REGULATION-2022

SYLLABUS

ADHIYAMAAN COLLEGE OF ENGINEERING - HOSUR
(An Autonomous institute affiliated to Anna University, Chennai)

SEMESTER-I

M.E. (STRUCTURAL ENGINEERING)

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	122SET01	Advanced Mathematical Methods	FC	3	1	0	4
2	122SET02	Theory of Elasticity and Plasticity	PCC	3	1	0	4
3	122SET03	Structural Dynamics and Earthquake Engineering	PCC	3	1	0	4
4	122SET04	Research Methodology and IPR	RMC	2	0	0	2
5	122SEEXX	Professional Elective I	PEC	3	0	0	3
6	122SEAXX	Audit Course – I*	AC	2	0	0	1
PRACTICALS							
7	122SEP06	Advanced Construction Engineering and Experimental Techniques Laboratory	PCC	0	0	2	1
8	122SEP07	Technical Seminar	EEC	0	0	2	1
	TOTAL			16	3	4	19

FOUNDATION COURSES

S.No.	Course Code	Course Title	Category	L	T	P	C
1	122SET01	Advanced Mathematical Methods	FCC	3	1	0	4

PROFESSIONAL CORE COURSES (PCC)

S.No.	Course Code	Course Title	Category	L	T	P	C
1	122SET02	Theory of Elasticity and Plasticity	PCC	3	1	0	4
2	122SET03	Structural Dynamics and Earthquake Engineering	PCC	3	1	0	4
3	122SEP06	Advanced Construction Engineering and Experimental Techniques Laboratory	PCC	0	0	4	2
4	222SET01	Advanced Steel Structures	PCC	3	1	0	4
5	222SET02	Advanced Concrete Structures	PCC	3	1	0	4
6	222SET03	Finite Element Analysis in Structural Engineering	PCC	3	0	0	3
7	222SEP07	Numerical and Finite Element Analysis Laboratory	PCC	0	0	4	2
	TOTAL			**14**	**1**	**8**	**23**

LIST OF PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER – I, ELECTIVE - I

S.No.	Course Code	Course Title	Category	L	T	P	C
1	122CEE01	Non-linear Analysis of Structures	PEC	3	0	0	3
2	122CEE02	Optimization of Structures	PEC	3	0	0	3
3	122CEE03	Wind and Cyclone Effects on Structures	PEC	3	0	0	3
4	122CEE04	Prefabricated Structures	PEC	3	0	0	3

122SET01 ADVANCED MATHEMATICAL METHODS **L T P C**
4 0 0 4

OBJECTIVES :

- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. Application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Laplace transform : Definitions – Properties – Transform error function – Bessel's function - Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace transform : Complex inversion formula – Solutions to partial differential equations : Heat equation – Wave equation.

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier transform : Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations : Heat equation – Wave equation – Laplace and Poisson's equations.

UNIT III CALCULUS OF VARIATIONS 12

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications : Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS 12

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient - Divergence and curl.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Application of Laplace and Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
- Maximizing and minimizing the functional that occur in various branches of Engineering Disciplines.
- Construct conformal mappings between various domains and use of conformal mapping in studying problems in physics and engineering particularly to fluid flow and heat flow problems.
- Understand tensor algebra and its applications in applied sciences and engineering and develops ability to solve mathematical problems involving tensors.
- Competently use tensor analysis as a tool in the field of applied sciences and related fields.

REFERENCES :

1. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolc, L.D., "Calculus of Variations", Dover Publications Inc., New York, 2007.
3. Mathews, J. H., and Howell, R.W., "Complex Analysis for Mathematics and Engineering", 6^{th} Edition, Jones and Bartlett Publishers, 2011.
4. Kay, D. C., "Tensor Calculus", Schaum's Outline Series, Tata McGraw Hill Edition, 2014.
5. Naveen Kumar, "An Elementary Course on Variational Problems in Calculus ", Narosa Publishing House, 2005.
6. Saff, E.B and Snider, A.D, "Fundamentals of Complex Analysis with Applications in Engineering, Science and Mathematics", 3^{rd} Edition, Pearson Education, New Delhi, 2014.
7. Sankara Rao, K., "Introduction to Partial Differential Equations", 3^{rd} Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
8. Spiegel, M.R., "Theory and Problems of Complex Variables and its Applications", Schaum's Outline Series, McGraw Hill Book Co., 1981.
9. Ramaniah. G. "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.

Adhiyamaan College of Engineering - Autonomous			**R-2022**
Department	Civil Engineering	Programme Code and Name	M.E STRUCTURAL ENGINEERING

Semester-I

Course Code	Course Name	Hours / week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
122SET02	**THEORY OF ELASTICITY AND PLASTICITY**	4	0	0	4	40	60	100

OBJECTIVES

- To develop the ability to use the principles of theory of elasticity in engineering problems
- To introduce theoretical fundamentals of theory of plasticity
- To understand the concept of 3D stress, strain analysis and its applications to simple problems.

UNIT-1	**Elasticity**	**TOTAL HOURS**	**12 HOURS**

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

UNIT-2	**Elasticity Solution**	**TOTAL HOURS**	**12 HOURS**

Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar coordinates.

UNIT-3	**Torsion of Non-Circular Section**	**TOTAL HOURS**	**12 HOURS**

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

UNIT-4	**Beams On Elastic Foundations**	**TOTAL HOURS**	**12 HOURS**

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi-infinite and finite beams – Rigid and flexible – Uniform cross section – Point load and udl – Solution by finite differences.

UNIT-5	**Plasticity**	**TOTAL HOURS**	**12 HOURS**

Physical Assumptions – Yield criteria – Failure theories – Applications of thick cylinder – Plastic stress strain relationship. Elasto-plastic problems in bending and torsion.

TOTAL HOURS TO BE TAUGHT	**60 HOURS**

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1	derive and write the fundamental equations of elasticity describing the linear behavior of element and develop constitutive models based on material behavior
CO2	Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems
CO3	Solve torsion problems in circular and non-circular cross-sections
CO4	Analyse beams resting on elastic foundations
CO5	Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties

REFERENCES:

1. Ansel.C.Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional technical Reference, New Jersy, 2003.
2. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth - Heinmann – UK, 2007.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
4. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.
5. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
6. Timoshenko, S. and GoodierJ.N."Theory of Elasticity", McGraw Hill Book Co., New York, 2017.

Adhiyamaan College of Engineering - Autonomous			**R-2022**
Department	Civil Engineering	Programme Code and Name	M.E. STRUCTURAL ENGINEERING

Semester-I

Course Code	Course Name	Hours/week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
122SET02	**STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING**	3	1	0	4	40	60	100

OBJECTIVES

- To make the students understand the basics of structural dynamics and earthquake engineering
- To develop the ability to design a earthquake resistant structure
- To exose the students the principles and methods of dynamic analysis of structures
- To prepare the students for designing the structures for wind, earthquake and other dynamic loads.

UNIT-1	**Principles of Vibration Analysis**	**TOTAL HOURS**	**12 HOURS**

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility.

UNIT-2	**Dynamic Response of Two Degree of Freedom Systems**	**TOTAL HOURS**	**12 HOURS**

Mathematical models of two degree of freedom systems, free and forced vibrations of two degree of freedom systems, normal modes of vibration, applications.

UNIT-3	**Dynamic Response of Multi-Degree of Freedom Systems**	**TOTAL HOURS**	**12 HOURS**

Mathematical models of Multi-degree of freedom systems, orthogonality of normal modes, free and forced vibrations of multi degree of freedom systems Mode superposition technique, Applications.

UNIT-4	**Dynamic Response of Continuous Systems**	**TOTAL HOURS**	**12 HOURS**

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

UNIT-5	**Direct Integration Methods for Dynamic Response**	**TOTAL HOURS**	**12 HOURS**

Damping in MDOF systems, Nonlinear MDOF systems, Wilson Theta method, Newmark beta method, step-by-step numerical integration techniques.

