NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 - 225585

Curriculum and Syllabus
for
M.E. – STRUCTURAL ENGINEERING [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year (2022-2023) onwards)

AUGUST 2022

INSTITUTE VISION AND MISSION	
VISION	•To be an Institute of excellence providing quality Engineering, Technology and Management education to meet the ever changing needs of the society.
MISSION	•To provide quality education to produce ethical and competent professionals with social Responsibility •To excel in the thrust areas of Engineering, Technology and Entrepreneurship by solving real-world problems. •To create a learner centric environment and improve continually to meet the changing global needs.

M.E. – STRUCTURAL ENGINEERING	
VISION	• To foster academic excellence by imparting knowledge in civil engineering and allied disciplines to meet the ever growing needs of the society.
MISSION	Post graduate programme in Structural Engineering is committed: • To impart quality education to produce professionals with social responsibility. • To excel in the thrust areas of civil and allied engineering to solve real world problems. • To create a learner centric environment with continual progress to meet the global engineering needs.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	Post graduate of Structural Engineering programme will be **PEO1: Core Competency:** Successful consultants in structural engineering and solve complex real life issues related to analysis, design and maintenance of structures under various environmental conditions by performing quality research. **PEO2: Ethics, Human values and Entrepreneurship:** Professionals with good communication, leadership, ethics and social responsibility and formulate solutions those are technically sound, economically feasible and socially acceptable. **PEO3: Research, Innovation and Life-long Learning :** Knowledgeable and skilled in structural engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations and adapt to evolving technologies through life-long learning and innovation.
PROGRAMME SPECIFIC OUTCOMES (PSO)	At the end of this program, the students will be able to • Critically analyze multifaceted structural engineering problems, apply independent judgment for creating information and make innovative advances in a theoretical, practical and policy context. • Evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions for structural engineering problems, with due consideration of health, safety, and socio cultural factors.

PROGRAM OUTCOMES:

At the end of a programme the students will be able to

a-f	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
a	Research aptitude	PO1	Independently carry out research, investigation and development work to solve practical problems.
b	Technical documentation	PO2	Write and present a substantial technical report and document.
c	Technical competence	PO3	Demonstrate a degree of mastery over the areas of structural analysis and design, aseismic, retrofitting, composite structures as per the specialization of the program.
d	Engineering Design	PO4	Analyze a system, component or process in the areas of structural engineering using classical methods and advanced tools.
e	The engineer and society	PO5	Design a system, component or process in the areas of structural engineering as per codal recommendations.
f	Environment and sustainability	PO6	Apply appropriate managerial and technical skills in the domain of structural design incorporating safety and sustainability to become a successful professional / entrepreneur through lifelong learning.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme educational objectives and the programme outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	A	B	C	D	E	F
1	2		3	3	3	3
2		3	3	3	3	3
3	3	2	3	3	3	3

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific outcomes and the programme outcomes is given in the following table

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES					
	A	**B**	**C**	**D**	**E**	**F**
1	2		3	3	3	3
2		2	3	3	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

SEMESTER: I									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22STA01	Advanced Mathematics for Structural Engineering	FC	NIL	3	3	0	0	3
2	22STB01	Design of Advanced Reinforced Concrete Structural Systems	PCC	NIL	4	3	1	0	4
3	22STB02	Structural Dynamics and Earthquake Engineering	PCC	NIL	3	3	0	0	3
4	22STB03	Advanced Concrete Technology	PCC	NIL	3	3	0	0	3
5	E1	Elective I	PEC	NIL	3	3	0	0	3
PRACTICAL									
6	22STP01	Advanced Structural Engineering Laboratory	PCC	NIL	4	0	0	4	2
Mandatory Non Credit Courses									
7	A1	Audit Course	EEC	Ref. AC	2	2	0	0	0
				TOTAL	**22**	**17**	**1**	**4**	**18**

SEMESTER: II									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22STB04	Theory of Elasticity and Plasticity	PCC	NIL	4	3	1	0	4
2	22STB05	Advanced Design of Steel Structures	PCC	NIL	4	3	1	0	4
3	22STB06	Finite Element Analysis in Structural Engineering	PCC	NIL	4	3	1	0	4
4	22STB07	Design of Substructures	PCC	NIL	3	3	0	0	3
5	E2	Elective II	PEC	NIL	3	3	0	0	3
6	E3	Elective III	PEC / OEC	Ref. PEC/OEC	3	3	0	0	3
PRACTICAL									
7	22STP02	Advanced Computer Aided Structural Analysis Laboratory	PCC	NIL	4	0	0	4	2
				TOTAL	**25**	**18**	**3**	**4**	**23**

SEMESTER: III									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	E4	Elective IV	PEC	Ref. PEC	3	3	0	0	3
2	E5	Elective V	PEC	Ref. PEC	3	3	0	0	3
3	E6	Elective VI	PEC	Ref. PEC	3	3	0	0	3
PRACTICAL									
4	22STE01	Practical Training (4 weeks)	EEC	NIL	0	0	0	0	2
5	22STE02	Project Work (Phase - I)	EEC	NIL	12	0	0	12	6
				TOTAL	**21**	**9**	**0**	**12**	**17**

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
PRACTICAL									
1	22STE03	Project Work (Phase - II)	EEC	22STE02	24	0	0	24	12
				TOTAL	**24**	**0**	**0**	**24**	**12**

Total Credits: 18 + 23 + 17 + 12 = 70

(A) FC,PC, PE,OE, and EEC Courses

(a) Foundation Courses (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22STA01	Advanced Mathematics for Structural Engineering	FC	NIL	3	3	0	0	3

(b) Professional Core Courses(PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22STB01	Design of Advanced Reinforced Concrete Structural Systems	PCC	NIL	4	3	1	0	4
2.	22STB02	Structural Dynamics and Earthquake Engineering	PCC	NIL	3	3	0	0	3
3.	22STB03	Advanced Concrete Technology	FCC	NIL	3	3	0	0	3
4.	22STB04	Theory of Elasticity and Plasticity	PCC	NIL	4	3	1	0	4
5.	22STB05	Advanced Design of Steel Structures	PCC	NIL	4	3	1	0	4
6.	22STB06	Finite Element Analysis in Structural Engineering	PCC	NIL	4	3	1	0	4
7.	22STB07	Design of Substructures	PCC	NIL	3	3	0	0	3
8.	22STP01	Advanced Structural Engineering Laboratory	PCC	NIL	4	0	0	4	2
9.	22STP02	Advanced Computer Aided Structural Analysis Laboratory	PCC	NIL	4	0	0	4	2

(c) Professional Electives Courses (PEC)									
S.NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUI SITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	22STX01	Optimization of Structures	PEC	NIL	3	3	0	0	3
2.	22STX02	Experimental Techniques and Analysis	PEC	NIL	3	3	0	0	3
3.	22STX03	Soil - Structure Interaction	PEC	NIL	3	3	0	0	3
4.	22STX04	Prefabricated Structures	PEC	NIL	3	3	0	0	3
5.	22STX05	Design of Tall Structures	PEC	NIL	3	3	0	0	3
6.	22STX06	Design of Plates and Shells	PEC	NIL	3	3	0	0	3
7.	22STX07	Structural Stability	PEC	NIL	3	3	0	0	3
8.	22STX08	Design of Industrial Structures	PEC	NIL	3	3	0	0	3
9.	22STX09	Maintenance and Rehabilitation of Structures	PEC	NIL	3	3	0	0	3
10.	22STX10	Design of Off Shore Structural Elements	PEC	NIL	3	3	0	0	3
11.	22STX11	Wind and Cyclone Effects on Structures	PEC	NIL	3	3	0	0	3
12.	22STX12	Design of Bridges	PEC	NIL	3	3	0	0	3
13.	22STX13	Mechanics of Composite Materials	PEC	NIL	3	3	0	0	3
14.	22STX14	Non-Linear Analysis of Structures	PEC	NIL	3	3	0	0	3
15.	22STX15	Design of Prestressed Concrete Structural Elements	PEC	NIL	3	3	0	0	3
16.	22STX16	Energy Efficient Buildings	PEC	NIL	3	3	0	0	3
17.	22STX17	Structural Health Monitoring	PEC	NIL	3	3	0	0	3
18.	22STX18	Fire Resistant Design of Structures	PEC	NIL	3	3	0	0	3
19.	22STX19	Design of Formwork	PEC	NIL	3	3	0	0	3
20.	22STX20	Green Building Management	PEC	NIL	3	3	0	0	3
21.	22STX21	Risk and Reliability of Structures	PEC	NIL	3	3	0	0	3
22.	22STX22	Design of Steel Concrete Composite Structures	PEC	NIL	3	3	0	0	3

(d)Open Elective Courses (OEC)									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	22BAZ01	Research Methodology and IPR	OEC	NIL	3	3	0	0	3

(e)Employability Enhancement Courses (EEC)									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	Ref. AC	Audit Course	EEC	NIL	2	2	0	0	0
2.	22STE01	Practical Training (4 weeks)	EEC	NIL	0	0	0	0	2
3.	22STE02	Project Work (Phase - I)	EEC	NIL	12	0	0	12	6
4.	22STE03	Project Work (Phase - II)	EEC	22STE02	24	0	0	24	12

(f) Audit Courses (AC)									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	22PGA01	English for Research Paper Writing	EEC	NIL	2	2	0	0	0
2.	22PGA02	Disaster Management	EEC	NIL	2	2	0	0	0
3.	22PGA03	Constitution of India	EEC	NIL	2	2	0	0	0

SUMMARY						
S.No.	SUBJECT AREA	CREDITS AS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1	FC	3				3
2	PCC	12	17			29
3	PEC	3	6	6		15
4	OEC			3		3
5	EEC			8	12	20
TOTAL CREDITS		18	23	17	12	70

22STA01- ADVANCED MATHEMATICS FOR STRUCTURAL ENGINEERING					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To acquire knowledge on random variable and moments & moments generating functions	**1.1**	The students will be able to infer expectation, variance, standard deviation moments and moment generating function for discrete and continuous random variables.		
2.0	To gain knowledge on calculus of variance.	**2.1**	The students will be able to solve problems involving functional, that occurs in various branches of engineering disciplines.		
3.0	To comprehend the concepts of parameter estimation.	**3.1**	The students will be able to use a sample data to compute point estimate.		
4.0	To evaluate mathematical expressions to compute quantities that deal with linear systems and eigenvalue problems	**4.1**	The students will be able to understand the concept of eigen value problems		
5.0	To introduce numerical solution methods for solving partial differential equations	**5.1**	The students will be able to solve elliptic partial differential equations by using finite difference methods.		

