PREREQUISITE:

- Knowledge on Soil Mechanics and Foundation Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C3303.1	***Design*** shallow foundations for various types of structures.	K4
C3303.2	***Calculate*** capacity of piles and design deep foundation	K4
C3303.3	***Understand*** the concepts of designing well foundations.	K4
C3303.4	***Analyze*** and design foundations for machines.	K4
C3303.5	***Understand*** the concepts of designing special foundations.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C3303.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3303.2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
C3303.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C3303.4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
C3303.5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
C3303	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits:3**

UNIT I SOIL STRUCTURE INTERACTION AND SHALLOW FOUNDATION 9

Overview of Soil-Structure Interaction –Soil-Structure System Behavior-Equations for Shallow Foundation Stiffness and Damping- Nonlinear Soil-Structure Interaction Models –Kinematic Interaction- Method of analysis –Implementation in Standards and Design Guidelines.

UNIT II PILE FOUNDATIONS 9

Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles – Uplift capacity of piles- configuration of piles- different shapes of piles cap – structural design of pile cap.

UNIT III WELL FOUNDATIONS 9

Types of well foundation – Grip length – load carrying capacity – construction of wells – Failures and Remedies – Design of well foundation – Lateral stability.

UNIT IV MACHINE FOUNDATIONS 9

Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation.

UNIT V SPECIAL FOUNDATIONS 9

Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete Towers, chimneys – Marine Foundations - Design of ground anchors - Reinforced earth retailing walls.

Total: 45 Periods

LEARNING RESOURCES:

REFERENCES:

1. Swami Saran, 'Analysis and Design of Substructures', Oxford & IBH Publishing Company Private Limited, 2009.
2. Bowels J. E, 'Foundation Analysis and Design', McGraw-Hill International Book Co, 2007.
3. Thomlinson, M.J. and Boorman. R., 'Foundation Design and Construction', ELBS Longman VI edition, 2005.
4. Nayak, N.V., 'Foundation Design manual for Practicing Engineers', Dhanpat Rai and Sons, 2009.
5. Winterkorn H.F., and Fang H.Y., 'Foundation Engineering Hand Book', Van Nostrard - Reinhold - 2004.
6. Braja M. Das, 'Principles of Foundation Engineering', Thomson Asia (P) Ltd- 2009.
7. John W Bull, 'Soil-Structure Interaction: Numerical Analysis and Modelling', E&FN Spon.
8. Srinivasalu, Vaidyanathan, Handbook of Machine Foundation- 2017, McGraw Hill Education, India.

Course code	21SE34P	Semester	III			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	INTERNSHIP II (4 WEEKS)		0	0	0	1

COURSE OBJECTIVES:

- To create knowledge for the students in the field work so as to have a preliminary knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in various types of difficulties facing and solving the field problems.
- To provide practical exposure in structural Engineering related organizations.

COURSE OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
- The students able to aware of the practical applications of theoretical concepts studied in the class rooms.

SYLLABUS:

- The students individually undertake training in reputed Industries during the summer vacation for a specified period of four weeks.
- At the end of training, a detailed report on the work done should be submitted within one month from the commencement of the semester.
- The students will be evaluated through a viva-voce examination by a team of internal staff.

Course code	21SE35P	Semester	III			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	TECHNICAL SEMINAR		0	0	2	1

COURSE OBJECTIVES:

- To work on a specific technical topic related to Structural Engineering and acquire the skills for written and oral presentation.
- To acquire writing abilities for seminars and conferences.

COURSE OUTCOMES:

- The students will be trained to face an audience and to tackle any problem during career opportunities.

SYLLABUS:

The students will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Structural Engineering and to engage in discussion with the audience. A brief copy of their presentation also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown during the seminar.

TOTAL: 30 PERIODS

Course code	21SE36P	Semester	III			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	PROJECT WORK PHASE - I		0	0	12	6

COURSE OBJECTIVES:

- To identify a specific problem for the future benefit of the society and collecting information related to the same through detailed literature reviews.
- To carry out the independent research work on the chosen topic and submit a thesis for evaluation.

COURSE OUTCOMES:

- At the end of the project work the students will have a clear idea about the literatures relevant to their area of research to and identify the research problems they are in a position to carry out the remaining phase II work in a systematic way.

SYLLABUS:

Each student is expected to do an individual project. The topic may be experimental or analytical or case studies. The work at this stage may involve extensive review of literature in the chosen area of interest. Based on the literature review, the project may be carried out by numerical simulation using software packages and/or experimental work. At the completion of a project the student will submit a project report, which will be evaluated by duly appointed examiner(s).

Total periods :180

DEPARTMENT OF CIVIL ENGINEERING

M.E- STRUCTURAL ENGINEERING

R-2021: CBCS

IV SEMESTER SYLLABI

Course code	21SE41P	Semester	IV			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	INTERNSHIP III (4 WEEKS)		0	0	0	1

COURSE OBJECTIVES:

- To create knowledge for the students in the field work so as to have a preliminary knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in various types of difficulties facing and solving the field problems.
- To provide practical exposure in structural Engineering related organizations.

COURSE OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
- The students able to aware of the practical applications of theoretical concepts studied in the class rooms.

SYLLABUS:

- The students individually undertake training in reputed Industries during the summer vacation for a specified period of four weeks.
- At the end of training, a detailed report on the work done should be submitted within one month from the commencement of the semester.
- The students will be evaluated through a viva-voce examination by a team of internal staff.

Course code	21SE42P	Semester	IV			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	PROJECT WORK PHASE - II		0	0	24	12

COURSE OBJECTIVES:

- To develop the skills to formulate the methodology for the chosen topic.
- To develop skills to analyze and discuss the test results, and make conclusions.

COURSE OUTCOMES:

- At the end of the project work the students will have a Perform analytical investigation. Critically assess and propose solutions to Structural Engineering problems. Demonstrate the research findings and present the solutions of the thesis work.

SYLLABUS:

Students are expected to carry out research work and submit a thesis for evaluation. The work at this stage may involve review of literature, extensive experimental work and/or Numerical simulation using software packages, development of analytical model, case study, field data collection and analysis etc. The students will give a periodical review seminar on each stage.

Total periods :360