TOTAL HOURS TO BE TAUGHT	**60 HOURS**

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1	Do vibration analysis of system/structures with single degree of freedom and can explain the method of damping the systems
CO2	Do dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration
CO3	Derive a mathematical model of continuous system and do a dynamic analysis under free and forced vibration

CO4	Explain the causes and effect of earthquake
CO5	Design masonry and RC structures to the earthquake forces as per there commendations of IS codes of practice

REFERENCES:

1.	Anil K.Chopra, Dynamics of Structures, Pearson Education, 2017.
2.	Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.
3.	Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, Fifth Edition 2006.
4.	Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.
5.	Brebbia C. A.,"Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
6.	Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science& Technology, 2012
7.	Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures",Prentice Hall of India, 2009.
8.	Paulay.T and Priestley M.J.N.,"Seismic Design of Reinforced Concrete and MasonryBuildings", John Wiley and Sons, 1992.
9.	Duggal S K, "Earthquake Resistant Design of Structures", Oxford University Press, 2007.
10	Madhujit Mukhopadhyay ," Structural Dynamics: Vibrations and Systems",Ane's Student Edition,2008

<table>
<tr><td colspan="4">Adhiyamaan College of Engineering - Autonomous</td><td colspan="6">R-2022</td></tr>
<tr><td>Department</td><td>Civil Engineering</td><td colspan="2">Programme Code and Name</td><td colspan="6">M.E. STRUCTURAL ENGINEERING</td></tr>
<tr><td colspan="10">Semester-I</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>EA</td><td>TOTAL</td></tr>
<tr><td>122SET02</td><td>RESEARCH METHODOLOGY AND IPR</td><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>UNIT-1</td><td colspan="3">RESEARCH DESIGN</td><td colspan="3">TOTAL HOURS</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="10">Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys</td></tr>
<tr><td>UNIT-2</td><td colspan="3">DATA COLLECTION AND SOURCES</td><td colspan="3">TOTAL HOURS</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="10">Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.</td></tr>
<tr><td>UNIT-3</td><td colspan="3">DATA ANALYSIS AND REPORTING</td><td colspan="3">TOTAL HOURS</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="10">Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation</td></tr>
<tr><td>UNIT-4</td><td colspan="3">INTELLECTUAL PROPERTY RIGHTS</td><td colspan="3">TOTAL HOURS</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="10">Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.</td></tr>
<tr><td>UNIT-5</td><td colspan="3">PATENTS</td><td colspan="3">TOTAL HOURS</td><td colspan="3">6 HOURS</td></tr>
<tr><td colspan="10">Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.</td></tr>
<tr><td colspan="7">TOTAL HOURS TO BE TAUGHT</td><td colspan="3">30 HOURS</td></tr>
</table>

REFERENCES:

1.	Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2.	Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3.	David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

Adhiyamaan College of Engineering – Autonomous							Regulation		R-2022	
Department	Civil Engineering	Programme Code and Name					M.E. Structural Engineering			

Semester – I

Course Code	Course Name	Hours/week			Credit	Maximum Marks	
		L	T	P	C	CA	EA
122SEP06	**Advanced Structural Engineering Laboratory**	**0**	**0**	**4**	**2**	**50**	**50**

OBJECTIVES

- To perform advanced laboratory experiments that emphasize the structure-property relationship, statistical analysis, and technical manuscript preparation.

LIST OF EXPERIMENTS

Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.

sting of simply supported steel beam for strength and deflection behaviour.

brication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.

Dynamic testing of cantilever steel beam
a. To determine the damping coefficients from free vibrations.
b. To evaluate the mode shapes.

Static cyclic testing of single bay two storied steel frames and evaluate
a. Drift of the frame.
b. Stiffness of the frame.
c. Energy dissipation capacity of the frame.

termination of in-situ strength and quality of concrete using i) rebound hammer and ii) Ultrasonic Pulse Velocity Tester

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1	Operate loading frame to conduct flexural and compression tests.
CO.2	Understand the behaviour of reinforced concrete and steel beam for strength and deflection.
CO.3	Understand the dynamic behaviour of cantilever steel beam and also able to understand the strength and quality of concrete.
CO.4	Understand the behaviour of reinforced concrete column subjected to concentric and eccentric loading.
CO5.	determine the load bearing capacity of the existing structures

<table>
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<tr><td>Department</td><td>Civil Engineering</td><td colspan="4">Programme Code and Name</td><td colspan="3">M.E. Structural Engineering</td></tr>
<tr><td colspan="9">Semester – I</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours/week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>EA</td></tr>
<tr><td>122SEP07</td><td colspan="2">TECHNICAL SEMINAR</td><td>0</td><td>0</td><td>4</td><td>2</td><td>50</td><td>50</td></tr>
<tr><td>OBJECTIVES</td><td colspan="8">To work on a specific technical topic in Structural Engineering in order to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences..</td></tr>
<tr><td colspan="9">SYLLABUS:
The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Structural Engineering and to engage in dialogue with the audience. A brief copy of their talk 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 also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar</td></tr>
<tr><td colspan="9">COURSE OUTCOMES:</td></tr>
<tr><td colspan="9">After undergoing the course, the students will have ability to</td></tr>
<tr><td>CO.1</td><td colspan="8">Identify latest developments in the field of Structural Engineering</td></tr>
<tr><td>CO.2</td><td colspan="8">Acquire technical writing abilities for seminars, conferences and journal publications</td></tr>
<tr><td>CO.3</td><td colspan="8">Use modern tools to present the technical details</td></tr>
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<tr><td colspan="4">Adhiyamaan College of Engineering - Autonomous</td><td colspan="5">R-2022</td></tr>
<tr><td>Department</td><td>Civil Engineering</td><td colspan="2">Programme Code and Name</td><td colspan="5">M.E STRUCTURAL ENGINEERING</td></tr>
<tr><td colspan="9">Semester-I</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>EA</td><td>TOTAL</td></tr>
<tr><td>122SEE01</td><td>NONLINEAR ANALYSIS OF STRUCTURES</td><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>OBJECTIVES</td><td colspan="8">study the concept of nonlinear behavior and analysis of elements and simple structures.</td></tr>
<tr><td>UNIT-1</td><td colspan="4">Introduction to Nonlinear Analysis</td><td colspan="2">TOTAL HOURS</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="9">Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate flexible bars of uniform and variable thickness.</td></tr>
<tr><td>UNIT-2</td><td colspan="4">Inelastic Analysis of Flexural Members</td><td colspan="2">TOTAL HOURS</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="9">Inelastic analysis of uniform and variable thickness members subjected to small deformations; Inelastic analysis of flexible bars of uniform and variable stiffness members with and without axial restraints</td></tr>
<tr><td>UNIT-3</td><td colspan="4">Vibration Theory and Analysis of Flexural Members</td><td colspan="2">TOTAL HOURS</td><td colspan="2">HOURS</td></tr>
<tr><td colspan="9">Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading.</td></tr>
<tr><td>UNIT-4</td><td colspan="4">Elastic and Inelastic Analysis of Plates</td><td colspan="2">TOTAL HOURS</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="9">Elastic and inelastic analysis of uniform and variable thickness plates</td></tr>
<tr><td>UNIT-5</td><td colspan="4">Nonlinear Vibration and Instability</td><td colspan="2">TOTAL HOURS</td><td colspan="2">9 HOURS</td></tr>
<tr><td colspan="9">Nonlinear vibration and Instabilities of elastically supported beams.</td></tr>
<tr><td colspan="7">TOTAL HOURS TO BE TAUGHT</td><td colspan="2">45 HOURS</td></tr>
<tr><td colspan="9">COURSE OUTCOMES:</td></tr>
<tr><td colspan="9">After undergoing the course, the students will have ability to</td></tr>
<tr><td>CO1</td><td colspan="8">Analyze bar system considering material and geometric nonlinearity</td></tr>
<tr><td>CO2</td><td colspan="8">Perform inelastic analysis flexural members</td></tr>
<tr><td>CO3</td><td colspan="8">Perform vibration analysis of flexural members</td></tr>
<tr><td>C04</td><td colspan="8">Perform elastic and inelastic analysis of Plates</td></tr>
<tr><td>CO5</td><td colspan="8">Perform nonlinear and instability analysis of elastically supported beams</td></tr>
<tr><td colspan="9">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="8">Fertis, D.G, Nonlinear Mechanics, CRC Press, 1999.</td></tr>
<tr><td>2.</td><td colspan="8">Reddy.J.N, Nonlinear Finite Element Analysis, Oxford University Press, 2008.</td></tr>
<tr><td>3.</td><td colspan="8">Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2010.</td></tr>
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Adhiyamaan College of Engineering - Autonomous			R – 2022
Department	Civil Engineering	Programme Code and Name	M.E STRUCTURAL ENGINEERING

Semester-I

Course Code	Course Name	Hours/week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
122SEE02	**OPTIMIZATION OF STRUCTURES**	3	0	0	3	40	60	100

OBJECTIVES	study the optimization methodologies applied to structural engineering

UNIT-1	**Basic Principles and Classical Optimization Techniques**	TOTAL HOURS	9 HOURS

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-2	**Linear and Non-Linear Programming**	TOTAL HOURS	9 HOURS

Linear Programming: Formulation of problems - Graphical solution – Analytical Methods - Standard form - Slack, surplus and artificial variables - Canonical form – Basic Feasible solution - simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm. Non Linear Programming: One Dimensional minimization methods: Unidimensional - Unimodal function - Exhaustive and unrestricted search – Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.

UNIT-3	**Geometric Programming**	TOTAL HOURS	9 HOURS

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.16

UNIT-4	**Dynamic Programming**	TOTAL HOURS	9 HOURS

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

UNIT-5	**Structural Applications**	TOTAL HOURS	9 HOURS

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-storey buildings, water tanks and bridges.

TOTAL HOURS TO BE TAUGHT	45 HOURS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

completion of this course students will have sufficient knowledge on various optimization techniques like linear programming, non-linear programming, geometric and dynamic programming and they will also in a position to design various structural elements for minimum weight.

REFERENCES:

1.	Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd
2.	Rao, S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd., 1984
3.	Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
4.	Uri Krish, "Optimum Structural Design", McGraw Hill Book Co. 1981

Adhiyamaan College of Engineering - Autonomous			R-2022
Department	Civil Engineering	Programme Code and Name	M.E STRUCTURAL ENGINEERING

Semester – I

Course Code	Course Name	Hours/week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
122SEE03	**WIND AND CYCLONE EFFECTS ON STRUCTURES**	3	0	0	3	40	60	100

OBJECTIVES	To study the consequence of wind effects, analysis and design of structures.