UNIT I - PROBABILITY AND RANDOM VARIABLES	**(9)**
Random variables - Probability mass function - Probability density function - Properties - Moments - Moment generating functions.	
UNIT II - CALCULUS OF VARIATIONS	**(9)**
Calculus of Variations: Concept of variation and its properties - Euler's equation - Functional dependent on first and higher order derivatives - Functional dependent on functions of several independent variables - Direct methods : Ritz and Kantorovich methods.	
UNIT III - PARAMETER ESTIMATION	**(9)**
Point Estimation - Characteristics of estimators - Unbiasedness - Consistency - Efficiency - Sufficiency - Methods of point estimation - Method of moments.	
UNIT IV - EIGEN VALUE PROBLEMS	**(9)**
Methods of solutions: Faddeev - Leverrier Method & Power Method with deflation - Approximate Methods: Rayleigh - Ritz method.	
UNIT V - NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS	**(9)**
Numerical Solution of Partial Differential Equations: Solution of one dimensional wave equation - Explicit and implicit methods (Crank-Nicolson, Bender Schmidt methods) - Solution of Elliptic equation: Solution of Laplace equation (Liebmann's iteration process).	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Richard A.Johnson and Miller & Freund's, "Probability and Statistics for Engineers", 8th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Smith, G. D., "Numerical Solutions of Partial Differential Equations: Finite Difference Methods", 3rd Edition,Clarendon Press, 1985.
4. Sankara Rao K, "Introduction to Partial Differential Equations", PHI Learning Pvt. Ltd, 3rd ed., 2011.
5. Curtis F. Gerald, Patrick O. Wheatley, "Applied Numerical Analysis", 7th Edition, Pearson Education India, 2007.
6. Richard I.Levin, H.Siddiqui Masood, David S. Rubin, Rastogi Sanjay, "Statistics for Management", Pearson Education, 8th ed., 2017.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3		2	3	2	1		1
2	3		1	2	1		2	
3	3	2		1		2		2
4	3		2	2	1	2	1	1
5	3		2	1	2	2	1	2
CO (W.A)	**3**	**2**	**1.75**	**1.8**	**1.5**	**1.75**	**1.33**	**1.5**

22STB01 - DESIGN OF ADVANCED REINFORCED CONCRETE STRUCTURAL SYSTEMS *(IS 456 -2000 code book is to be permitted)*				
L	**T**	**P**	**C**
3	**1**	**0**	**4**

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make familiar to students in Design standards. which helps them,	**1.1**	The students will be able to calculate the deflection and crack width in the flexural members
2.0	To acquire knowledge about the design of special reinforced concrete elements.	**2.1**	The students will be able to formulate the procedure to design the slender column, corbels and spandrel beams
3.0	To know about the design of the flat slabs and grid floors	**3.1**	The students will be able to analysis and design the flat slabs and grid floors
4.0	To learn the knowledge about inelastic behavior of concrete structures.	**4.1**	The students will be able to evaluate the inelastic behavior of concrete structures
5.0	To impart knowledge on design of RC wall and concepts of ductility	**5.1**	The students will be able to design RC walls and observe the concepts of ductile detailing

UNIT I - DESIGN CONCEPTS AND LIMIT STATE OF SERVICEABILITY	**(12+3)**
Limit state method - Design of beams - Deflection - Calculation of short term deflection and long term deflection - Limits on deflection. Cracking - causes of cracking - Factors influencing crack width - Mechanism of flexural cracking - Calculation of crack width by IS 456.	
UNIT II - DESIGN OF SPECIAL R.C.ELEMENTS	**(9+3)**
Design of Slender Column - Design of corbels - Strut and tie method - Design of simply supported and continuous deep beams - Design of Spandrel beams	
UNIT III - DESIGN OF FLAT SLABS AND YIELD LINE THEORY	**(9+3)**
Design of flat slabs (IS method) - Check for shear - Yield line theory and Hiller borgs strip method of design of slabs - Analysis and design of grid floors as per IS 456	
UNIT IV - INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES	**(9+3)**
Inelastic analysis of RC beams - Moment- Rotation curves - moment redistribution - Concept of plastic hinges - Baker's method of plastic design	
UNIT V - DESIGN OF RC WALL AND DUCTILE DETAILING	**(6+3)**
Design of RC wall - Concepts and Detailing for ductility - Concrete cover - Fire resistance of structural members - Design of cast-in-situ joints in frames	
TOTAL (L:45, T: 15) : 60 PERIODS	

REFERENCES:

1. Unnikrishna Pillai and Devdas Menon, "Reinforced concrete Design", 4th Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2021.
2. Krishnaraju, N. "Advanced Reinforced Concrete Design",3rd Edition., CBS Publishers and Distributors, Delhi, 2016
3. Subramanian N., "Design of Reinforced Concrete Structures", 1st Edition, Oxford University Press, 2014.
4. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2nd Edition, 2007.
5. IS 456 -2000, "Plain and Reinforced Concrete - Code of Practice" 4th revision, Bureau of Indian Standards, New Delhi.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2	2	3	2	3	2	3	3
2	3	2	3	2	3	3	2	3
3	3	2	3	3	3	3	2	3
4	2	2	2	2	3	2	2	3
5	3	2	3	3	3	3	3	3
CO (W.A)	**2.6**	**2**	**2.8**	**2.4**	**3**	**2.6**	**2.4**	**3**

22STB02 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING *(IS 1893:2002, IS 13920:2016 & IS 4326:1993 codes are to be permitted)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
sPRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To expose the students the principles and methods of dynamic analysis of structures.	**1.1**	The students will be able to do vibration analysis of system / structures with single degree of freedom and can explain the method of damping systems		
2.0	To study the analysis procedure for calculating the response of MDOF systems.	**2.1**	The students will be able to do the dynamic analysis of system /structures with Multi degrees of freedom under free and forced vibration		
3.0	To Educate the dynamic analysis of continuous systems using virtual work method	**3.1**	The students will be able to derive a mathematical model of continuous system and do a dynamic analysis under free and forced vibration		
4.0	To study the effects of earthquake, analysis and design of Earthquake resistant design of structures	**4.1**	The students will be able to explain the causes and effect of earthquake		
5.0	To obtain knowledge on design an earthquake resistant RC and masonry structure	**5.1**	The students will be able to design masonry and RC structures to the earthquake forces as per there commendations of IS codes of practice		

UNIT I - PRINCIPLES OF VIBRATION ANALYSIS	**(9)**
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, Evaluation of damping, Transmissibility, vibration control, Tuned mass damper	
UNIT II - DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS	**(9)**
Mathematical models of two degree of freedom systems and multi degree of freedom systems, free and forced vibrations of two degree and multi degree of freedom systems, normal modes of vibration, applications. Orthogonality of normal modes, free and forced vibrations of multi degree of freedom systems, Mode superposition technique, Applications.	
UNIT III - DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS	**(9)**
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 IV - EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES	**(9)**
Engineering Seismology - Seismotectonics and Seismic zoning of India, Plate tectonics, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures - Lessons Learnt	

From Past Earthquakes - Evaluation of Earthquake Forces as per codal provisions - Response Spectra, Design Spectra
UNIT V - EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES **(9)**
Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - effect of material of construction on performance of structures - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design of Masonry Buildings and R.C.C. Buildings. Design consideration - Rigid Frames - Shear walls - Capacity based Design and detailing
TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Anil K.Chopra, Dynamics of Structures, 5th Edition, Pearson Education, 2017.
2. Paulay.T and Priestley M.J.N., "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and Sons, 2013.
3. Mario Paz, "Structural Dynamics - Theory and Computation", Kluwer Academic Publishers, 5th Edition, 2006.
4. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2009.
5. Duggal S K, "Earthquake Resistant Design of Structures", Oxford University Press, 2007.
6. IS 1893:2002 (Part -1), "Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards, New Delhi
7. IS 13920- 2008, "Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice", Bureau of Indian Standards, New Delhi
8. IS 4326 : 1993, "Earthquake Resistant Design and Construction of Buildings - Code of Practice", Second Revision, Bureau of Indian Standards, New Delhi.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	2	3	3	2	3	2	3
2	3	2	3	3	2	3	3	3
3	2	1	2	2	2	3	2	3
4			2	2	3	2	2	2
5	3	2	3	3	3	3	3	3
CO (W.A)	**2.75**	**1.75**	**2.6**	**2.6**	**2.4**	**2.8**	**2.4**	**2.8**

22STB03 - ADVANCED CONCRETE TECHNOLOGY *(IS 456 & IS 10262: 2019 codes are to be permitted)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE REQUISITE : NIL

Course Objectives		**Course Outcomes**	
1.0	To study the properties of materials, tests, admixtures for concrete and concreting under special circumstances.	**1.1**	The students will be able to develop knowledge on various materials needed for concrete manufacture
2.0	To acquire knowledge about mix design of concrete by various methods	**2.1**	The students will be able to apply the rules to do mix designs for concrete by various methods
3.0	To identify different tests for identifying the properties of concrete	**3.1**	The students will be able to explain different tests for identifying the properties of concrete
4.0	To gain knowledge about the types of special concrete	**4.1**	The students will be able to apply the usage of special concretes
5.0	To learn about the durability and quality control on concrete	**5.1**	The students will be able to perform tests for permeability and durability properties.

UNIT I - CONCRETE MAKING MATERIALS	**(9)**
Aggregates - classification - IS Specifications - Properties, Grading, Methods of combining aggregates, specified grading, Testing of aggregates - Cement, Grade of cement, Chemical composition, Hydration of cement, Structure of hydrated cement, special cements - Water - Chemical admixtures - Mineral admixtures.	
UNIT II - MIX DESIGN	**(9)**
Principles of Concrete Mix Design - Factors in the choice of mix proportions - Mix design methods - A.C.I Method - I.S Method - DOE Method - Design of High strength concrete Design of Self Compacting Concrete by using EFNARC Specifications - Design of concrete mix using mineral admixtures - Design mix for pump ability and effect of super plasticizers in water reduction.	
UNIT III - TESTING ON CONCRETE	**(9)**
Workability - Compression - Tension - Flexure - Bond strength - Factors affecting the results - Accelerated strength results - Stress strain characteristics - Modulus of Elasticity - In situ strength determination - Variation in results - Distribution of strength - Standard deviation - Nondestructive tests - Microstructure analysis of Concrete	
UNIT IV - SPECIAL CONCRETES	**(9)**
Method of Manufacture, properties and applications - Lightweight concrete-Aerated concrete - No fines concrete - Heavy weight concrete - High Strength Concrete - High Performance Concrete - Polymer Concrete - Steel fiber Reinforced Concrete - Ferrocement Concrete - Vaccum Concrete - Shotcrete - Concrete using waste material - Ready Mixed Concrete – Self compacting concrete - Geopolymer concrete.	

UNIT V - DURABILITY OF CONCRETE	(9)
Permeability - chemical attack - sulphate attack - Quality of water - marine conditions - Methods to improve durability - Thermal properties of concrete - fire resistance - Mass Concrete - Formwork - Structural Concrete Block Masonry - Quality Control of Concrete Construction.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. A.M. Neville, "Properties of Concrete", Prentice Hall, London, 2012
2. Santhakumar A.R., "Concrete Technology", Oxford University Press, New Delhi, 2006.
3. Shetty M.S., "Concrete Technology - Theory and Practice", S.Chand and Company Ltd. Delhi, 2018
4. Gambhir.M.L., "Concrete Technology", 5th Edition, McGraw Hill Education, New Delhi 2017.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			3		2	2	2	3
2	3	3	2		3	3	2	3
3	2	2			2	2	3	3
4	2		3	2	2	2		3
5	2	2	2	3	3	3	2	3
CO (W.A)	**2.25**	**2.33**	**2.5**	**2.5**	**2.4**	**2.4**	**2.25**	**3**

22STP01 - ADVANCED STRUCTURAL ENGINEERING LABORATORY					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn the principles and procedures of testing of beam & column for strength and deflection behavior	**1.1**	The students will be able to assess the strength and deflection behavior of simply supported reinforced concrete beam		
2.0	To learn the knowledge about the dynamic testing of steel elements.	**2.1**	The students will be able to examine the dynamic testing of steel elements		
3.0	To acquire about the method of testing of static cyclic testing of single bay two storied steel frames.	**3.1**	The students will be able to evaluate the strength behavior of reinforced concrete column		
4.0	To understand about quality of concrete of existing elements.	**4.1**	The students will be able to assess the quality of reinforced concrete by non-destructive test		
5.0	To imparts knowledge on the behavior of steel beams	**5.1**	The students will be able to observe the effect of mineral and chemical admixture in concrete		

List of Experiments:

1. Mix design of concrete as per IS, ACI methods for high strengthe concrete.
2. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
3. Testing of simply supported steel beam for strength and deflection behaviour.
4. Fabrication, casting and testing of reinforced concrete column subjected to concentric loading.
5. Fabrication, casting and testing of R.C column subjected to eccentric loading.
6. Dynamic testing of cantilever steel beam
    a. To determine the damping coefficients from free vibrations.
    b. To evaluate the mode shapes.
7. 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.
8. Determination of in-situ strength and quality of concrete using
    a. Rebound hammer
    b. Ultrasonic Pulse Velocity Tester.
9. Effect of mineral and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability

TOTAL: P: 60 = 60 PERIODS

REFERENCES:

1. Gambhir.M. L., "Design of Reinforced Concrete Structures", Prentice Hall of India, 2012.
2. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005
3. Sinha.S.N., "Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd.2014
4. Dally J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill Inc. New York, 1991.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2	2	3	3	3	3	2	3
2	2		3	2	2	3	3	3
3	2	2	3	3	3	3	2	3
4	3	2	3	2	3	3	3	3
5			2	2		3	3	2
CO (W.A)	**2.75**	**2**	**2.8**	**2.4**	**2.75**	**3**	**2.6**	**2.8**