UNIT-1	**Introduction**	**TOTAL HOURS**	**10 HOURS**

Introduction, Types of wind – Characteristics of wind – Method of Measurement of wind velocity, variation of wind speed with height, shape factor, aspect ratio, drag and lift effects - Dynamic nature of wind –Pressure and suctions - Spectral studies, Gust factor.

UNIT-2	**EFFECT OF WIND ON STRUCTURES**	**TOTAL HOURS**	**5 HOURS**

Classification of structures – Rigid and Flexible – Effect of wind on structures –Vortex shedding, translational vibration of structures - Static and dynamic effects on Tall buildings – Chimneys

UNIT-3	**DESIGN OF SPECIAL STRUCTURES**	**TOTAL HOURS**	**12 HOURS**

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – Design of Industrial Structures– Tall Buildings – Chimneys – Transmission towers and steel monopoles

UNIT-4	**CYCLONE EFFECTS**	**TOTAL HOURS**	**12 HOURS**

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding.

UNIT-5	**WIND TUNNEL STUDIES**	**TOTAL HOURS**	**6 HOURS**

Wind Tunnel Studies, Types of wind tunnels, Types of wind tunnel models - Modelling requirements - Aero dynamic and Aero-elastic models, Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design

TOTAL HOURS TO BE TAUGHT	**45 HOURS**

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1	Explain the characteristics of wind
CO2	Evaluate the intensity of wind on structures
CO3	Design some special structures subjected to wind loading
CO4	Design of structures for cyclone
CO5	Model and analyse a structure in a wind tunnel

REFERENCES:

1.	**Cook.N.J.,** "The *Designer's Guide to Wind Loading of Building Structures",* Butterworths, 1989.
2.	**Kolousek.V**, **Pirner.M, Fischer.O and Naprstek.J,** "*Wind Effects on Civil Engineering Structures"*, Elsevier Publications, 1984
3.	**Peter Sachs,** "*Wind Forces in Engineering"*, Pergamon Press, New York, 1972.
4.	**Lawson T.V.,** *"Wind Effects on Building Vol. I and II",* Applied Science Publishers, London, 1980.

Adhiyamaan College of Engineering - Autonomous			R-2022
Department	Civil Engineering	Programme Code and Name	M.E.STRUCTURAL ENGINEERING

Semester-I

Course Code	Course Name	Hours/week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
122SEP04	**PREFABRICATED STRUCTURES**	3	0	0	3	50	50	100

OBJECTIVES	• To Study the design principles, analysis and design of prefabricated elements.

UNIT-1	**Design Principles**	**TOTAL HOURS**	**9 HOURS**

General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, Deflection control.

UNIT-2	**REINFORCED CONCRETE**	**TOTAL HOURS**	**9 HOURS**

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

UNIT-3	**FLOORS, STAIRS AND ROOFS**	**TOTAL HOURS**	**9 HOURS**

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

UNIT-4	**WALLS**	**TOTAL HOURS**	**9 HOURS**

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

UNIT-5	**INDUSTRIAL BUILDINGS AND SHELL ROOFS**	TOTAL HOURS	9 HOURS

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing. Cylindrical, Folded plate and paraboloid shells, Erection and jointing of components in industrial buildings.

TOTAL HOURS TO BE TAUGHT	**45**

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1	Explain the design principles involved in prefabrication
CO2	Detail the different types of connection
CO3	Design for stripping forces during manufacture
CO4	Determine the forces in shear walls
CO5	Identify the different roof trusses used in industrial buildings

REFERENCES:

1.	Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
2.	Koncz.T. Manual of Precast Concrete Construction, Vol.I II and III & IV Bauverlag, GMBH, 1971.
3.	Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, AkademiaiKiado, Budapest, 2007.
4.	Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, 1988.
5.	Structural Design manual, Precast concrete connection details, Society for studies in the use of Precast concrete, Netherland BetorVerlag, 2009

AUDIT COURSES

Adhiyamaan College of Engineering – Autonomous			R-2022	
Department	Civil Engineering	Programme Code and Name	M.E.STRUCTURAL ENGINEERING	
Semester-I				
	ENGLISH FOR RESEARCH PAPER WRITING			
OBJECTIVES	• Teach how to improve writing skills and level of readability • Tell about what to write in each section • Summarize the skills needed when writing a Title • Infer the skills needed when writing the Conclusion • Ensure the quality of paper at very first-time submission			
UNIT-1	**INTRODUCTION TO RESEARCH PAPER WRITING**		**TOTAL HOURS**	**6 HOURS**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness				
UNIT-2	**PRESENTATION SKILLS**		**TOTAL HOURS**	**6 HOURS**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check				
UNIT-3	**TITLE WRITING SKILLS**		**TOTAL HOURS**	**6 HOURS**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check				
UNIT-4	**RESULT WRITING SKILLS**		**TOTAL HOURS**	**6 HOURS**
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions				
UNIT-5	**VERIFICATION SKILLS**		TOTAL HOURS	6 HOURS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission.				
TOTAL HOURS TO BE TAUGHT				**30 HOURS**

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1	Understand that how to improve your writing skills and level of readability CO2 – Learn about what to write in each section
CO2	Understand the skills needed when writing a Title
CO3	Understand the skills needed when writing the Conclusion CO5 – Ensure the good quality of paper at very first-time submission
CO4	Understand that how to improve your writing skills and level of readability CO2 – Learn about what to write in each section
CO5	Understand the skills needed when writing a Title

REFERENCES:

1.	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2.	Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman’s book 1998.

<table>
<tr><td colspan="3">Adhiyamaan College of Engineering – Autonomous</td><td colspan="2">R-2022</td></tr>
<tr><td>Department</td><td>Civil Engineering</td><td>Programme Code and Name</td><td colspan="2">M.E.STRUCTURAL ENGINEERING</td></tr>
<tr><td colspan="5">Semester-I</td></tr>
<tr><td></td><td colspan="4">DISASTER MANAGEMENT</td></tr>
<tr><td>OBJECTIVES</td><td colspan="4">Summarize basics of disaster
Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
Develop the strengths and weaknesses of disaster management approaches</td></tr>
<tr><td>UNIT-1</td><td>INTRODUCTION</td><td>TOTAL HOURS</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="5">Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.</td></tr>
<tr><td>UNIT-2</td><td>REPERCUSSIONS OF DISASTERS AND HAZARDS</td><td>TOTAL HOURS</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="5">Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.</td></tr>
<tr><td>UNIT-3</td><td>DISASTER PRONE AREAS IN INDIA</td><td>TOTAL HOURS</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="5">Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics</td></tr>
<tr><td>UNIT-4</td><td>DISASTER PREPAREDNESS AND MANAGEMENT</td><td>TOTAL HOURS</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="5">Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness</td></tr>
<tr><td>UNIT-5</td><td>RISK ASSESSMENT</td><td>TOTAL HOURS</td><td colspan="2">6 HOURS</td></tr>
<tr><td colspan="5">Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival</td></tr>
<tr><td colspan="3">TOTAL HOURS TO BE TAUGHT</td><td colspan="2">30 HOURS</td></tr>
<tr><td colspan="5">COURSE OUTCOMES:</td></tr>
<tr><td colspan="5">After undergoing the course, the students will have ability to</td></tr>
<tr><td>CO1</td><td colspan="4">Ability to summarize basics of disaster</td></tr>
<tr><td>CO2</td><td colspan="4">Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.</td></tr>
<tr><td>CO3</td><td colspan="4">Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.</td></tr>
<tr><td>CO4</td><td colspan="4">Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.</td></tr>
<tr><td>CO5</td><td colspan="4">Ability to develop the strengths and weaknesses of disaster management approaches</td></tr>
<tr><td colspan="5">REFERENCES:</td></tr>
<tr><td>1.</td><td colspan="4">Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.</td></tr>
<tr><td>2.</td><td colspan="4">NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.</td></tr>
<tr><td>3.</td><td colspan="4">Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.</td></tr>
</table>

Adhiyamaan College of Engineering – Autonomous								R-2022
Department	Civil Engineering	Programme Code and Name				M.E.STRUCTURAL ENGINEERING		
Semester-I								
	CONSTITUTION OF INDIA	3	0	0	3	50	50	100

OBJECTIVES	Students will be able to: • Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. • To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism. • To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.		
UNIT-1	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION**	**TOTAL HOURS**	**9 HOURS**
History, Drafting Committee, (Composition & Working)			
UNIT-2	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**TOTAL HOURS**	**9 HOURS**
Preamble, Salient Features			
UNIT-3	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**TOTAL HOURS**	**9 HOURS**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.			
UNIT-4	**ORGANS OF GOVERNANCE**	**TOTAL HOURS**	**9 HOURS**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.			
UNIT-5	**LOCAL ADMINISTRATION**	**TOTAL HOURS**	**9 HOURS**
District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy			
UNIT VI	**ELECTION COMMISSION**	**TOTAL HOURS**	**9 HOURS**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.			
TOTAL HOURS TO BE TAUGHT			**30 HOURS**
COURSE OUTCOMES:			
After undergoing the course, the students will have ability to			

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4	Discuss the passage of the Hindu Code Bill of 1956
SUGGESTED READING :	
1.	The Constitution of India,1950(Bare Act),Government Publication.
2.	Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3.	M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4.	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

SEMESTER II

M.E. (STRUCTURAL ENGINEERING)

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	222SET01	Advanced Steel Structures	PCC	3	1	0	4
2	222SET02	Advanced Concrete Structures	PCC	3	1	0	4
3	222SET03	Finite Element Analysis in Structural Engineering	PCC	3	0	0	3
4	222SEE04	Professional Elective II	PEC	3	0	0	3
5	222SEE05	Professional Elective III	PEC	3	0	0	3
PRACTICALS							
7	222SEP07	Structural Design Studio	PCC	0	0	4	2
	TOTAL			15	2	6	21

No. of Credits: 21

SEMESTER-II, ELECTIVE - II

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	222SEE01	Advanced Concrete Technology	PEC	3	0	0	3
2	222SEE02	Advanced Prestressed Concrete	PEC	3	0	0	3
3	222SEE03	Reliability Analysis of Structures	PEC	3	0	0	3
4	222SEE04	Design of Formwork	PEC	3	0	0	3

SEMESTER-II, ELECTIVE - III

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	222SEE05	Maintenance, Repair and Rehabilitation of Structures	PEC	3	0	0	3
2	222SEE06	Mechanics of Fiber Reinforced Polymer Composite Materials	PEC	3	0	0	3
3	222SEE07	Design of Steel Concrete Composite Structures	PEC	3	0	0	3
4	222SEE08	Design of Masonry Structures	PEC	3	0	0	3

222SET01 **ADVANCED STEEL STRUCTURES** **L T P C**
3 1 0 4

OBJECTIVE:

- To study the behaviour of members and connections, analysis and design of Industrial buildings and to study the design of with cold formed steel and plastic analysis of structures.

UNIT I GENERAL **12**

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.

UNIT II DESIGN OF CONNECTIONS 12

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.

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 12

Structural Configurations - Functional and Serviceability Requirements- Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non-sway frames – Crane Gantry Girders - Aseismic design of steel buildings.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES 12

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement–Moment resisting connections. Design of Straight Corner Connections – Haunched Connections– Design of continuous beams.

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES 12

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: 60 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Design the steel members such as purlins, gable wind girders, base platessubjected to combined forces
CO2	Explain and design the different types of steel connections such as welded, boltedand moment resisting connections
CO3	Analyse and design the industrial structures such as trusses, portal framessubjected to seismic forces
CO4	Explain the effect of axial force and shear force on steel structures and analyse the continuous beams, frames using plastic theory
CO5	Evaluate the behaviour and design of compression and flexural members

REFERENCES:

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.
2. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry ofSteel Publishing, 2000.
3. Subramanian.N, Design of Steel Structures, Oxford University Press, 2016.
4. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996
5. S.K. Duggal ,Limit State Design of Steel Structures, McGraw Hill Book Company, 2

222SET02 **ADVANCED CONCRETE STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To make the students be familiar with behaviour of RCC beams and columns and to design special structural members with proper detailing

UNIT I BEHAVIOUR AND DESIGN OF R.C. BEAMS 12

Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure, shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

UNIT II BEHAVIOUR AND DESIGN OF R.C. COLUMNS 12

Behaviour of short and long columns - behaviour of short column under axial load with uniaxial andbi-axial moments - construction of P_u - M_u interaction curves - Design of slender columns -

UNIT III DESIGN OF SPECIAL R.C. ELEMENTS 12

Design of RC walls - design of corbels - strut and tie method - design of simply supported and continuous deep beams - analysis and design of grid floors.

UNIT IV FLAT SLABS AND YIELD LINE BASED DESIGN 12

Design of flat slabs according to IS method – Check for shear - Design of spandrel beams - Yield line theory and design of slabs - virtual work method - equilibrium method.

UNIT V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 12

Inelastic behaviour of concrete beams - Moment-curvature curves - moment redistribution - Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Explain structural behaviour of flexural members and columns
CO2	Design compression members and construct interaction diagrams
CO3	Design the special elements like corbels, deep beams and grid floors
CO4	Design flat slab and spandrel beams
CO5	Predict the moment curvature behavior and design and detail concrete elementsbased on ductility

REFERENCES:

1. Gambhir.M. L., “Design of Reinforced Concrete Structures”, Prentice Hall of India, 2012.
2. Purushothaman, P, “Reinforced Concrete Structural Elements: Behaviour Analysis andDesign”, Tata McGraw Hill, 1986
3. Unnikrishna Pillai and Devdas Menon “Reinforced Concrete Design’, Third Edition, TataMcGraw Hill Publishers Company Ltd., New Delhi, 2017.
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5. Sinha.S.N., Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd.2014

222SET03 **FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING** **L T P C**
3 0 03

OBJECTIVE:

- To make the students understand the basics of the Finite Element Technique, and to coverthe analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.

UNIT I INTRODUCTION 9

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity - Steps in FiniteElement Analysis - Finite Element Formulation Techniques - Virtual Work and Variational Principle - Galerkin Method - Finite Element Method: Displacement Approach - Stiffness Matrix and Boundary Conditions

UNIT II ELEMENT PROPERTIES 9

Natural Coordinates - Triangular Elements-Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two and Three Dimensional - Problems

UNIT III ANALYSIS OF FRAME STRUCTURES 9

Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysisof Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame

UNIT IV FEM FOR TWO AND THREE DIMENSIONAL SOLIDS 9

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements-Problems

UNIT V FEM FOR PLATES AND SHELL & APPLICATIONS OF FEM 9

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate - Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate -Introduction to Finite Strip Method-Finite Element Analysis of Shell - Finite Elements for Elastic Stability - Dynamic Analysis

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Formulate a finite element problem using basic mathematical principles
CO2	Explain the various types of elements and Select the appropriate element for modelling
CO3	Analyse a frame using truss element
CO4	Formulate and analyse two and three dimensional solid finite element problems
CO5	Analyse a shells, thick and thin plate and explain dynamic analysis in FEM

REFERENCES:

1. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill PublishingCompany Limited, New Delhi, 2005.
2. Logan D. L.,A First Course in the Finite Element Method, Thomson- Engineering, 3rdedition, 2001.
3. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Seventh Edition, McGraw **– Hill, 2013.**
4. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”,Fourth Edition, Prentice Hall of India, 2015.
5. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice HallInc., 1999.

222SEP06 **STRUCTURAL DESIGN STUDIO** **L T P C**

0 0 4 2

- To design a structure using modern software tools available like ETABS, STAAD, STRAP etc. and present it in the form of complete detail drawing
- Students have to work individually with standard codes, computational tools and software packages for analyzing, designing and detailing a structure.
- A detailed report on the work done shall be submitted by individual student in the form of a report and presentation.

TOTAL: 60 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Plan a layout of a structure
CO2	Calculate loads using IS codes and various computational tools
CO3	Analyze the structure for various loads and load combination according to the relevant IS codes
CO4	Design and detail structures using computer software/tools and check the correctness using manual approximate methods
CO5	Prepare the complete structural drawings using computer software

222SEE01 **ADVANCED CONCRETE TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVE:

- To study the properties of concrete making materials, tests, mix design, special concretesand various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS 9

Aggregates classification IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates. Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements. Water Chemical admixtures, Mineral admixture.

UNIT II MIX DESIGN 9

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Mix design for special concretes- changes in Mix design for special materials.

UNIT III CONCRETING METHODS 9

Process of manufacturing of concrete, methods of transportation, placing and curing, Extreme weather concreting, special concreting methods. Vacuum dewatering – Underwater Concrete

UNIT IV SPECIAL CONCRETES 9

Light weight concrete Fly ash concrete, Fiber reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete. High performance fiber reinforced concrete, Self- Compacting-Concrete, Geo Polymer Concrete, Waste material-based concrete – Ready mixed concrete.

UNIT V TESTS ON CONCRETE 9

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep andshrinkage – Durability of concrete. Non-destructive Testing Techniques microstructure of concrete

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1	Develop knowledge on various materials needed for concrete manufacture
CO2	Apply the rules to do mix designs for concrete by various methods
CO3	Develop the methods of manufacturing of concrete.
CO4	Explain about various special concrete
CO5	Explain various tests on fresh and hardened concrete

REFERENCES:

1. Gambhir.M.L. Concrete Technology, Fifth Edition, McGraw Hill Education, 2017.
2. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Shetty M.S., Concrete Technology, Revised Edition, S.Chand and Company Ltd. Delhi,2006.
5. Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015.

222SEE02 **ADVANCED PRESTRESSED CONCRETE** **L T P C**

3 0 0 3

OBJECTIVE:

- Principle of prestressing, analysis and design of prestressed concrete structures.

UNIT I PRINCIPLES OF PRESTRESSING 9

Basic concepts of Prestressing - Types and systems of prestressing - Need for High Strength materials, Analysis methods, losses of prestress – Short and Long term deflections – Cable layouts.

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design of flexural members, Design for shear, bond and torsion. Transfer of prestress – Box girders.