22STB04 - THEORY OF ELASTCITY AND PLASTICITY				
	L	T	P	C
	3	1	0	4

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To gain knowledge about the equilibrium and compatibility equations, plane stress & plane strain.	1.1	The students will be able to derive and write the fundamental equations of elasticity describing the linear behavior of elements and develop constitutive models based on material behavior
2.0	To study 2D stress strain relationship of materials	2.1	The students will be able to demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems
3.0	To learn about the membrane analogy and torsion of non circular section.	3.1	The students will be able to solve torsion problems in circular and non-circular cross-sections
4.0	To learn the energy theorem by various methods	4.1	The students will be able to apply the energy theorem to elastic problems
5.0	To know about elastic plastic problems in bending.	5.1	The students will be able to solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties

UNIT I - ELASTICITY	**(9+3)**
Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law - Constitutive Equations	
UNIT II - 2D STRESS STRAIN PROBLEMS	**(9+3)**
Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Coordinates - Strain transformation - Stress invariants	
UNIT III - TORSION OF NON-CIRCULAR SECTION	**(9+3)**
St.Venant's approach - Prandtl's approach - Membrane analogy - Torsion of Thin Walled - Open and Closed sections - Design approach to open web section subjected to torsion - Finite Difference Method	
UNIT IV - ENERGY METHODS	**(9+3)**
Strain energy - Principle of virtual work - Energy theorems - Rayleigh Ritz method - Finite difference method - Application to elasticity problems	
UNIT V - PLASTICITY	**(9+3)**
Physical Assumptions - Yield Criteria - Failure Theories -Thick Cylinder - Plastic Stress Strain Relationship - Bending and Torsion in Elasto-Plastic Materials - Strain hardening Materials	
TOTAL (L:45, T: 15) : 60 PERIODS	

REFERENCES:

1. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.
2. Timoshenko, S. and GoodierJ.N."Theory of Elasticity", 3rd Edition, McGraw Hill Book Co., New York, 2017.
3. Chakrabarty.J, "Theory of Plasticity", 3rd Edition, Elsevier Butterworth - Heinmann - UK, 2007.
4. Sadhu Singh, "Theory of Elasticity", 4th Edition, Khanna Publishers, New Delhi.2000.
5. Sadhu singh., "Theory of Plasticity", 4th Edition, Khanna Publishers, New Delhi.2000.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		2	3		2	2	3
2	2		3	3		2		2
3	2		2	3		2	3	2
4	3	2	2		2	1	2	2
5	2			3	2	3	2	2
CO (W.A)	**2.2**	**2**	**2.25**	**3**	**2**	**2**	**2.5**	**2.2**

22STB05 - ADVANCED DESIGN OF STEEL STRUCTURES *(IS 800: 2007, IS 801, IS 811, IS 875 Part 3, IS 804, IS 805 & SP-06 are to be permitted)*					
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes** The students will be able to			
1.0	To study the analysis and design of industrial buildings and Gable column and Gable wind girder	**1.1**	Analyze and design industrial structures such as trusses and portal frames subjected to wind and seismic forces		
2.0	To gain knowledge about the design of connections.	**2.1**	Design different types of steel connections such as welded and bolted flexible as well as moment resisting connections		
3.0	To study of plastic analysis of structures.	**3.1**	Apply the knowledge of plastic analysis in steel design		
4.0	To learn the analysis and design of steel towers	**4.1**	Design the special structures such as steel water tank and chimney, Silo and Towers		
5.0	To acquire knowledge about the design of light gauge steel structures	**5.1**	Evaluate the behaviour and design of compression and flexural Cold-formed Steel members		

UNIT I - ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS	**(9+3)**
Roof trusses - Roof and side coverings - Design of truss elements - Design of purlins -Design of end bearings - Gable column, gable rafter, gable wind girder and end bracings of industrial buildings - Introduction to the design of steel structures for fire loads - Aseismic design of steel buildings.	
UNIT II - DESIGN OF CONNECTIONS	**(9+3)**
Types of connections - Structural joints - 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 - PLASTIC ANALYSIS OF STRUCTURES	**(9+3)**
Introduction - Shape factors - Mechanisms - Plastic hinge - Analysis of beams and portal frames - Design of fixed and continuous beams and portal frame	
UNIT IV - SPECIAL STRUCTURES	**(9+3)**
Water tanks - Water pressure on tank walls - Seismic Analysis of water tank - Types of chimneys - Components of chimney - Design of self-supporting chimney - Design of Silos - Bunker design - Design of towers.	
UNIT V - DESIGN OF LIGHT GAUGE STEEL STRUCTURES	**(9+3)**
Types of cold formed cross sections - Local buckling - Design of compression and tension members - Design of beams - General concept of pre-engineered buildings - Simple portal frame design.	
TOTAL (L:45, T:15) : 60 PERIODS	

REFERENCES:

1. Subramanian N, "Design of Steel Structures", 2nd Edition, Oxford University Press, New Delhi, 2015.
2. Duggal. S K, "Limit State Design of Steel Structures", 3rd Edition, McGraw Hill Private Limited, New Delhi, 2017.
3. Wie Wen Yu, Design of Cold-Formed Steel Structures, McGraw Hill Book Company, 2019
4. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1997

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	2	3	3	3	3	2	3
2	2		3	3	2	3	3	3
3			2	3		2		3
4	3	2	3	3	3	3	3	3
5	2			2	3	3		2
CO (W.A)	**2.5**	**2**	**2.75**	**2.8**	**2.75**	**2.8**	**2.67**	**2.8**

22STB06 - FINITE ELEMENTANALYSIS IN STRUCTURAL ENGINEERING					
		L	T	P	C
		3	1	0	4
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To impart fundamental knowledge on the finite element method and its applications	**1.1**	The student will be able to demonstrate the concept of finite element analysis and approximate solutions, techniques		
2.0	To gain knowledge on one dimensional structural engineering problems	**2.1**	The student will be able to execute finite element analysis concept in one dimensional element problems		
3.0	To Acquire knowledge about the finite element analysis of 2-D and 3-D problems	**3.1**	The student will be able to apply the finite element analysis concept in two and three dimensional element problems		
4.0	To understand the FEM analysis for framed structuresAnalyse the framed structures using FEM analysis	**4.1**	The student will be able to analyze the framed structures		
5.0	To study the applications of FEM	**5.1**	The student will be able to apply finite element analysis concept in nonlinear, vibration and thermal problems		

UNIT I - INTRODUCTION	**(9+3)**
Approximate solutions of boundary value problems-Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method. Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method.	
UNIT II - ONE DIMENSIONAL PROBLEMS	**(9+3)**
One dimensional problems - Coordinate systems - global, local and natural coordinate systems, shape functions - Bar, beam and truss element - Generation of Stiffness Matrix and Load Vector.	
UNIT III - TWO AND THREE DIMENSIONAL PROBLEMS	**(9+3)**
Two Dimensional problems - Plane Stress, Plane Strain Problems -Triangular and Quadrilateral Elements - Isoparametric Formulation - Natural Coordinates, Shape function, stiffness matrix - Asymmetric Problems - Higher Order Elements -Numerical Integration - Three dimensional elasticity - Governing differential equations - Higher order Isoparametric solid elements	
UNIT IV - ANALYSIS OF FRAMED STRUCTURES	**(9+3)**
Stiffness of Truss Member - Analysis of Truss - Stiffness of Beam Member - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Numerical Evaluation of Element Stiffness - Formulation for 3 Dimensional Elements - Solution for simple frames	
UNIT V - APPLICATIONS	**(9+3)**
Finite Elements for Elastic Stability - Dynamic Analysis - Nonlinear, Vibration and Thermal Problems - Meshing and Solution Problems - Modeling and analysis using FEA software's.	
TOTAL (L:45 ,T:15) : 60 PERIODS	

REFERENCES:

1. S. S. Bhavikatti, "Finite Element Analysis", 4th Edition, New Age Publishers, 2005
2. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2006
3. Seshu, P, "Text Book of Finite Element Analysis", Prentice - Hall of India Pvt. Ltd., New Delhi, 2004
4. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall of India, 2015.
5. C. Krishnamoorthy, "Finite Element Analysis: Theory and Programming", Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2017.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		2	2			2	2
2			2	3		2		2
3	2		2	3	2	1	2	2
4		2		3	3	3	2	2
5	2		2		2		3	2
CO (W.A)	**2**	**2**	**2**	**2.75**	**2.33**	**2**	**2.25**	**2**

22STB07 - DESIGN OF SUBSTRUCTURES					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the design aspects of shallow foundations	**1.1**	The student will be able to analyze and design different types of shallow and raft foundations		
2.0	To study about design of the pile foundations	**2.1**	The student will be able to calculate the load carrying capacity of the piles and pile group and design various types of piles		
3.0	To gain knowledge on the design methods of piers and caisson	**3.1**	The student will be able to design pier and caissons for tower, bridges and chimneys		
4.0	To study requirements and design criteria for the machine foundations	**4.1**	The student will be able to examine the structural aspects of machine foundation		
5.0	To learn about design concepts of the tunnels and conduits	**5.1**	The student will be able to explain the concept of tunnel and conduits construction		

UNIT I - SHALLOW FOUNDATIONS	**(9)**
Types of foundations and their specific applications - Depth of foundation - Bearing capacity and settlement estimates - Structural design of isolated - strip - rectangular - trapezoidal and combined footings - strap - raft foundation.	
UNIT II - PILE FOUNDATIONS	**(9)**
Types of piles and their applications - Load carrying capacity - Settlements - Group action - Design of piles and pile caps - Design of under reamed piles.	
UNIT III - PIERS AND CAISSONS	**(9)**
Drilled piers - construction - advantages and disadvantages - design and construction of open caissons - pneumatic caissons - floating caisson - piers and caissons for bridges - Foundations for towers, chimneys and silos.	
UNIT IV - MACHINE FOUNDATIONS	**(9)**
Types - General requirements and design criteria - vibration analysis of machine foundation - determination of natural frequency - foundation for reciprocating machine - vibration isolation and control.	
UNIT V - TUNNEL AND CONDUITS	**(9)**
Stresses in soil around tunnels - construction of earth tunnels - arching in soils - types of underground conduits - ditch, positive and negative projecting conduits - surface load on conduits - construction of conduits.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Nayak N.V., "Foundation Design Manual for Practicing Engineers", 2nd Edition, Dhanpatrai and Sons, 2012.
2. Braja M. Das, "Principles of Foundations Engineering", 8th Edition, Thomson Asia (P) Ltd., 2017
3. Megaw T.M. and Bartlett J.V., "Tunnels: planning, design, construction", 3rd Edition, John Wiley & Sons, Ellis Horwood, 1983.
4. Varghese. P.C, "Design of Reinforced Concrete foundations", PHI Learning Pvt.Ltd , 2009.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	2	3	3	3	3	2	3
2	3	3	3	3	3	3	3	3
3	2	2	3	2	3	2	2	3
4		2	3	2	3	3	2	3
5	1		2	3	1	2	2	2
CO (W.A)	**2**	**2.25**	**2.8**	**2.6**	**2.6**	**2.6**	**2.2**	**2.8**

22STP02 - ADVANCED COMPUTER AIDED STRUCTURAL ANALYSIS LABORATORY					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

PRE REQUISITE : 22STB02

Course Objectives		**Course Outcomes**	
1.0	To acquire knowledge in the application of computer softwares for the analysis and design of structures	**1.1**	The student will be able to analyze and design different types of structures using software packages
2.0	To gain knowledge on design and detailing of various reinforced concrete and steel structures as per IS codal provisions using software	**2.1**	The student will be able to analyze and design the structure for various load combinations according to the relevant IS codes
3.0	To train the students in the application of programming for the analysis and design of structures	**3.1**	The student will be able to analyze the structures subjected to earthquake and wind forces

LIST OF EXPERIMENTS

1. Analysis and design of a single storey RCC building.
2. Analysis and design of Flat Slab
3. Analysis and design of a continuous beam.
4. Analysis and design of a continuous slab.
5. Analysis and Design of shear wall.
6. Analysis and Design of Foundation.
7. Analysis and Design of a 2D steel truss
8. Analysis and Design of Water tank.
9. Analysis and Design of Multi-storey RCC Building subjected to wind forces.
10. Analysis and Design of Multi-storey RCC Building subjected to seismic forces.