UNIT III DESIGN OF CONTINUOUS AND CANTILEVER BEAMS 9

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

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

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

UNIT V DESIGN OF COMPOSITE MEMBERS 9

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

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1	Identify the various methods of prestressing
CO2	Design the beams for shear, bond and torsion
CO3	Design the continuous beams
CO4	Design the water tank, piles and masts
CO5	Analyze and design the composite beams

REFERENCES:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York,2004.
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 6th Edition, 2018.
3. Lin.T.Y.and Burns.H “Design of Prestressed Concrete Structures”, John Wiley and SonsInc, 3rd Edition, 2010.
4. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2014.
5. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 1998.

222SEE03 **RELIABILITY ANALYSIS OF STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

To develop knowledge to solve structural analysis problems using reliability concepts.

UNIT I DATA ANALYSIS 9

Graphical representation Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form $y = ab^x$, and parabola, Coefficient of correlation

UNIT II PROBABILITY CONCEPTS 9

Random events-Sample space and events, Venn diagram and event space, Measures of probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem

UNIT III RANDOM VARIABLES 9

Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions

UNIT IV RELIABILITY ANALYSIS 9

Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method).

UNIT V SYSTEM RELIABILITY 9

Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers, random numbers with standard uniform distribution, continuous random variables, discrete random variables

TOTAL: 45 PERIODS

OUTCOME:

On completion of this course, the student is expected to be able to

CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of reliability.
CO3	Design and develop analytical skills.
CO4	Summarize the Probability distributions
CO5	Understands the concept of System reliability.

REFERENCES:

1. A Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, NewYork, 1993.
2. R E Melchers, Structural Reliability Analysis and Prediction, Third Edition, John Wiley &Sons Ltd, Chichester, England,2018.
3. O. Ditlevsen, H. O. Madsen, Structural Reliability Methods, Wiley, 1st Edition, 1996.
4. Srinivasan Chandrasekaran, Offshore Structural Engineering: Reliability and Risk Assessment, CRC Press, Florida, 2016.
5. Jack R Benjamin ,C. Allin Cornell, Probability, Statistics, and Decision for Civil Engineers ,Dover Publications, Newyork, 2014.

222SEE04 **DESIGN OF FORMWORK** **L T P C**
3 0 0 3

OBJECTIVE:

To study and understand the detailed planning of formwork , Design of forms for variouselements such as foundation, slabs, beams, columns and walls.

UNIT I INTRODUCTION 9

General objectives of formwork building - Development of a Basic System - Key Areas of costreduction - Requirements and Selection of Formwork.

UNIT II FORMWORK MATERIALS AND TYPES 9

Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete,

UNIT III FORMWORK DESIGN 9

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT IV FORMWORK DESIGN FOR SPECIAL STRUCTURES 9

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT V FORMWORK FAILURES 9

Formwork Management Issues – Pre- and Post-Award. Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi story Building Construction.

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1	Select proper formwork, accessories and material
CO2	Design the form work for Beams, Slabs, columns, Walls and Foundations
CO3	Design the form work for Special Structures
CO4	Describe the working of flying formwork.
CO5	Judge the formwork failures through case studies

REFERENCES:

1. Formwork for Concrete Structures, R. L. Peurifoy, McGraw Hill India, 2010.
2. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
4. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute,Detroit, 1996
5. Michael P. Hurst, Construction Press, London and New York, 2003.

222SEE05 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES **L T P C**
3 0 0 3

OBJECTIVE:

- To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures Facets of Maintenance, importance of Maintenance, routine and preventive maintenance, causes of deterioration. Non-destructive Testing Techniques

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete based on Strength and Durability - Thermal properties, microstructure of concrete – packing density- Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Health and safety precautions for handling and applications of repair materials, Special mortars and concretes- Polymer Concrete and Mortar, Quick setting compounds, Grouting materials-Gas forming grouts, Sulfoalumate grouts, Polymer grouts, Acrylate and Urethane grouts, Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets

UNIT IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING 9

Concrete protection methods – reinforcement protection methods- Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, cathodic protection, Structural health monitoring.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosiondamaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jacketing, Steel jacketing, FRP jacketing, Strengthening, Beam shear strengthening, Flexural strengthening

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Explain the importance of maintenance assessment of distressed structures
CO2	Apply the knowledge on Quality assurance for concrete based on Strength andDurability
CO3	Identify various repair materials and advancements in concrete
CO4	Explain the knowledge on Concrete protection methods Structural health monitoring
CO5	Select Various strengthening and repair methods for different cases

REFERENCES:

1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier,New Delhi 2012
2. DovKominetzky.M.S., - Design and Construction Failures, Galgotia Publications Pvt.Ltd.,2001
3. Ravishankar.K., Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, NarosaPublishers, 2008.
5. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General worksCPWD ,Govt of India , New Delhi – 2002

22SEE06 MECHANICS OF FIBER REINFORCED POLYMER COMPOSITE MATERIALS LT P C

3 0 0 3

OBJECTIVE:

To study the behaviour of composite materials and to investigate the failure and fracturecharacteristics.

UNITI INTRODUCTION 9

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites and Short Fiber Composites.

UNIT II STRESS STRAIN RELATIONS 9

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT III ANALYSIS OF LAMINATED COMPOSITES 9

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates – Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminar stresses.

UNIT IV FAILURE AND FRACTURE OF COMPOSITES 9

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT V APPLICATIONS AND DESIGN 9

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design withComposites, Review, Environmental Issues

TOTAL: 45 PERIODS

OUTCOME:

On completion of this course, the student is expected to be able to

CO1	Explain the various types of composites and its constituents
CO2	Derive the constitutive relationship and determine the stresses and strains ina composite material
CO3	Analyze a laminated plate
CO4	Explain the various failure criteria and fracture mechanics of composites
CO5	Design simple composite elements

REFERENCES

1. Agarwal.B.D. Broutman.L.J. and Chandrashekara.K. "Analysis and Performance of FiberComposites", Fourth Edition, John-Wiley and Sons, 2017
2. Daniel.I.M, and Ishai.O, "Engineering Mechanics of Composite Materials", Second Edition,Oxford University Press, 2005.
3. Hyer M.W., and White S.R., "Stress Analysis of Fiber-Reinforced Composite Materials",D.Estech Publications Inc., 2009
4. Jones R.M., "Mechanics of Composite Materials", Taylor and Francis Group 1999.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universities Press,India, 2005.

222SEE07 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES **L T P C**

3 0 0 3

OBJECTIVE:

To develop an understanding of the behaviour and design concrete composite elementsand structures.

UNIT I INTRODUCTION 9

Introduction to steel - concrete composite construction – Codes – Composite action –Serviceabilityand Construction issues in design.

UNIT II DESIGN OF COMPOSITE MEMBERS 9

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

UNIT III DESIGN OF CONNECTIONS 9

Shear connectors – Types – Design of connections in composite structures – Design of shearconnectors – Partial shear interaction.

UNIT IV COMPOSITE BOX GIRDER BRIDGES 9

Introduction - behaviour of box girder bridges - design concepts.

UNIT V CASE STUDIES 9

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

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1	Explain composite action
CO2	Design composite elements
CO3	Design connections
CO4	Explain the concept of design of composite box girder bridges
CO5	Study and evaluate case studies

REFERENCES:

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns andFrames for Buildings”, Vol.I, Fourth Edition, Blackwell Scientific Publications, 2018
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members,Fundamental behaviour”, Revised Edition, Pergamon press, Oxford, 2000.
3. Owens.G.W and Knowles.P, ”Steel Designers Manual”, Seventh Edition, Steel ConcreteInstitute(UK), Oxford Blackwell Scientific Publications, 2011.
4. Narayanan R, “Composite steel structures – Advances, design and construction”, Elsevier,Applied science, UK, 1987
5. Teaching resource for, “Structural Steel Design,” Volume 2 of 3, Institute for SteelDevelopment and Growth (INSDAG), 2002.

222SEE08 **DESIGN OF MASONRY STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

To design, detail and retrofit a masonry structure

UNIT I INTRODUCTION 9

Introduction - Masonry construction - National and International perspective - Historical development, Modern masonry, Material Properties - Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

UNIT II DESIGN OF COMPRESSION MEMBER 9

Principles of masonry design, Masonry standards: IS 1905 and others.- Masonry in Compression - Prism strength, Eccentric loading -Kern distance. Structural Wall, Columns and Plasters, RetainingWall, Pier and Foundation – Prestressed masonry

UNIT III DESIGN OF MASONRY UNDER LATERAL LOADS 9

Masonry under Lateral loads - In-plane and out-of-plane loads, Ductility of Reinforced Masonry Members Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms. Behaviour of Masonry - Shear and flexure - Combined bending and axial loads - Reinforced and unreinforced masonry -- Infill masonry

UNIT IV ASEISMIC DESIGN OF MASONRY STRUCTURES 9

Structural design of Masonry - Consideration of seismic loads - Cyclic loading and ductility of shear walls for seismic design -Code provisions- Working and Ultimate strength design - In-plane and out-of-plane design criteria for load-bearing and infills, connecting elements and ties. ModelingTechniques, Static Push Over Analysis and use of Capacity Design Spectra – use of Software.