TOTAL (P:60) : 60 PERIODS

REFERENCES:

1. Unnikrishna Pillai and Devdas Menon, "Reinforced concrete Design", 3rd Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2. Subramanian N., "Design of Reinforced Concrete Structures", 1st Edition, Oxford University Press, 2014

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2	3	2	3	3	2	2	3
2	2	2	3	3	2	2	3	3
3	3		3	3	3	3	3	3
CO (W.A)	**2.33**	**1.67**	**2.67**	**3**	**2.67**	**2.33**	**2.67**	**3**

22STE01 - PRACTICAL TRAINING (4 Weeks)					
		L	T	P	C
		0	0	0	2

Course Objectives		Course Outcomes	
1.0	To get knowledge of practical problems related to structural engineering in carrying out engineering tasks.	1.1	The students will be able to participate in real-life construction projects
2.0	To develop skills in facing and solving the field problems	2.1	The students will be able to put to use the theoretical knowledge gained
3.0	To know about structural design and construction activities in practical	3.1	The students will be able to realize the various functions of construction activities and structural problems

SYLLABUS	The students individually undertake training in reputed engineering companies doing Structural Engineering during the summer vacation for a specified duration of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.	
Evaluation	**Component**	**Weightage**
	Mid semester presentation	25%
	Final presentation (Internal)	25%
	End Semester Training Report	30%
	Presentation	20%
	Total	100%

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		3		3	3	3	3
2	2		2		2	3	3	3
3	2		3	2	3	3	3	2
CO (W.A)	**2**		**2.67**	**2**	**2.67**	**3**	**3**	**2.67**

22STE02 - PROJECT WORK (PHASE – I)					
		L	T	P	C
		0	0	12	6

Course Objectives		Course Outcomes	
1.0	To identify a specific problem for the current need of the society and collect information related to the same through a detailed review of literature.	1.1	The students will be able to apply the knowledge gained from theoretical and practical courses in solving problems
2.0	To develop the methodology to solve the identified problem.	2.1	The students will be able to develop a clear outline and methodology for the project
3.0	To train the students in preparing project reports and to face reviews and viva-voce examinations	3.1	The students will be able to report and present the findings of the work conducted

SYLLABUS	The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner
	TOTAL (P:180) : 180 PERIODS

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	3		3	3	3	2	3
2	1		1			2	2	
3		2	2	3	2	3		2
CO (W.A)	**2**	**2.5**	**1.5**	**3**	**2.5**	**2.67**	**2**	**2.5**

22STE03 - PROJECT WORK (PHASE – II)					
		L	T	P	C
		0	0	24	12

Course Objectives		Course Outcomes	
1.0	To solve the identified problem based on the formulated methodology.	1.1	The students will be able to apply the knowledge gained from theoretical and practical courses to be creative, well - planned, organized and coordinated
2.0	To develop skills to analyze and discuss the test results, and make conclusions.	2.1	The students will be able to derive detailed conclusions from work carried out
3.0	To prepare the reports from identified problems	3.1	The students will be able to report and present the findings of the work conducted

SYLLABUS	The student should continue the phase I work on the selected topic as per the formulated methodology / Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.
	TOTAL (P:360) : 360 PERIODS

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3		3	2	3	2	2	3
2			1			2		2
3	2	2				2	3	3
CO (W.A)	**2.5**	**2**	**2**	**2**	**3**	**2**	**2.5**	**2.67**

22STX01 - OPTIMIZATION OF STRUCTURES				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study the concepts of basic principles and optimization techniques like linear, non-linear	**1.1**	The students will be able to classify the optimization techniques
2.0	To bring knowledge about programming methods of linear programming	**2.1**	The students will be able to identify the suitable method for solving linear structural problem
3.0	To acquire knowledge about the Non linear programming	**3.1**	The students will be able to identify the suitable method for solving non-linear structural problem
4.0	To learn about the concept of solving problems with geometric and dynamic programming	**4.1**	The students will be able to apply the engineering knowledge to understand the concept of dynamic programming.
5.0	To study the underlying concepts of non-traditional optimization methods	**5.1**	The students will be able to apply optimization technique in structural problems

UNIT I - BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES	**(9)**
Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behaviour and other constraints - Design space - Feasible and infeasible - Convex and Concave - Active constraint - Local and global optima. Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints - (Lagrange Multiplier method) - with inequality constraints (Khun - Tucker Criteria).	
UNIT II - LINEAR PROGRAMMING	**(9)**
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 – Dual simplex method.	
UNIT III - NON LINEAR PROGRAMMING	**(9)**
One Dimensional minimization methods: Uni-dimensional - Uni-modal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.	
UNIT IV - GEOMETRIC AND DYNAMIC PROGRAMMING	**(9)**
Polynomial - 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. Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems	

UNIT V - STRUCTURAL APPLICATIONS	(9)
Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C structures such as multistory buildings, water tanks and bridges.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Belengundu A.D and Chandrapatla T.R. "Optimisation concepts and Applications in Engineering" Pearson Education, 2011.
2. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 1997.
3. Rao S.S., "Engineering Optimization: Theory and Practice", 1st Edition, New Age International Pvt. Ltd., New Delhi, 2013.
4. Taha H.A., "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 2013.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1				2		2	1	2
2	2		2	2		2		2
3	2		2	1		2		2
4			1	2		1	2	3
5	2		2	3	2	3	2	3
CO (W.A)	**2**		**1.75**	**2**	**2**	**2**	**1.67**	**2.4**

22STX02 - EXPERIMENTAL TECHNIQUES AND ANALYSIS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study about the measurements and performance of strains.	**1.1**	The students will be able to evaluate the measurement system of strains in structural elements
2.0	To learn about the characteristics of structural vibrations measurements.	**2.1**	The students will be able to assess the different measurement method of vibrations
3.0	To gain knowledge about the non-destructive structures testing and wind flow measurements	**3.1**	The students will be able to demonstrate on various testing methods and technologies.
4.0	To understand the concepts of distress measurements and control	**4.1**	The students will be able to analyse the construction and damage assessment of RC Structures
5.0	To apply the non destructive testing on various structures and elements.	**5.1**	The students will be able to determine strength by using NDT testing

UNIT I - STRAIN MEASUREMENTS	**(9)**
Methods of measurements-Errors in measurements - Calibration of Testing Machines - Strain gauge, Principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges - Electronic load cells - Proving Rings.	
UNIT II - VIBRATION MEASUREMENTS	**(9)**
Characteristics of Structural Vibrations - Linear Variable Differential Transformer (LVDT) - Transducers for velocity and acceleration measurements. Vibration meter - Seismographs - Vibration Analyzer - Display and recording of signals - Cathode Ray Oscilloscope - XY Plotter - Chart Plotters - Digital data Acquisition systems.	
UNIT III - ACOUSTICS AND WIND FLOW MEASURES	**(9)**
Principles of pressure and flow measurements - pressure transducers - sound level meter - venturimeter - flow meters - wind tunnels and its uses in structural analysis - structural modeling - direct and indirect analysis.	
UNIT IV - DISTRESS MEASUREMENTS AND CONTROL	**(9)**
Diagnosis of distress in structures - crack observation and measurements - corrosion of reinforcement in concrete - Half cell, construction and use - damage assessment - controlled blasting for demolition - Techniques for residual stress measurements	
UNIT V NON DESTRUCTIVE TESTING METHODS	**(9)**
Load testing on structures, buildings, bridges and towers - Rebound Hammer - acoustic emission - ultrasonic testing principles and application - Holography - use of laser for structural testing - Brittle coating, Advanced NDT methods - Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR & GPR.	

TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, 4th Edition, New Delhi, 2006.
2. Jindal U C ., "Experimental stress analysis", Pearson, New Delhi, 2013
3. Srinath.L.S, Raghavan.M.R, ingaiah.K, Gargesha.G, Pant.B and Ramachandra.K, "Experimental Stress Analysis", Tata McGraw Hill Company, New Delhi, 1984.
5. C. S. Rangan, "Instrumentation - Devices and Systems", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1983

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		2	2		2	2	3
2	2	1	3	2		2		2
3	2		2		2	2	3	2
4	3			3		2	2	
5			2			2		3
CO (W.A)	**1.8**	**1**	**2.25**	**2.33**	**2**	**2**	**2.33**	**2.5**

22STX03 - SOIL STRUCTURE INTERACTION				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To enable the students to learn the basics of soil-structure interactions.	1.1	The students will be able to illustrate the overview of soil-structure interactions
2.0	To understand the relevance and significance of soil-structure interaction in the different cases of shallow foundation	2.1	The students will be able to analyze soil structure interaction problems in shallow foundation
3.0	To analysis beams on elastic foundation -soil models.	3.1	The students will be able to demonstrate different types of soil structure models
4.0	To acquire about the elastic analysis of piles and pile groups on the behavior of a structure.	4.1	The students will be able to investigate soil structure interaction parameters involved in the pile foundation
5.0	To know the effects of soil-structure interactions in retaining structures.	5.1	The students will be able to analyze the soil structure interaction involved in retaining structures

UNIT I - INTRODUCTION TO SSI	(9)
Introduction to SSI - Importance of SSI - Applications and Examples of SSI for geotechnical engineer- Effect of structure roughness / smoothness on soil behavior.	
UNIT II - SSI IN SHALLOW FOUNDATION	**(9)**
General soil-structure interaction problems - Shallow foundation, Sheet piles, Mat/Raft foundation, etc., Contact pressure and soil - structure interaction for shallow foundation, Fixed / Flexible base, Differential foundation settlement for high rise buildings - Pressure - settlement prediction from constitutive laws.	
UNIT III - SSI MODELS	**(9)**
Elastic continuum, Winkler's model, Multi parameter models, Hybrid models, Codal provisions, Machine foundation - Idealization of semi-infinite and finite beams - Analysis of finite plates, rectangular and circular plates - Numerical analysis of finite plates - simple solutions	
UNIT IV - ELASTIC ANALYSIS OF PILE	**(9)**
Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.	
UNIT V - SSI IN RETAINING STRUCTURES	**(9)**
Curved failure surfaces, their utility and analytical / graphical predictions from Mohr - Coulomb envelope and circle of stress, Earth pressure computations by friction circle method, Earth pressure on wall with limited / restrained deformations, Earth pressure on sheet piles, braced excavations, Design of supporting system for excavations.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Chandrakant S. Desai, Musharraf Zaman. "Advanced Geotechnical Engineering - Soil-Structure Interaction using Computer and Material Models", 1st Edition, CRC Press (Taylor and Francis group), 2010.
2. Michael J Tomlinson, John C Woodward. "Pile Design and Construction Practice". 6th Edition, CRC Press, 2014.
3. Edward Tsudik. "Analysis of Structures on Elastic Foundations". 1st Edition, J. Ross Publishing, Cengage learning, Delhi, 2013.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		2			2		2
2	2		3	2		2	2	3
3			3			2		3
4	2	2	3	2	2	3	2	3
5	3	2	3	3	2	3	3	3
CO (W.A)	**2.25**	**2**	**2.8**	**2.33**	**2**	**2.4**	**2.33**	**2.8**

22STX04 - PREFABRICATED STRUCTURES					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To study the principles designing prefabricated structures	**1.1**	The students will be able to apply the basic principles to compare monolithic construction and prefabrication		
2.0	To impart Knowledge on pre fabricated elements and the technologies used in fabrication and erection	**2.1**	The students will be able to classify the types of prefabricated elements.		
3.0	To study the behavior and design principles of elements	**3.1**	The students will be able to design for stripping forces during manufacture		
4.0	To understand the concept of Eccentricity and stability	**4.1**	The students will be able to determine the forces in shear walls		
5.0	To give an exposure on of prefabricated components in industrial buildings	**5.1**	The students will be able to identify the different roof trusses used in industrial buildings		

UNIT I - DESIGN PRINCIPLES	**(9)**
General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection - elimination of erection stresses, stages of loading and code provisions, safety factors.	
UNIT II - PREFABRICATED ELEMENTS	**(9)**
Roof and floor panels, ribbed floor panels - wall panels - footings - Joints for different structural Connections - Effective sealing of joints for water proofing - Provisions for non - structural fastenings - Expansion joints in pre-cast construction.	
UNIT III - FLOORS, STAIRS AND ROOFS	**(9)**
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, behaviour and reinforcement requirements, Deflection control for short term and long term loads.	
UNIT IV - WALLS	**(9)**
Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, Lateral load resistance, Location and types of shear walls, approximate design of shear walls.	
UNIT V - INDUSTRIAL BUILDINGS AND SHELL ROOFS	**(9)**
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 - Application of prestressed concrete in prefabrication- Pre Engineered Buildings Vs Conventional Steel Buildings - Advantages	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Laszlo Mokk, "Prefabricated Concrete for Industrial and Public Structures", Akademiai Kiado, Budapest, 2007.
2. Hubert Bachmann and Alfred Steinle , "Precast Concrete Structures", 2012.
3. Koncz.T, "Manual of Precast Concrete Construction", Vol.I II and III & IV Bauverlag, GMBH, 1971.
4. "Structural Design Manual, Precast Concrete Connection Details", Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1			2	2		3	3	2
2	1					2	2	2
3	2		2	2	3	2	3	
4	3	2	2	3	3	2	2	2
5	1		2	2				2
CO (W.A)	**1.75**	**2**	**2**	**2.25**	**3**	**2.25**	**2.5**	**2**

22STX05 - DESIGN OF TALL STRUCTURES

L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To study the behaviour of different types of tall structural systems	**1.1**	The students will be able to apply the knowledge of design and development of problem-solving skills.
2.0	To understand the behaviour of tall structures subjected to dynamic loads	**2.1**	The students will be able to estimate lateral force for various structural systems
3.0	To know the behaviour of structural systems.	**3.1**	The students will be able to summarize the behavior of various structural systems.
4.0	To impart knowledge about approximate structural analysis and design of tall buildings.	**4.1**	The students will be able to design of total structural systems and analyse the forces acting in 2D and 3D structures
5.0	To analyse and design such structures taking in to account the effects of creep, shrinkage, and P-delta effect	**5.1**	The students will be able to evaluate the structural stability and its stiffness using approximate methods.

UNIT I - DESIGN CRITERIA	**(9)**
Design philosophy, loading, sequential loading, and materials - high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes. Loading and Movement: Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads	
UNIT II - WIND LOADING	**(9)**
Static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading, working stress design, Limit state design, Plastic design	
UNIT III - BEHAVIOR OF VARIOUS STRUCTURAL SYSTEMS	**(9)**
Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Futigger - braced and hybrid mega system.	
UNIT IV - ANALYSIS AND DESIGN	**(9)**
Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three dimensional analyses.	
UNIT V - STABILITY OF TALL BUILDINGS	**(9)**
Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Taranath.B.S., Structural Analysis and Design of Tall Buildings, Mc Graw Hill,2010
2. Bryan Stafford Smith & Alexcoull, "Tall building structures Analysis and Design",1st Edition, John Wiley publisher, Noida, 1991.
3. Alex Coull and Bryan Stafford Smith., " Tall Building Structures ", Analysis and Design, Wiley India Pvt Ltd ,2011

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		2			3	2	
2	2		3	2	2	3	3	3
3			2	2		2	2	3
4	3	2			3	3	2	3
5		1	3	2	3	3	3	3
CO (W.A)	**2.33**	**1.5**	**2.5**	**2**	**2.67**	**2.8**	**2.4**	**3**

22STX06 - DESIGN OF PLATES AND SHELLS					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the behaviour and analysis of plate and shell structures	**1.1**	The students will be able to explain the concepts of plate structures		
2.0	To analyse the behaviour of plate as per codal recommendations	**2.1**	The students will be able to analyze plate structures various structural loadings		
3.0	To impart knowledge about the behavior of shell structures	**3.1**	The students will be able to identify the characteristics and structural behaviour of shells		
4.0	To analyse the behaviour of shells using standard theories	**4.1**	The students will be able to apply the knowledge of bending theory in shell structures		
5.0	To understand the design concepts of plates and shell structures	**5.1**	The students will be able to design the various plates and shell structures		

UNIT I - INTRODUCTION TO PLATE STRUCTURES	**(9)**
Thin and thick plates - Structural action of plates - Assumptions involved in plate theories - Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported and built-in edges - Small deflection theory of laterally loaded rectangular plates - Kirchoffs boundary conditions Corner effects	
UNIT II - ANALYSIS OF PLATE STRUCTURES	**(9)**
Simply supported rectangular plates under Sinu-soidal load - Navier solution - Levys method - Symmetrical bending of laterally loaded circular plates - Circular plates with simply supported and built-in edges - Bending of annular plates.	
UNIT III - INTRODUCTION TO SHELL STRUCTURES	**(9)**
Classification of shells - Membrane action - Stressed shell element and stress resultants - Load transfer mechanism - Characteristics of shell surfaces -Structural behaviour of shells - Membrane theory of cylindrical shells	
UNIT IV - ANALYSIS OF SHELL STRUCTURES	**(9)**
Bending theory of circular cylindrical shells - Comparison of various bending theories - Introduction to other types of shells	
UNIT V- DESIGN OF PLATES AND SHELL STRUCTURES	**(9)**
Necessary design inputs - Detailed design - Prismatic folded plates - Circular cylindrical barrel shell roofs - Spherical dome - Conical dome - HYPAR shell - Helicoids	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. G.S.Ramaswamy, "Design & Construction of Concrete Shell Roofs",1st Edition, CBS publishers & distributors Pvt. Ltd, New Delhi, 2005.
2. Timoshenko and Krieger, Theory of Plates and Shells, McGraw Hill Inc, 2nd Edition, New Delhi, 2017
3. Varghese. P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt.Ltd., 2010

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1						2		2
2	2			3	2	3	2	3
3			2			2	2	
4	2		2		2	3		3
5	2			2	3	2	2	3
CO (W.A)	**2**		**2**	**2.5**	**2.33**	**2.4**	**2**	**2.75**

22STX07 - STRUCTURAL STABILITY					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the concepts of stability of structures	**1.1**	The students will be able to explain the concepts of stability		
2.0	To gain the knowledge about the basic concept of stability of columns	**2.1**	The students will be able to analyse the buckling of columns with various boundary conditions		
3.0	To learn the behavior of beam, column and frame	**3.1**	The students will be able to analyze the buckling of frames		
4.0	To impart the knowledge about torsional buckling	**4.1**	The students will be able to apply the concept of lateral and torsional buckling		
5.0	To study the concept buckling of thin plates	**5.1**	The students will be able to identify the torsional, lateral and inelastic buckling of plates		

UNIT I - FUNDAMENTAL CONCEPTS OF STABILITY	**(9)**
Criterion for design of structures: strength, stability and stiffness - Concepts of stability, instability and bifurcation - Stability criteria - Concepts of Equilibrium and Energy approaches - South well Plot.	
UNIT II - BUCKLING OF COLUMNS	**(9)**
Governing differential equations - Higher order differential equations - Analysis for various boundary conditions - Behaviour of imperfect column - eccentrically loaded column - Rayleigh Ritz, Galerkin Methods - Effect of shear on buckling	
UNIT III - BUCKLING OF BEAM – COLUMN AND FRAMES	**(9)**
Buckling of Beam - columns: Buckling of Beam - columns with concentrated lateral loads - Distributed loads - Effect of axial loads on bending stiffness. Buckling of frames: Mode of buckling - Single storey frames with and without sway	
UNIT IV - LATERAL AND TORSIONAL BUCKLING	**(9)**
Differential equations for lateral buckling - Lateral buckling of beams in pure bending - Lateral buckling of simply supported I beams. Buckling of Thin Walled Open Sections: Introduction - Torsional buckling -Torsional flexural buckling.	
UNIT V - STABILITY OF PLATES AND INELASTIC BUCKLING	**(9)**
Buckling of rectangular plates for various edge conditions - Finite difference method. Introduction to inelastic buckling - Double modulus theory (reduced modulus) - Tangent modulus theory - Shanley's theory	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", Dover Publication, 2012.
2. Gambhir.M.L, "Stability Analysis and Design of Structures", Springer, New York, 2013
3. Iyengar N.G.R., "Structural Stabilityof Columns and Plates", Affiliated East West Press Pvt. Ltd., New Delhi, 2000

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1			2			1	2	
2	2			3	2	2	2	3
3			2	2		2	2	
4	2			2		3	3	2
5	2		2				2	
CO (W.A)	**2**		**2**	**2.33**	**2**	**2**	**2.2**	**2.5**

22STX08 - DESIGN OF INDUSTRIAL STRUCTURES *(IS 800: 2007, IS 801, IS 811, IS 875 Part 3 & SP-06 are to be permitted)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE REQUISITE : NIL

	Course Objectives		**Course Outcomes**
1.0	To study the Requirements of Industrial Structures.	**1.1**	The students will be able to develop the concept of planning & functional requirements of industrial standards.
2.0	To learn about the roof for Industrial Structures.	**2.1**	The students will be able to analyse and design Steel Gantry girders & Crane girders and RCC design of corbels, nibs and staircase.
3.0	To study the design of power plant structures	**3.1**	The students will be able to analyse and design cooling towers, bunkers, silos and pipe supporting structures.
4.0	To acquire knowledge about the basic concepts of power transmission structures	**4.1**	The students will be able to analyse and design Steel transmission line towers and chimneys.
5.0	To understand the design concepts of foundation	**5.1**	The students will be able 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 Requirement regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.	
UNIT II - INDUSTRIAL BUILDINGS	**(9)**
Roofs for Industrial Buildings - Steel and RCC - Gantry Girders - Design of Corbels and Nibs - Machine foundations	
UNIT III - POWER PLANT STRUCTURES	**(9)**
Types of power plants - Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures	
UNIT IV - POWER TRANSMISSION STRUCTURES	**(9)**
Introduction -Transmission Line Towers - Substation Structures - Testing Towers	
UNIT V - FOUNDATION	**(9)**
Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. N.Subramaniyan, Design of Steel Structures, United Press, 2018
2. Santhakumar A.R. and Murthy S.S., "Transmission Line Structures", Tata McGraw Hill, 1992.
3. N. Krishna Raju, Advanced Reinforced concrete Design, 3rd Edition, 2016,
4. Dunham.V, "Planning of Industrial Structures", Mc-Graw Hill Book Co. 2002.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		3	2		2	3	2
2		2		3	3	2	2	3
3	2			2	2	2	3	3
4	2			3	3		3	2
5				2	2		3	3
CO (W.A)	**2**	**2**	**3**	**2.4**	**2.5**	**2**	**2.8**	**2.6**

22STX09 - MAINTENANCE AND REHABILITATION OF STRUCTURES					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To emphasize the importance of maintenance and inspection of structures	**1.1**	The students will be able to explain the importance of maintenance assessment and repair strategies		
2.0	To get the knowledge on strength and durability of concrete with effects due to environment, chemicals, fire and earthquakes.	**2.1**	The students will be able to identify the effects due to climate and temperature		
3.0	To gain knowledge about the materials for repair.	**3.1**	The students will be able to realize the basic concepts, materials and techniques available for repair works.		
4.0	To impart fundamental knowledge on various repairing strategies	**4.1**	The students will be able to explain the techniques for repair and protection methods		
5.0	To impart a broad knowledge in the area of repair and rehabilitation of structures	**5.1**	The students will be able to identify the suitable methods for the repair, retrofitting and demolition of structures		

UNIT I - MAINTENANCE AND REPAIR STRATEGIES	**(9)**
Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures - Service life behaviour - importance of Maintenance, causes and effects of deterioration. Non-destructive Testing Techniques	
UNIT II - STRENGTH AND DURABILITY OF CONCRETE	**(9)**
Quality assurance for concrete based on Strength, Durability and Microstructure of concrete - NDT techniques- Cracks- different types, causes - Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage	
UNIT III - REPAIR MATERIALS AND SPECIAL CONCRETES	**(9)**
Repair materials - Various repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes - Polymer Concrete and Grouting materials - 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 - cathodic protection - Sacrificial anode - Corrosion protection techniques - Corrosion inhibitors, concrete coatings - Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring	
UNIT V - REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES	**(9)**