UNIT V RETROFITTING OF MASONRY 9

Seismic evaluation and Retrofit of Masonry - In-situ and non-destructive tests for masonry - properties - Repair and strengthening of techniques.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Explain the properties of a masonry unit and the various components
CO2	Design a masonry structure for compression
CO3	Design a masonry structure for lateral loads
CO4	Design a earthquake resistant masonry wall
CO5	Suggest retrofitting techniques for existing masonry walls

REFERENCES:

1. Drysdale, R. G. Hamid, A. H. and Baker, L. R, “Masonry Structures: Behaviour &Design”,Prentice Hall Hendry, 1994.
2. A.W. Hendry, B.P. Sinha and Davis, S. R, “Design of Masonry Structures”, E & FN Spon,UK, 1997.
3. R.S. Schneider and W.L. Dickey, “Reinforced Masonry Design”, Prentice Hall, 3rd edition,1994.
4. Paulay, T. and Priestley, M. J. N., “Seismic Design of Reinforced Concrete and MasonryBuildings”, John Wiley, 1992.
5. A.W. Hendry, “Structural Masonry”, 2nd Edition, Palgrave McMillan Press, 1998.

SEMESTER-III

S.No.	Course Code	Course Title	Category	L	T	P	C
		THEORY					
1	322CET01	Professional Elective IV	PEC	3	0	0	3
2	322CET02	Professional Elective V	PEC	3	0	0	3
3	322CEE03	Open Elective	OEC	3	0	0	3
PRACTICALS							
7	322CEP04	Practical Training (4 weeks)	PC	0	0	4	2
8	322CEP05	Project Work I	PC	0	0	12	6
	TOTAL			9	0	12	17

SEMESTER-III, ELECTIVE - IV

S.No.	Course Code	Course Title	Category	L	T	P	C
		THEORY					
1	322CEE01	Design of Industrial Structures	PEC	3	0	0	3
2	322CEE02	Power plant Structures	PEC	3	0	0	3
3	322CEE03	Structural Stability	PEC	3	0	0	3
4	322CEE04	Structural Health Monitoring	PEC	3	0	0	3

SEMESTER-III, ELECTIVE - V

S.No.	Course Code	Course Title	Category	L	T	P	C
		THEORY					
1	322CEE05	Design of Offshore Structures	PEC	3	0	0	3
2	322CEE06	Performance of Structures with Soil Structure Interaction	PEC	3	0	0	3
3	322CEE07	Design of Bridge Structures	PEC	3	0	0	3
4	322CEE08	Design of Shell and Spatial Structures	PEC	3	0	0	3

SEMESTER-III, OPEN ELECTIVE

S.No.	Course Code	Course Title	Category	L	T	P	C
		THEORY					
1	322CEE09	Advanced Design of Foundation Structures	OEC	3	0	0	3
2	322CEE10	Smart Structures and Applications	OEC	3	0	0	3
3	322CEE11	Energy Efficient Structures	OEC	3	0	0	3
4	322CEE12	Structures in Disaster prone areas	OEC	3	0	0	3

322CEE01 **DESIGN OF INDUSTRIAL STRUCTURES** **L T P C**

3 0 0 3

OBJECTIVE:

- To disseminate knowledge about planning and design of RCC and Steel Industrial structures**.**
- To analyze and design Steel Gantry girders & Crane girders and RCC design of corbels,nibs and staircase
- To Analyze & design cooling towers, bunkers, silos and pipe supporting structures.
- To Analyze and design Steel transmission line towers and chimneys
- To design foundations for cooling tower, chimneys and turbo generator

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.

UNIT II INDUSTRIAL BUILDINGS 9

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

UNIT III POWER PLANT STRUCTURES 9

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

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

Foundation for Towers, Chimneys and Cooling Towers –Design of Block foundations for machines - Design of Turbo Generator Foundation.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Develop the concept of planning & functional requirements of industrial standards.
CO2	Analyse and design Steel Gantry girders & Crane girders and RCC design of corbels,nibs and staircase.
CO3	Analyse & design cooling towers, bunkers, silos and pipe supporting structures.
CO4	Analyse and design Steel transmission line towers and chimneys.
CO5	Design foundations for cooling tower, chimneys and turbo generator.

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings:A Design Manual, Birkhauser Publishers, 2004.
2. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
3. Swami saran, Analysis & Design of substructures, Limit state Design second Edition.2018.
4. N.Subramaniyan, Design of Steel Structures, United Press, 2018
5. N. Krishna Raju, Advanced Reinforced concrete Design, 3rd edition 2016,

318SEE07 POWER PLANT STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the students familiar with various planning and lay out of power plants
- To study the design of steel and concrete chimneys
- To be familiar with cooling towers
- To make the student to understand the design of machine foundations and turbo generator foundations
- To study the design of silos and bunkers

UNIT-1 Power Plants 9

Planning and Layout of different types of Power plants.

UNIT-2 Chimneys 9

Analysis and Design of Chimneys - IS codal provisions.

UNIT-3 Cooling Towers 9

Design of Induced draught and natural draught cooling towers.

UNIT-4 Foundations 9

Machine foundations and Turbo generator foundations.

UNIT-5 Material Handling Structures 9

Silos and Bunkers

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 The student will be able to formulate the planning and layout of different power plants.

CO.2 The student can analyse and design chimneys as per codal provisions

CO.3 The student will be efficient in design of cooling towers.

CO.4 The student may be familiar with all types of machine foundations. The students will be able to design all types of material handling systems.

CODE BOOKS:

1.IS: 456-2000 - Code of Practice for Plain and Reinforced Concrete.
2.IS 6533 (Part 2) -1989 - Code of practice for design and construction of steel chimneys.
3.IS: 875 (Part 1 to 5) - Code of Practice for Design loads.
4.IS:9178-1980 - Criteria for Design of Steel Bins for Storage of Bulk Materials
5.IS: 2974 (Part I toV) - Code of practice for design and construction of machine foundations.
6.IS 4995 (Part II) -1974 - General Requirements and assessment of bin Loads.
7.IS 6060 -1971 - Code of practice for Day lighting of factory buildings.

REFERENCES:

1.Krishna Raju N. "Advanced Reinforced Concrete Design", CBS Publishers and Distributors, 2nd Edition, 2008.

2. Srinivasulu, P and Vaidyanathan, G.V., "Handbook of Machine Foundations", Tata McGraw Hill, 2nd Edition, 2009.

3.Vijay K. Puri and ShamsherPrakash, "Foundations for Machines: Analysis and Design (Series in Geotechnical Engineering)", John Wiley & Sons, 2nd Edition, 2000.

4.Eldey Mc. K., Naxey Brooke K.K. "The Industrial Cooling Tower with special reference to design, construction, operation and maintenance of water cooling tower", Elsevier Publishing company, 1st Ed., 2000.

222CEE03 | **STRUCTURAL STABILITY** | **L T P C 3 0 0 3**

OBJECTIVES:

- To study the concept of buckling and analysis of structural elements
- To Estimate the buckling load of beam – columns and frames
- To Explore the concepts of torsional and lateral buckling of thin walled members
- To explain the phenomenon of buckling of plates
- To Analyze the inelastic buckling of columns and plates

UNIT I BUCKLING OF COLUMNS 9

States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method.

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.

UNIT III TORSIONAL AND LATERAL BUCKLING 9

Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES 9

Governing differential equation - Buckling of thin plates with 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.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1	Explain the phenomenon of buckling of columns and calculate the buckling load on column by various approaches
CO2	Estimate the buckling load of beam – columns and frames
CO3	Explore the concepts of torsional and lateral buckling of thin walled members
CO4	Explain the phenomenon of buckling of plates
CO5	Analyze the inelastic buckling of columns and plates

REFERENCES:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
3. Gambhir.M.L, "Stability Analysis and Design of Structures", springer, New York, 2013.
4. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
5. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", Dover Publication, 2012.

322CEE04 **STRUCTURAL HEALTH MONITORING** **L T P C**

3 0 0 3

OBJECTIVE:

- To Understand the need, advantages and challenges of SHM
- To Know the different types of sensors and instrumentation techniques
- To Gain knowledge of the static and dynamic measurement techniques
- To Compare the various damage detection techniques
- To Know the various data processing methods through case studies

UNIT I INTRODUCTION TO STRUCTURAL HEALTH MONITORIN 9 HOURS

Need for SHM, Structural Health Monitoring versus Non-Destructive Evaluation, Methods of SHM-Local & Global Techniques for SHM, Short & Long-Term Monitoring, Active & Passive Monitoring, Remote Structural Health Monitoring- Advantages of SHM - Challenges in SHM

UNIT II SENSORS AND INSTRUMENTATION FOR SHM 9 HOURS

Sensors for measurements: Electrical Resistance Strain Gages, Vibrating Wire Strain Gauges, Fibre Optic Sensors, Temperature Sensors, Accelerometers, Displacement Transducers, Load Cells, Humidity Sensors, Crack Propagation Measuring Sensors, Corrosion Monitoring Sensors, Pressure Sensors, Data Acquisition – Data Transmission - Data Processing – Storage of processed data - Knowledgeable information processing

UNIT III STATIC AND DYNAMIC MEASUREMENT TECHNIQUES FOR SHM 9 HOURS

Static measurement - Load test, Concrete core trepanning, Flat jack techniques, Static response measurement, Dynamic measurement -Vibration based testing- Ambient Excitation methods, Measured forced Vibration-Impact excitation, step relaxation test, shaker excitation method.