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks - Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition - Case studies
TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Ravishankar.K.,Krishnamoorthy. T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004
2. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.
3. Dayaratnam P. and Rao R., "Maintenance and Durability of Concrete Structures", 1st Edition, University Press, India, 1997
4. Santhakumar. A.R., "Training Course Notes on Damage Assessment and Repair in Low Cost Housing", "RHDC- NBO", Anna University, July, 1992.
5. Dodge Woodson, "Concrete Structures, Protection, Repair and Rehabilitation", Butterworth - Heinemann, Elsevier, New Delhi 2012

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		3	3		2	2	
2				2		3		3
3			2	3	2	3	3	3
4	2		2			2	3	2
5	3		3	2		3	3	3
CO (W.A)	**2.5**		**2.5**	**2.5**	**2**	**2.6**	**2.75**	**2.75**

22STX10 - DESIGN OF OFFSHORE STRUCTURAL ELEMENTS *(IS 456, IS875- PART 3, IS9527 Part 1 - 1981, IS9527 Part 3 - 1983, IS9527 Part 4 - 1981, IS10020 Part 4 - 1981 codes are to be permitted)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To impart knowledge about the concept of wave theories,	**1.1**	The students will be able to apply the concepts of wind effects in offshore structures		
2.0	To identify various types of forces acting on the structures	**2.1**	The students will be able to apply the knowledge of wave forces and offshore structures		
3.0	To get offshore structural modeling and design	**3.1**	The students will be able to classify and model the off shore structures		
4.0	To determine the wave forces acting on structures	**4.1**	The students will be able to analysis the forces in offshore structures		
5.0	To study the concept of design of jacket towers, pipes and cables	**5.1**	The students will be able to design the offshore structures		

UNIT I - WIND EFFECTS:	**(9)**
Wind on Structures - Rigid Structures - Flexible Structures - Static and dynamic effects.	
UNIT II - FORCES OF OFFSHORE STRUCTURES	**(9)**
Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation	
UNIT III - OFFSHORE STRUCTURE MODELLING	**(9)**
Introduction - Offshore soil - Different types of offshore structures - foundation modeling, - structural modeling.	
UNIT IV - WAVE LOADING	**(9)**
Wave forces on vertical - inclined - cylindrical structures - Environmental loadings - Use of Morrison equation.	
UNIT V - DESIGN OF OFFSHORE STRUCTURES	**(9)**
Introduction - offshore structure - design of platforms - helipads - Jacket tower and mooring cables and pipe lines.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Mohamed Abdallah El-Reedy "Off shore structures" Gulf Professional Publication, 2012.
2. Chakrabarti, S.K., "Handbook of Offshore Engineering ", Elsevier, 2005
3. Chakrabarti, S.K., "Hydrodynamics of Offshore Structures", Springer - Verlag, 2003.
4. Chandrasekaran, S., Dynamic analysis and design of ocean structures, 2017
5. Reddy, D.V. and Arockiasamy, M., "Offshore Structures", Vol.1 and Vol.2", Krieger Publishing Company, Florida, 1991.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3		3	3		2	3	
2	2		2	2			2	2
3	2			2			2	
4	3	2		3		2	3	3
5	3			2	3	3	3	3
CO (W.A)	**2.6**	**2**	**2.5**	**2.4**	**3**	**2.33**	**2.6**	**2.67**

22STX11 - WIND AND CYCLONE EFFECTS ON STRUCTURES				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study the concept of wind and cyclone effects for the analysis and design of structures	**1.1**	The students will be able to explain the characteristics of wind
2.0	To promote research and development work in the field of Wind tunnel studies.	**2.1**	The students will be able to model and analyse a structure in a wind tunnel
3.0	To learn about the effects of static and dynamic effects on tall buildings.	**3.1**	The students will be able to evaluate the intensity of wind on structures
4.0	To get the design concept of chimneys and transmission towers as per codal provisions	**4.1**	The students will be able to design some special structures subjected to wind loading
5.0	To gives knowledge of cyclone effects on structures for helping in cladding design.	**5.1**	The students will be able to design the structures as cyclone resistant

UNIT I - INTRODUCTION	**(9)**
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 II - WIND TUNNEL STUDIES	**(9)**
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	
UNIT III - EFFECT OF WIND ON STRUCTURES	**(9)**
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 IV - DESIGN OF SPECIAL STRUCTURES	**(9)**
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 V - CYCLONE EFFECTS	**(9)**
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.	
TOTAL (L:45) : 45 PERIODS	

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. Lawson T.V, "Wind Effects on Building Vol. I and II", Applied Science Publishers, London, 1980.
4. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, New York, 2014.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1			2		2			2
2	2		2	3		2	2	
3	3	3	3	3		2	3	3
4	2	2	2		3	2	3	3
5	3				3	3	3	3
CO (W.A)	**2.5**	**2.5**	**2.25**	**3**	**2.67**	**2.25**	**2.75**	**2.75**

22STX12 - DESIGN OF BRIDGES *(IS456:2000, IS 458-1971,IRC 5-1998,IRC 6-2001,IRC 18-2000,IRC 21-2000,IRC 22-1986, IRC 24-2001,IRC 78-2000,IRC 83 Part 1-1989, IRC 83 Part 2-1987 codes are to be permitted)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE REQUISITE : NIL

Course Objectives		**Course Outcomes**	
1.0	To study about the Classification, Specification and Design Considerations for Bridge Structures.	**1.1**	The students will be able to apply knowledge in IRC specification
2.0	To study the design principles of substructure and design of different types of bearings as per IRC loadings standards	**2.1**	The students will be able to simplify the stresses in sub-structure and design the piers and abutments
3.0	To learn and understand the Design of Various Elements of the Bridge Structure.	**3.1**	The students will be able to analyze and design the short span bridges
4.0	To get knowledge on the Design Principles of Bridges	**4.1**	The students will be able to formulate the procedure to design the long span bridges
5.0	To study the design concepts of Prestressed Bridges.	**5.1**	The students will be able 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 as per IRC loadings - introduction to bridge loading worldwide	
UNIT II - SUBSTRUCTURE, BEARINGS AND DECK JOINTS	**(9)**
Pier - Abutment - Wing walls - Importance of Soil-Structure Interaction - Types of foundations - Open foundation - Pile foundation - Well foundation Different types of bridge bearings and expansion joints; Design of bearings and joints.	
UNIT III - SHORT SPAN BRIDGES AND CULVERTS	**(9)**
Design of box culverts, short span slab decks in square & skew - Design of T & I girder and Introduction to Box girder bridges by IRC method	
UNIT IV - LONG SPAN BRIDGES	**(9)**
Analysis & design principles of continuous bridges, arch bridges, cable stayed bridges and suspension bridges- Design principles only	
UNIT V - PRESTRESSED CONCRETE BRIDGES AND STEEL BRIDGES	**(9)**
Design principles of PSC bridges - PSC girders - design principles of steel bridges - Plate girder bridges – Box girder bridges - Truss bridges	

REFERENCES:

1. Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", 2nd Edition, Prentice Hall of India Pvt. Ltd. 2009
2. Ponnuswamy, S., "Bridge Engineering", 3rd Edition, Tata McGraw Hill, 2017.
3. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi,2014
4. Krishnaraju.N, "Design of Bridges" Oxford & IBH publishing Co. Pvt Ltd, 4th Edition, 2008

TOTAL (L:45) : 45 PERIODS

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	3	2	3	3	3	3	3
2	3	2	3	3	3	3	3	3
3	3	2	3	3		3	3	3
4		2		2		2	2	3
5			2			2	2	
CO (W.A)	**2.67**	**2.25**	**2.5**	**2.75**	**3**	**2.6**	**2.6**	**3**

22STX13 - MECHANICS OF COMPOSITE MATERIALS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study the behavior of composite materials and investigate the failures	**1.1**	The students will be able to classify different types of composite materials
2.0	To gain knowledge about analysis, failure, fracture and stress strain relations of composite materials	**2.1**	The students will be able to select material, configuration and manufacturing process of composite materials.
3.0	To analyse the composite plates.	**3.1**	The students will be able to analyze laminated composite plates and sheets
4.0	To study the behaviour of composite materials and to investigate the failure and fracture characteristics.	**4.1**	The students will be able to examine the failure pattern of composite structures
5.0	To learn about the composite components and applications	**5.1**	The students will be able to design simple composite elements

UNIT I - INTRODUCTION	**(9)**
Introduction to Composites, Classifying composite materials, Commonly used fibre and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites, Short Fiber Composites and processing of FRP Composites	
UNIT II - FIBRE REINFORCED COMPOSITE STRUCTURES	**(9)**
Introduction, Composite structural design, Design spiral, Design criteria, Design allowables and Material selection in composite design, Selection of configuration, Manufacturing process, Laminate selection, Laminate design procedure.	
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 with Composites, Review, Environmental Issues.	

TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Daniel. I.M, and Ishai. O, "Engineering Mechanics of Composite Materials", 2nd Edition, Oxford University Press, 2005.
2. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universities Press, India, 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", McGraw - Hill, Kogakusha Ltd., Tokyo, 1975.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			2	2			3	
2	2		2			2	2	
3			2	3		2	3	3
4	2		3	3		2	2	2
5	3				3		3	3
CO (W.A)	**2.33**		**2.25**	**2.67**	**3**	**2**	**2.6**	**2.67**

22STX14 - NON-LINEAR ANALYSIS OF STRUCTURES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To study the concept of nonlinear behaviour and analysis of elements and simple structures	**1.1**	The students will be able to distinguish determinate and indeterminate non linear analysis		
2.0	To analyze inelastic analysis for uniform stiffness members	**2.1**	The students will be able to predict the type of analysis for flexural members		
3.0	To acquire knowledge on the concepts of vibration theory	**3.1**	The students will be able to outline the dynamic analysis for flexural members		
4.0	To study about the elastic and inelastic plates	**4.1**	The students will be able to analyze the plates using elastic and inelastic theories		
5.0	To understand the concepts of non linear vibration theories	**5.1**	The students will be able to demonstrate the non- linear analysis and failure pattern of beams		

UNIT I - INTRODUCTION TO NONLINEAR ANALYSIS	**(9)**
Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness	
UNIT II - INELASTIC ANALYSIS OF FLEXURAL MEMBERS	**(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.	
UNIT III - VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS	**(9)**
Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading.	
UNIT IV - ELASTIC AND INELASTIC ANALYSIS OF PLATES	**(9)**
Elastic and inelastic analysis of uniform and variable thickness plates.	
UNIT V - NONLINEAR VIBRATION AND INSTABILITY	**(9)**
Nonlinear vibration and Instabilities of elastically supported beams	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1.Sathyamoorthy, M., "Nonlinear Analysis of Structures", CRC Press, Boca Raton, Florida, 2017.

2.Fertis, D. G., "Nonlinear Mechanics", CRC Press, Boca Raton, Florida, 1998.

3.Reddy.J.N, "Non linear Finite Element Analysis", Oxford University Press, 2014.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1				2				2
2	3			3		2	2	
3	3			2	2		2	
4			2	3				2
5		2		3		2	2	
CO (W.A)	**3**	**2**	**2**	**2.6**	**2**	**2**	**2**	**2**

22STX15 - DESIGN OF PRESTRESSED CONCRETE STRUCTURAL ELEMENTS *(IS 1343-1980 & IS 3370 codes are to be permitted)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To develop the skill of the student in gaining knowledge of prestressing principles.	**1.1**	The students will be able to analyse the stresses in prestressed concrete member due to prestressing force and its variation due to losses.		
2.0	To design the flexural members as per codal provision	**2.1**	The students will be able to design the beams for shear, bond and flexure.		
3.0	To design the prestressed members to check the anchorage zone and deflection as per codal provision	**3.1**	The students will be able to compute the deflections and anchorage zone stresses.		
4.0	To analyze the composite continuous beams and its applications	**4.1**	The students will be able to implement the methods for achieving continuity in beams.		
5.0	To learn and design the special structures as per codal provisions	**5.1**	The students will be able to evaluate the design of circular prestressing and the uses of non prestressed reinforcement.		