UNIT IV DAMAGE DETECTION 9 HOURS

Damage Diagnostic methods based on vibrational response- Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivitymethod, Baseline-free method, Cross-correlation method, Damage Diagnostic methods based on wave propagation Methods-Bulk waves/Lamb waves, Reflection and transmission, Wave tuning/mode selectivity, Migration imaging, Phase array imaging, Focusing array/SAFT imaging

UNIT V DATA PROCESSING AND CASE STUDIES 9 HOURS

Advanced signal processing methods -Wavelet, Hilbert-Huang transform, Neural networks, Support Vector Machine Principal component analysis, Outlier analysis. Applications of SHM on bridges and buildings, case studies of SHM in Civil/ Structural engineering.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1	Understand the need, advantages and challenges of SHM
CO2	Know the different types of sensors and instrumentation techniques
CO3	Gain knowledge of the static and dynamic measurement techniques
CO4	Compare the various damage detection techniques
CO5	Know the various data processing methods through case studies

REFERENCES:

1. Daniel Balageas, Peter Fritzen, Alfredo Guemes, Structural Health Monitoring, John Wiley & Sons,2006.
2. Douglas E Adams, Health Monitoring of Structural Materials and Components Methods with Applications, Wiley Publishers, 2007
3. Hua-Peng Chen, Structural Health Monitoring of Large Civil Engineering Structures, Wiley Publishers, 2018
4. Ansari, F Karbhari, Structural health monitoring of civil infrastructure systems, V.M,WoodheadPublishing, 2009
5. J. P. Ou, H. Li and Z. D, "Duan Structural Health Monitoring and Intelligent Infrastructure", Vol1, Taylor and Francis Group, London, UK, 2006.
6. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 2007.

322CEE05 **DESIGN OF OFFSHORE STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To impart knowledge about the concept of wave theories, forces, offshore foundation, analysis and design of jacket towers, pipes and cables**.**
- To Apply the knowledge of wave forces and offshore structures.
- To Explain the modeling for offshore structure and its foundation.
- To Analyze offshore structures by means of static and dynamic methods.
- To Design of jacket towers, mooring cables and pipelines.

UNIT I WAVE THEORIES 9

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES 9

Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING 9

Different types of offshore structures, foundation modelling, fixed jacket platform structural modelling.

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 9

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

UNIT V DESIGN OF OFFSHORE STRUCTURES 9

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Develop the concept of wave theories
CO2	Apply the knowledge of wave forces and offshore structures
CO3	Explain the modeling for offshore structure and its foundation
CO4	Analyze offshore structures by means of static and dynamic methods
CO5	Design of jacket towers, mooring cables and pipelines

REFERENCES:

1. Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
2. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, Springer – Verlag, 2003.
3. Chakrabarti, S.K. 1994, Offshore Structure Modelling: World Scientific
4. Chandrasekaran, S. 2017. Dynamic analysis and design of ocean structures.
5. B. Gou, S.Song, J Chacko and A. Ghalambar, offshore pipelines, GPP publishers, 2006.

322CEE06 PERFORMANCE OF STRUCTURES WITH SOIL STRUCTURE INTERACTION **L T P C**
3 0 0 3

OBJECTIVES:

- To study the concept of soil-structure – interaction in the analysis and design of structures.
- To Do a static analysis of infinite and finite beams resting on elastic foundation
- To Analyze finite thin and thick plates
- To do a static and dynamic analysis of soil structure interaction problems
- To Analyze ground foundation and structure interaction problems.

UNIT I SOIL-FOUNDATION INTERACTION 9

Introduction to soil-foundation interaction problems – Soil behaviour – Foundation behaviour-Interface behaviour- Scope of soil foundation interaction analysis- soil response models–Elastic continuum- Two parameter elastic models- Elastic-plastic behaviour- Time dependent behaviour.

UNIT II BEAM ON ELASTIC FOUNDATION- SOIL MODELS 9

Infinite beam – Two-parameters models – Isotropic elastic half space model – Analysis of beams of finite length – combined footings.

UNITIII PLATES ON ELASTIC CONTINUUM 9

Thin and thick rafts – Analysis of finite plates - Numerical analysis of finite plates.

UNIT IV ANALYSIS OF AXIALLY AND LATERALLY LOADED PILES AND PILE GROUPS 9

Elastic analysis of single pile – Theoretical solutions for settlement and load distributions – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap – Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile-raft system.

UNIT V GROUND-FOUNDATION-STRUCTURE INTERACTION 9

Effect of structure on ground-foundation interaction – Static and dynamic loads- Contact pressure and its estimation – Estimation of the settlement from the constitutive laws – Free-field response – Kinetic interaction – Inertial interaction

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Explain the concept of soil structure interaction.
CO2	Do a static analysis of infinite and finite beams resting on elastic foundation
CO3	Analyze finite thin and thick plates
CO4	Do a static and dynamic analysis of soil structure interaction problems
CO5	Analyze ground foundation and structure interaction problems

REFERENCES:

1. John P. Wolf, (1985) Soil-structure interaction, Prentice Hall, 1987.
2. Bowels, J.E., “Analytical and Computer methods in Foundation” McGraw Hill Book Co., New York., 1974
3. Desai C.S. and Christian J.T., “Numerical Methods in Geotechnical Engineering” McGrawHill Book Co. New York,1977.
4. Soil Structure Interaction, the real behaviour of structures, Institution of Structural

Engineers,1989.
5. A.P.S. Selvadurai, Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co., 1979.
6. Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice."John Wiley & Sons, New York, 1990.
7. Rolando P. Orense, Nawawi Chouw& Michael J. Pender – Soil-Foundation-Structure Interaction, CRC Press, Taylor & Francis Group, London, UK, 2010.

322CEE07 **DESIGN OF BRIDGE STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the loads, forces on bridges and design principles of several types of bridges.
- To Design an RC solid slab culvert bridge
- To Design an RC Tee Beam and Slab bridge
- To Design the bridge bearings and substructure
- To Explain the design principles of PSC bridges, box girder bridges, truss bridges

UNIT I **INTRODUCTION** **9**

Introduction-Selection of Site and Initial Decision Process - Classification of Bridges- General Features of Design- Standard Loading for Bridge Design as per different codes - Road Bridges – Railway Bridges - Design Codes - Working Stress Method- Limit State Method of Design

UNIT II **SUPERSTRUCTURES** **9**

Selection of main bridge parameters, design methodologies -Choices of superstructure types - Orthotropic plate theory, load distribution techniques - Grillage analysis - Finite element analysis Different types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge - Transverse Analysis of Bridge

UNIT III **BRIDGE DESIGN PRINCIPLES** **9**

Analysis and Design of RCC solid slab culverts -Design of RCC Tee beam and slab bridges - Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges–Design principles only

UNIT IV **SUBSTRUCTURE, BEARINGS AND DECK JOINTS** **9**

Design of bridge bearings and substructure

UNIT V **PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES** **9**

Design principles of PSC bridges – PSC girders –Design principles of steel bridges - Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, student will be able to

CO1	Explain the different types of bridges and design philosophies
CO2	Design an RC solid slab culvert bridge
CO3	Design an RC Tee Beam and Slab bridge
CO4	Design the bridge bearings and substructure
CO5	Explain the design principles of PSC bridges, box girder bridges, truss bridges

REFERENCES:

1. Jagadeesh. T.R. and Jayaram. M.A., “Design of Bridge Structures”, Second Edition, PrenticeHall of India Pvt. Ltd. 2009.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Sixth Edition, Oxford and IBHPublishing Co. New Delhi, 2019.
3. Ponnuswamy, S., “Bridge Engineering”, Third Edition, Tata McGraw Hill, 2017.
4. Raina V.K.” Concrete Bridge Practice” Tata McGraw Hill Publishing Company, NewDelhi,2014.
5. Design of Highway Bridges, Richard M. Barker & Jay A. Puckett, John Wiley & Sons, Inc.,2021

322CEE08 DESIGN OF SHELL AND SPATIAL STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the behavior and design of shells, folded plates, space frames and application of FORMIAN software.
- To Evaluate the structural behavior and design of folded plate structures
- To know the various functional configurations of space frames
- To understand the Design of space frames and apply the knowledge of CAD for the analysis of spacestructures
- To Analyse the configurations of space structures using FORMIAN software

UNITI CLASSIFICATION OF SHELLS 9

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

UNIT II FOLDED PLATES 9

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

UNIT III INTRODUCTION TO SPACE FRAME 9

Space frames - configuration - types of nodes - Design Philosophy - Behaviour.

UNIT IV ANALYSIS AND DESIGN 9

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to Computer-Aided Design.

UNIT V SPECIAL METHODS 9

Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1	Explain the different forms of shells and design the domes and shells
CO2	Evaluate the structural behavior and design of folded plate structures
CO3	Explain the various functional configurations of space frames
CO4	Design of space frames and apply the knowledge of CAD for the analysis of space structures
CO5	Analyse the configurations of space structures using FORMIAN software

REFERENCES:

1. Billington. D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, ASCEManual No.31, Design of Cylindrical Shells,1982.
2. Varghese. P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt.Ltd., 2010.
3. Subramanian. N,” Space Structures: Principles and Practice”, Multi-Science Publishing Co.Ltd. 2008.
4. Ramasamy, G.S., “Analysis, Design and Construction of Steel Space Frames”, ThomasTelford Publishing, 2002.
5. Wilby. C “Concrete Folded Plate Roofs”, Elsevier, 1998.

322CEE09 ADVANCED DESIGN OF FOUNDATION STRUCTURES **L T P C**
3 0 0 3

OBJECTIVE:

- To design various types of foundations to fulfill the required criteria.
- To Design piles and pile caps
- To Design well foundation for bridge piers and related structures
- To Gain knowledge on design and construction of machine foundation
- To Design foundations for bridges, towers and chimneys

UNIT I SHALLOW FOUNDATIONS 9

soil investigation – Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates – structural design of isolated, strip, rectangular and trapezoidal and combined footings – strap – raft foundation.

UNIT II PILE FOUNDATIONS 9

Types of Pile foundations and their applications – Load Carrying capacity – pile load test – Settlements – Group action – pile cap – structural design of piles and pile caps – undreamed pile foundation.

UNIT III WELL FOUNDATION 9

Types of well foundations – grip length – load carrying capacity – construction of wells – failure and remedies – structural design of well foundation – lateral stability.

UNIT IV MACHINE FOUNDATIONS 9

Types – General requirements and design criteria – General analysis of machine foundations-soil system – Stiffness and damping parameters – Tests for design parameters – design of foundation for reciprocating engines, impact type machines and rotary type machines.

UNIT V SPECIAL FOUNDATIONS 9

General requirements and design criteria – Foundations for towers, Chimneys and Silos – designof anchors

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course student will be able to

CO1	Design shallow and deep foundations for various types of structures
CO2	Design piles and pile caps
CO3	Design well foundation for bridge piers and related structures
CO4	Gain knowledge on design and construction of machine foundation
CO5	Design foundations for bridges, towers and chimneys

REFERENCES:

1. Tomlinson, M.J. and Boorman. R., Foundation Design and Construction, ELBS Longman, Seventh Edition, 2001.
2. Nayak, N.V., Foundation Design manual for Practicing Engineers, Dhanpat Rai and Sons, 2018.
3. Brain J. Bell and M.J. Smith, Reinforced Concrete Foundations, George Godwin Ltd., 1981.
4. Braja M. Das, Principles of Foundations Engineering, Eighth Edition, Thomson Asia (P) Ltd., 2017.
5. Bowels J.E., Foundation Analysis and Design, Fifth Edition, McGraw-Hill International Book Co., 2017.

322SEE10 SMART STRUCTURES AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe the basic principles and mechanisms of smart materials and devices
- To study about the components of smart systems
- To study about the materials used in smart construction
- To know about the control systems and its features
- To study about sensors in smart structures

UNIT-1 Introduction to passive and active systems 9

Introduction to passive and active systems – need for active systems – smart systems –definitions and implications - active control and adaptive control systems – examples.

UNIT-2 Components of smart systems 9

Components of smart systems– system features and interpretation of sensor data – proactive and reactive systems – demo example in component level – system level complexity

UNIT-3 Materials used in smart systems 9s

Smart Materials (Physical Properties) piezoelectric materials, materials, magnetostrictive electrostrictive materials, magneto electric materials. magneto rheological fluids, electrorheological fluids, shape memory materials, fiber-optic sensors.

UNIT-4 Control Systems 9

Control Systems – features – active systems – adaptive systems – electronic, thermal and hydraulic type actuators – characteristics of control systems – application examples.

UNIT-5 Sensors in smart structures 9

Smart Sensor, Actuator and Transducer Technologies smart sensors: accelerometers; force sensors; load cells; torque sensors; pressure sensors; microphones; impact hammers; mems sensors; sensor arrays smart actuators: displacement actuators; force actuators; power actuators; vibration dampers; shakers; fluidic pumps; motors smart transducers: ultrasonic transducers; sonic transducers; air transducers.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To understand active and passive systems
CO2: To know the components of smart systems and its features
CO3: To know the materials used in smart system and its physical properties
CO4: To know about the types of actuators and the characteristics of control system
CO5: To know about the sensors used in smart structures

REFERENCES:

1.Srinivasan, A.V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University Press, 2000.
2.Yoseph Bar Cohen, Smart Structures and Materials 2003, The International Society for Optical Engineering 2003.
3.Brian Culshaw, Smart Structures and Materials, Artech House, Boston, 2006.
4.M.V.Gandhi and B.S.thompson, Smart Materials and Structures, Chapman and Hall 2002.

318SEE11 ENERGY EFFICIENT STRUCTURES **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the concepts of energy efficient building
- To study the different climate types and their influence in building design
- To study the thermal environment of structures
- To study the principles of solar heating and cooling systems
- To study the energy survey and energy audit in buildings

UNIT-1 Concepts Of Energy Efficient Building 9
Need of energy in buildings - assessment - Energy consumption pattern of various types of buildings - Factors influencing the energy use in building - Concepts of energy efficient building.

UNIT-2 Influence of Climate 9
Study of Climate types - their influence in building design - Environmental factors affecting building design - Analysis of thermal and visual environment.

UNIT-3 Influence of Heat and Light 9
Heat gain and loss phenomenon in buildings - Thermal performance parameters - Role of building enclosures, openings and materials in thermal environment - Basic principles of light and daylight - Energy efficient light design of buildings - Daylight design of buildings.

UNIT-4 Appliances in Buildings 9
Major appliances in building and their energy consumptions - Principles of solar heating, cooling and power (PV) systems - Integration of energy efficient appliances with the buildings.

UNIT-5 Energy Audit 9
Energy survey and energy audit of buildings - Calculation of energy inputs and utilization in buildings – Energy audit reports of buildings - Concepts of Green Buildings - energy rating of buildings.

TOTAL:45PERIODS

COURSE OUTCOMES:
After undergoing the course, the students will have ability to
CO1: To understand the concepts of energy efficient building
CO2: To understand te influence of climate and environmental factors affecting building design
CO3: To gain knowledge on design of buildings according to thermal environment
CO4: To acquire the skills of utilisation of appliances and the principles
CO5: To obtain the knowledge of energy audit in buildings.

CODE BOOKS:
1.'Handbook on functional requirements of buildings', Parts 1-4, SP: 41 (S&T), Bureau of Indian Standards – 1995.
REFERENCES:
1.Chand, I. and Bhargava, P.K., "The Climatic Data Handbook", Tata McGraw Hill Publishing Company Limited, New Delhi 1999.
2. Threlkeld, J.L,"Thermal Environmental Engineering", Printice-Hall, Englewood Cliffs, NJ,
3.LalJayamaha, "Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance", McGraw Hill, 2007.
4.Krishnan, A., Baker, N., Yannas, S. and Szokolay, S.V., "Climate Responsive Architecture – A Design Hand Book for Energy Efficient Buildings", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2001.

318SEE12 STRUCTURES IN DISASTER PRONE AREAS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand various types of disasters
- To study the philosophy for design to resist earthquake
- To study the seismic vulnerability of urban areas
- To use modern materials and techniques in disaster reduction
- To study the various stages of disaster management

UNIT-1 Introduction 9

Introduction - Types of disasters - Disaster mitigating agencies and their organization structure at different levels - Overview of disaster situations in India - Vulnerability profile of India and vulnerability mapping including disaster prone areas, communities and places.

UNIT-2 Response of the Structure 9

Philosophy for design to resist Earthquake, Cyclone and flood –Bye-laws of urban and Semi-Urban areas- Traditional and modern structures. Response of dams, bridges, buildings - Testing and evaluation – Classification of structures from safety point of view - Methods of strengthening for different disasters – Qualification test.

UNIT-3 Seismic Vulnerability of Urban Areas 9

Seismic response of R.C frames buildings with soft first storey - Preparedness and planning for an urban earthquake disaster - Tsunami and its impact - Urban settlements.

UNIT-4 Modern Materials and Techniques 9

Use of modern materials their impact on disaster reduction – Use of modern analysis, design and construction techniques - Optimization for performance - Damage surveys – Maintenance and modifications to improve hazard resistance – Different types of foundation and its impact on safety.

UNIT-5 Disaster Management 9

Landslide hazards zonation mapping - Geo-environmental problems associates with the occurrence of landslides - Role of remote sensing, science and technology - Rehabilitation programmes - Management of Relief Camp - information systems and decision making tools, voluntary agencies and community participation - various stages of disaster Management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 To overview different disaster situations,

CO2: To understand various types of disasters

CO3: To be prepared and planned in earthquake disaster and Tsunami

CO4: To use modern materials for disaster risk reduction

CO5: To know about the geo-environmental problems associated with the occurrence of landslides

CODE BOOKS:

1. IS 1893: 2002 (Part 1) - Criteria for Earthquake Resistant Design of Structures – General.
2. IS 4326: 1993 - Code of Practice for Earthquake Resistant Design and Construction of Buildings.

REFERENCES:

1. Allen, R.T. and Edwards, S.C., “Repair of Concrete Structures”, Blakie and Sons, 2005.
2. Moskvin V, “Concrete and Reinforced Structures – Deterioration and Protection”, MirPublishers, Moscow,03
3. Singh R.B, “Disaster Management”, Rawat Publications, 2000.
4. Jon Ingleton, Tulor Rose, “Natural Disaster management”, 1999.
5. Sachindra Narayan, “Anthropology of Disaster management”, Gyan Publishing house.