UNIT I - INTRODUCTION	**(9)**
Basic principles of Prestressing - Classification and types - Advantages over ordinary reinforced concrete - Materials - high strength concrete and high tensile steel - Methods of Prestressing - Freyssinet, Magnel Blaton, Lee Mc Call and Killick anchorage systems - Analysis of sections for stresses by stress concept, strength concept and load balancing concept - Losses of prestress	
UNIT II - DESIGN FOR FLEXURE AND SHEAR	**(9)**
Basic assumptions for calculating flexural stresses - Permissible stresses in steel and concrete as per IS 1343 Code - Design of sections of Type I, II and III posts - tensioned and pre -tensioned beams - Check for strength limit state based on IS 1343 Code - Layout of cables in post-tensioned beams - Location of wires in pre-tensioned beams - Design for shear based on IS 1343 codal provisions.	
UNIT III - DEFLECTION AND DESIGN OF ANCHORAGE ZONE	**(9)**
Factors influencing deflections - Short term deflections of uncracked members - Prediction of long term deflections due to creep and shrinkage - Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post - tensioned beams by Magnel's method, Guyon's method and I.S.1343 code - Design of anchorage zone reinforcement.	
UNIT IV - COMPOSITE BEAMS	**(9)**
Types of R.C.C. - P.S.C composite beams - Analysis and design of composite beams and Continuous Beams - Methods of achieving Continuity in continuous beams - Analysis for secondary moments - Concordant cable and	

linear transformation - Calculation of stresses - Principles of design.

UNIT V - MISCELLANEOUS STRUCTURES	**(9)**
Design of tanks, pipes, sleepers, tension and compression members - Use of non- pre stressed reinforcement - Definition, methods of achieving, merits and demerits of partial Pre stressing.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1.Krishna Raju, N., "Prestressed Concrete", Tata McGraw Hill Publishing Company, New Delhi, 2008.

2.Rajagopalan, N., "Prestressed Concrete", Narosa Publishing House, New Delhi, 2008

3.Dayaratnam, P., "Prestressed Concrete Structures", Oxford and IBH, New Delhi, 1982.

4.Sinha, N.C.and Roy, S.K., "Fundamentals of Prestressed Concrete", S.Chand & Co., Ltd.,

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1		2	3	3		2	3	
2	2				3	3	3	3
3			2	2			2	
4			2			2		2
5			3	2	2		2	
CO (W.A)	**2**	**2**	**2.5**	**2.33**	**2.5**	**2.33**	**2.25**	**2.5**

22STX16 - ENERGY EFFICIENT BUILDINGS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the concept of reduction in energy consumption through low energy building design	**1.1**	The students will be able to eExplain the climate responsive building design and concepts
2.0	To gain knowledge on the l landscape and building envelopes	**2.1**	The students will be able to design landscape with the basic terminologies related to buildings
3.0	To acquire knowledge on the applications of ventilation model air flow and ventilation	**3.1**	The students will be able to explain the passive (air) conditioning techniques
4.0	To Highlight strategies to integrate daylighting and low energy heating/cooling in buildings	**4.1**	The students will be able to summarize the performance of buildings
5.0	To learn the sources of Renewable Energy	**5.1**	The students will be able to outline the renewable energy systems in buildings

UNIT I - INTRODUCTION	**(9)**
Conventional versus Energy Efficient buildings - Historical perspective - Water - Energy - IAQ requirement analysis - Future building design aspects - Criticality of resources and needs of modern living.	
UNIT II - LANDSCAPE AND BUILDING ENVELOPES	**(9)**
Energy efficient Landscape design - Micro-climates - various methods - Shading, water bodies-Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, Insulation, Design methods and tools.	
UNIT III - HEATING, VENTILATION AND AIR-CONDITIONING	**(9)**
Natural Ventilation, Passive cooling and heating - Application of wind, water and earth for cooling, evaporative cooling, radiant cooling - Hybrid Methods - Energy Conservation measures, Thermal Storage integration in buildings	
UNIT IV - HEAT TRANSMISSION IN BUILDINGS	**(9)**
Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.	

UNIT V - PASSIVE COOLING AND RENEWABLE ENERGY IN BUILDINGS	(9)
Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel. Introduction of renewable sources in buildings, Solar water heating, small wind turbines, stand-alone PV systems, Hybrid system - Economics.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Clarke, Joseph. "Energy simulation in building design" 2nd Edition, Routledge, 2007
2. Krishan, Arvind, ed. "Climate responsive architecture: a design handbook for energy efficient buildings,. Tata McGraw-Hill Education, 2001.
3. Krieder, J and Rabi, A., "Heating and Cooling of buildings: Design for Efficiency", McGraw Hill, 2010.
4. Lal Jayamaha, "Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance", McGraw Hill Professional. 2006

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1				2		2		2
2		3		2	3	3	3	3
3			2			2		2
4				2		2	2	2
5	2		2	2	2		3	3
CO (W.A)	**2**	**3**	**2**	**2**	**2.5**	**2.25**	**2.67**	**2.4**

22STX17 - STRUCTURAL HEALTH MONITORING					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn concepts involved SHM advantages and challenges	**1.1**	The students will be able to adopt a proper health monitoring technique		
2.0	To develop knowledge on sensor technique	**2.1**	The students will be able to suggest the materials and techniques used for repair of structures.		
3.0	To learn different static and dynamic measurement techniques	**3.1**	The students will be able to identify the suitable static and dynamic measurement technique		
4.0	To Gain Knowledge about Damage Detection techniques	**4.1**	The students will be able to compare the various damage detection techniques		
5.0	To impart knowledge on both elementary and advanced applications of SHM with case studies	**5.1**	The students will be able to apply the various data processing methods through case studies		

UNIT I - INTRODUCTION TO STRUCTURAL HEALTH MONITORING	**(9)**
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)**
Sensors for measurements: Electrical Resistance Strain Gages, Vibrating Wire Strain Gauges, Fiber 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)**
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)**
Damage Diagnostic methods based on vibration response - Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, 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, Phased array imaging, Focusing	

array/SAFT imaging
UNIT V - DATA PROCESSING AND CASE STUDIES **(9)**
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 (L:45) : 45 PERIODS

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, Woodhead Publishing, 2009

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			2	2		2		2
2			3	3	3	3	3	3
3			2		2		2	2
4	2			2			3	2
5	2			2		2	2	
CO (W.A)	**2**		**2.33**	**2.25**	**2.5**	**2.33**	**2.5**	**2.25**

22STX18 – FIRE RESISTANT DESIGN OF STRUCTURES				
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL				

Course Objectives		Course Outcomes	
1.0	To learn about the offshore structures and environmental loads.	**1.1**	The students will be able to classify the offshore platforms and explain the characteristics, merits and demerits of offshore platforms.
2.0	To study about the special loads.	**2.1**	The students will be able to explain the method of analysis and design requirements for special loads acting on a structure.
3.0	To familiarize with the advanced structural analysis methods	**3.1**	The students will be able to enumerate the applications of curved beams, marine risers and other special structures.
4.0	To study overview of about the fire safety and blast resistance.	**4.1**	The students will be able to outline the Fire damage and its control by identifying the suitable fire protection systems.
5.0	To expose the students to fundamentals of fire resistant design concepts	**5.1**	The students will be able to explain the design approach for the behaviour of structural members and offshore platforms under fire.

UNIT I - OFFSHORE STRUCTURES AND ENVIRONMENTAL LOADS	**(9)**
Introduction - Types of offshore platforms - Fixed, Compliant and Floating structures - Novelty of offshore structures - New generation offshore platforms - Response Characteristics - Merits and demerits	
UNIT II - SPECIAL LOADS	**(9)**
Wave loads - Wind loads - Ice loads - Earthquake loads - Impact and Non-impact wave loads - Estimation of loads and methods of analyses - General Design Requirements - Application to offshore platforms	
UNIT III - ADVANCED STRUCTURAL ANALYSIS	**(9)**
Unsymmetrical bending - Shear Centre - Curved beams - Rings and Chains - Marine risers - Application problems - Vortex induced vibration - Suppression systems for VIV	
UNIT IV - FIRE SAFETY AND BLAST RESISTANCE	**(9)**
Fire safety overview - Objective of fire resistance - Potential fire risks - Fire ratings - Fire damage and control - Explosion - Fire protection - Fire protection system design - Blast resistance	
UNIT V - FIRE RESISTANCE DESIGN	**(9)**
Overview - Fire and explosion characteristics of materials - Types of fire - Behaviour of structural members under fire - Design Approach - Complications in the fire resistant design of offshore platforms	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Eurocode,"Design of steel structures, Part 1-2, General rules: Fire resistant design", Document CEN, European Comm. of Standardization, U.K. 2005
2. Malhotra, H.L.. "Design of fire-resistant structures", Surrey University Press, Glasgow,1982
3. Malhotra, H.L.. "Fire safety in buildings", Garston,1987
4. Srinivasan Chandrasekaran and A.K.Jain. "Ocean structures: Construction, Materials and Operations", CRC Press, Florida, and ISBN: 978-14-987-9742-9, 2016.
5. Srinivasan Chandrasekaran, "Offshore structural engineering: Reliability and Risk Assessment",CRC Press, Florida, ISBN:978-14-987-6519-0, 2016

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1			2	2		2	2	
2		2	3	2			3	3
3	3		2	2				3
4				2		2	2	
5	2		2		3	2	3	3
CO (W.A)	**2.5**	**2**	**2.25**	**2**	**3**	**2**	**2.5**	**3**

22STX19 - DESIGN OF FORM WORK *(IS 14687 code is to be permitted)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To study and understand the detailed planning of formwork	**1.1**	The students will be able to select proper formwork
2.0	To know the formwork materials and types	**2.1**	The students will be able to select accessories and material for form work
3.0	To Design formwork for various elements such as foundation, slabs, beams, columns and walls.	**3.1**	The students will be able to design the form work for Beams, Slabs, columns, Walls and Foundations
4.0	To Design forms for various special structures like domes, towers, bridges	**4.1**	The students will be able to design the form work for Special Structures
5.0	To identify the causes and failures of form work	**5.1**	The students will be able to judge the formwork failures through case studies

UNIT I - INTRODUCTION	**(9)**
General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - 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 (L:45) : 45 PERIODS	

REFERENCES:

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

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1			2		2	2		2
2				2	2			
3			2	3	2		2	2
4				2	2		2	
5	2		2	2			2	
CO (W.A)	**2**		**2**	**2.25**	**2**	**2**	**2**	**2**

22STX20 - GREEN BUILDING MANAGEMENT					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					

Course Objectives		Course Outcomes	
1.0	To understand the concept of green building concept	**1.1**	The students will be able to understand the concepts of green building
2.0	To Understand the green rating system	**2.1**	The students will be able to summarize the existing green building rating systems
3.0	To design the alternate material	**3.1**	The students will be able to apply alternate construction materials and methods
4.0	To Highlight strategies to integrate energy efficient buildings	**4.1**	The students will be able to rate the green buildings
5.0	To analyses the green building rating system	**5.1**	The students will be able to survey the codes for certification of green construction.

UNIT I - INTRODUCTION TO IGBC AND GREEN BUILDING CONCEPT	**(9)**
Green Building Concept - Introduction to IGBC- Green Building Rating Tools - Green Project Management and Certification - Documentation and Certification	
UNIT II - INTRODUCTION TO GREEN RATING SYSTEMS	**(9)**
History of green Rating systems - LEED, GRIHA, BREEAM, IGBC - Need and use of green rating systems - Structure of the rating systems - Market response to various rating systems - Selection of the appropriate rating system. ZEB - NZEB -ZCB ratings	
UNIT III - ALTERNATIVE CONSTRUCTION MATERIALS AND METHODS	**(9)**
Building and Material Reuse - Salvaged Materials - Material Content - Manufactured Materials - Recycled Content - Eco Block - Volatile Organic Compounds (VOC's) Natural Non-Petroleum Based Materials - Alternative Construction Methods - Waste Management and Recycling - Design For Deconstruction	
UNIT IV - PERFORMANCE TESTING	**(9)**
Cost and Performance Comparisons and Benchmarking - Building Modeling & Energy Analysis - Cost Benefit Analysis - Energy, Shell and Systems Installation Testing - Blower Door - Duct Tightness - Thermal Imagery - Air Quality - Moisture Testing - Commissioning, Metering, Monitoring -Weatherization - Air Sealing – HVAC - Moisture Control - Energy Retrofits and Green Remodels	
UNIT V - FUTURE OF BUILDING RATING SYSTEMS	**(9)**
Role of Green building consultant - Determining the various green points - Green Accreditation examinations - Energy modeling and energy auditing in green building ratings - Consultancy scope and services for green rating systems - Codes and Certification Programs - Green Rating Registration - Green Remodel Ratings - International Green Construction Codes and ratings - Service life span - Case Study	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Linda Reeder, "Guide to green building rating systems ", 3rd Edition, John Wiley & Sons, 2010.
2. Dru Meadows," Preparing a Building Service Life Plan for Green Buildings", McGraw-Hill Publications, 1st Edition, 2014.
3. Abe Kruger," Green Building: Principles and Practices in Residential Construction", 1st Edition, Cengage learning India Pvt Ltd, 2012.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		2	2	3		2	3
2			2			2		3
3		2	2	3		2	3	3
4				2		2		2
5			2		3	2	3	3
CO (W.A)	**2**	**2**	**2**	**2.33**	**3**	**2**	**2.67**	**2.8**

22STX21 - RISK AND RELIABILITY OF STRUCTURES				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the concepts in probability and plausibility.	**1.1**	The students will be able to relate the different approaches to quantify uncertainties and plausible reasoning
2.0	To learn about modelling random variables and sampling estimates	**2.1**	The students will be able to analyse the structural reliability on structure
3.0	To introduce the basics of structural reliability and analysis procedures	**3.1**	The students will be able to analyse the reliability by error estimation and examine the failure patterns
4.0	To impart knowledge on reliability based design and principles underlying code calibration	**4.1**	The students will be able to propose a mechanical model for reliability analysis and studies on behaviour of tubular joints
5.0	To understand the importance of safety and reliability issues of offshore facilities during analysis, design, inspection and planning	**5.1**	The students will be able to analyse and manage risk by Fault Tree Analysis, Event Tree Analysis

UNIT I - PROBABILITY AND PLAUSIBILITY	**(9)**
Introduction - Types of uncertainties- Probability - Probabilistic and non-probabilistic methods - Modular Bayesian Approach - Frequensitic Approach - Rules of probability - Plausible reasoning - Quantitative rules	
UNIT II - MODELLING RANDOM VARIABLES AND SAMPLING ESTIMATES	**(9)**
Probability distribution - Random variables - Sampling estimates - Modelling of environmental loads structural reliability - variables in reliability analysis	
UNIT III - RELIABILITY ANALYSIS	**(9)**
Components of reliability analysis - Levels of Reliability-Error estimation - Reliability methods-System Reliability -Failure domains - Application problems	
UNIT IV - MECHANICAL MODELS AND FATIGUE RELIABILITY	**(9)**
Codes on structural reliability - Mechanical models in Reliability analysis-Stochastic process - Fatigue reliability - Design SN curve - Simplified Fatigue Assessment - Short term fatigue damage - Behaviour of tubular joints - Experimental studies on Tubular joints	
UNIT V - RISK AND RELIABILITY	**(9)**
Risk Assessment-Logical Risk Analysis - Risk Analysis of Mechanical Systems-FMEA - Fault Tree Analysis - Event Tree Analysis - Consequence Analysis - Risk Acceptability-Risk and Hazard Assessment - Risk Management	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Chakrabarti, S.K. "Non-linear Method in Offshore Engineering", Elsevier Science Publisher, The Netherlands, 1990
2. Chandrasekaran, S. and Bhattacharyya, S.K. "Analysis and Design of Offshore Structures", HRD Center for offshore and Plant Engineering (HOPE), Changwon National University, Republic of Korea, pp. 285. 2011
3. Cowell RG, Dawid AP, Lauritzen SL, Spiegelhalter DJ. "Probabilistic networks and expert systems", New York: Springer; 1999.
4. Halder, A. and Mahaderan, S., "First order and Second order Reliability Method Probabilistic Structural Mechanics Hand Book, Edited by C. (Raj) Sundararajan, Chapman and Hall, PP. 27-52, 1995.
5. Srinivasan Chandrasekaran. "Offshore structural engineering: Reliability and Risk Assessment",CRC Press, Florida, ISBN:978-14-987-6519-0, 2016

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2			2		2		2
2			1	3		1	2	2
3			2	2	3	2	3	2
4			2	2		1		2
5			2	2			2	
CO (W.A)	**2**		**2.33**	**2.2**	**3**	**1.5**	**2.33**	**2**

22STX22 - DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES *(IS: 800-2007, IS 11384-1985 & EURO code-4 are to be permitted)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To develop an understanding of the behaviour and design procedure of steel - concrete composite elements and structures.	**1.1**	The students will be able to identify the different types of steel-concrete composite structures		
2.0	To study the design of composite beams and columns	**2.1**	The students will be able to design the composite beam and column.		
3.0	To acquire knowledge about the composite trusses	**3.1**	The students will be able to apply the studs in roofs and slabs and predict the cracking pattern.		
4.0	To gain knowledge about composite box girder bridges, vibration of composite section and cyclic behavior of composite sections	**4.1**	The students will be able to analyze the various bridges and design the economical one		
5.0	To give an exposure on case studies related to steel-concrete composite construction.	**5.1**	The students will be able to study and evaluate case studies		

UNIT I - INTRODUCTION	**(9)**
Introduction to steel - concrete composite construction - Advantages - Theory of composite structures - Introduction to steel - Concrete - Steel sandwich construction	
UNIT II - DESIGN OF COMPOSITE BEAMS AND SLABS	**(9)**
Behaviour of composite beams - Design of composite beams including shear connector - Behaviour and design of composite columns and composite slab	
UNIT III - COMPOSITE TRUSSES	**(9)**
Introduction - Stud shear connectors - Effective Concrete Slab - Design consideration: Preliminary design, detailed analysis and design - Design of studs - Partial shear - Concrete cracking - Practical considerations - Cost implications - Design problems	
UNIT IV - COMPOSITE BRIDGES	**(9)**
Introduction - design of composite bridge deck - Composite box girder bridges - Behaviour of composite box girder bridges - Design concepts	
UNIT V - GENERAL	**(9)**
Case studies on steel - Concrete composite construction -Seismic behavior of composite structures	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol. I, 4th 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, 2013.
3. Owens. G.W and Knowles. P,"Steel Designers Manual", 7th Edition, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 2011.
4. Narayanan R, "Composite steel structures - Advances, design and construction", Elsevier, Applied science, UK, 1987

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	2		2	3		2	2	3
2			3	2	3	2	3	3
3		2	2	2			2	2
4	2		3	2	3	3	3	3
5	2			2			2	
CO (W.A)	**2**	**2**	**2.5**	**2.2**	**3**	**2.33**	**2.4**	**2.75**

22BAZ01 - RESEARCH METHODOLOGY AND IPR

L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To understand the basic concepts of research and its methodologies, investigation of solutions for research problem, data collection, analysis and interpretation	1.1	The students will be able to demonstrate the concepts of research and its methodologies, Approaches of information investigation of solutions for research problem, data collection, analysis and interpretation
2.0	To identify the various procedures to collectliterature studies approaches, analysis, plagiarism, and research ethics.	2.1	The students will be able to formulate effective literature studies approaches, analysis, plagiarism, and research ethics.
3.0	To inculcate knowledge on Effective technical writing and method to write report	3.1	The students will be able to identify the design for Effective technical writing and how to write report
4.0	To provide knowledge process like drawing and drafting tools and reviewing research papers	4.1	The students will be able to choose the process like drawing and drafting tools and reviewing research papers
5.0	To summarize the design for Intellectual property rights and code of ethics	5.1	The students will be able to formulate the design for Intellectual property rights and code of ethics

UNIT I - RESEARCH PROBLEM FORMULATION	**(9)**
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations	
UNIT II - LITERATURE REVIEW	**(9)**
Effective literature studies approaches, analysis, plagiarism, and research ethics	
UNIT III - TECHNICALWRITING /PRESENTATION	**(9)**
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.	
UNIT IV - INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)	**(9)**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
UNIT V- INTELLECTUAL PROPERTY RIGHTS (IPR)	**(9)**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Cooper, D. R. and Schindler, P.S., "Business Research Methods", Tata McGraw Hill, 9th Edition, 2009
2. Krishnaswamy, K.N., Sivakumar, A.I., and Mathirajan, M., "Management Research Methodology", Pearson Education, 2006.
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	2	1	1	2	1	3	
2	2	3	2	1			2	1
3	2	3	2	2	1	1	2	1
4	1	3	2	2	2	1	1	2
5	1	1	2	3	2	2	1	2
CO (W.A)	**1.80**	**2.4**	**1.80**	**1.80**	**1.75**	**1.25**	**1.80**	**1.50**

22PGA01 ENGLISH FOR RESEARCH PAPER WRITING				
	L	T	P	C
	2	0	0	0
PRE REQUISITE : NIL				

Course Objectives		Course Outcomes	
1.0	To make the students to improve writing skills and level of readability	**1.1**	The students will be able to improve writing skills and level of readability
2.0	To explain the strategic planning process and apply different presentation method	**2.1**	The students will be able to describe what to write in each section
3.0	To foster the ability to understand and to utilize the mechanics of writing	**3.1**	The students will be able to explain the skills needed for writing quality research paper
4.0	To Infer the skills needed when writing the Conclusion	**4.1**	The students will be able to explore the recent areas of research
5.0	To focus research and its key variables, guiding through research process	**5.1**	The students will be able to illustrate the good quality of paper at very first-time submission

UNIT I - INTRODUCTION	**(6)**
Planning and Preparation - Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
UNIT II - PRESENTATION SKILLS	**(6)**
Clarifying Who Did What- Highlighting Findings - Hedging and Criticizing- Paraphrasing - Sections of a Paper – Abstracts - Introduction	
UNIT III - MECHANICS OF RESEARCH	**(6)**
Key skills needed for writing - Title, Abstract, Introduction, Discussion, Conclusion, The Final Check	
UNIT IV - PROCESS OF RESEARCH WRITING	**(6)**
Skills needed for writing Methods - skills needed when writing Results - skills needed when writing Discussion - skills needed when writing Conclusion.	
UNIT V - QUALITY RESEARCH PAPER	**(6)**
Useful phrases, Checking Plagiarism – Bibliography – Citation - how to ensure paper is as good as it could possibly be the first- time submission	
TOTAL (L:30) :30 PERIODS	

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.

22PGA02 DISASTER MANAGEMENT				
	L	T	P	C
	2	0	0	0

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To Summarize basics of disaster	**1.1**	The students will be able to summarize basics of disaster
2.0	To Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response	**2.1**	The students will be able to explain a critical understanding of key concepts in disaster risk reduction and Humanitarian response.
3.0	To Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	**3.1**	The students will be able to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4.0	To Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	**4.1**	The students will be able to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
5.0	To Develop the strengths and weaknesses of disaster management approaches	**5.1**	The students will be able to develop the strengths and weaknesses of disaster management approaches

UNIT I - INTRODUCTION	**(6)**
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	
UNIT II - REPERCUSSIONS OF DISASTERS AND HAZARDS	**(6)**
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.	
UNIT III - DISASTER PRONE AREAS IN INDIA	**(6)**
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.	
UNIT IV - DISASTER PREPAREDNESS AND MANAGEMENT	**(6)**
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.	

UNIT V - RISK ASSESSMENT	(6)
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	
TOTAL (L:30) :30 PERIODS	

REFERENCES:

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", 'New Royal book Company, 2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.

22PGA03 CONSTITUTION OF INDIA				
	L	T	P	C
	2	0	0	0

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	1.1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2.0	To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional	2.1	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3.0	To role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.	3.1	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..
4.0	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.	4.1	Discuss the passage of the Hindu Code Bill of 1956.
1.0	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	1.1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

UNIT I - HISTORY OF MAKING OF THE INDIAN CONSTITUTION	**(6)**
History, Drafting Committee, (Composition & Working)	
UNIT II - PHILOSOPHY OF THE INDIAN CONSTITUTION	**(6)**
Preamble, Salient Features	
UNIT III- ONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	**(6)**
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 IV - LOCAL ADMINISTRATION	**(6)**
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 V- ELECTION COMMISSION	(6)
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	
	TOTAL (L:30) :30 PERIODS

REFERENCES:

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 Edition, Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.