Pune University.

SYLLABUS

OF

M.E. CIVIL (STRUCTURES)

To be effective from

July 2013

University of Pune

M.E. (Civil) (Structures)

COURSE STRUCTURE FOR M.E. (For 2013Course)
(w.e.f. June – 2013)
SEMESTER I

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					
		Lect./ Pract.	Paper		TW	Oral/ Presentation	Total	Credits
			In Semester Assessment	End Semester Assessment				
501401	Advanced Mechanics of Solids	4	50	50	--	--	100	4
501402	Structural Dynamics	4	50	50	--	--	100	4
501403	Advanced Design of steel Structures	4	50	50	--	--	100	4
501404	Research Methodology Treatment	4	50	50	--	--	100	4
501405	Elective -I	5	50	50	--	--	100	5
501406	Lab Practice- I	4			50	50	100	4
	Total	**25**	**250**	**250**	**50**	**50**	**600**	**25**

SEMESTER –II

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pract.	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End Semester Assessment				
7	Finite Element Analysis	4	50	50	--	--	100	4
8	Theory of Plates & Shells	4	50	50	--	--	100	4
9	Advanced Design of Concrete Structures	4	50	50	--	--	100	4
10	Elective- II	5	50	50	--	--	100	5
11	Lab Practice- II	4	--	--	50	50	100	4
12	Seminar -I	4	--	--	50	50	100	4
	Total	**25**	**200**	**200**	**100**	**100**	**600**	**25**

SEMESTER –III

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pract.	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End Semester Assessment				
5014013	Earthquake Engineering and Disaster management	4	50	50	--	--	100	4
5014014	Design of RCC&Pr.CC bridges	4	50	50	--	--	100	4
5014015	Elective- III	5	50	50			100	5
5014016	Seminar-II	4			50	50	100	4
5014017	Project stage I	8	--	--	50	50	100	8
	Total	25	250	200	100	100	500	25

SEMESTER –IV

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pract.	Paper		TW	Oral/Presentation	Total	
			In Semester Assessment	End Semester Assessment				
5014018	Seminar III	5	--	50	50	100	200	
5014019	Project Work Stage II	20	--	150	50	100	300	25
	Total	**25**	**--**	**200**	**100**	**200**	**500**	**25**

Lab Practice I & II

The laboratory work will be based on completion of assignments / practicals /site visits, confined to the course in that semester.

***Note*:- Select any one module from Section-I , II from each & III where ever applicable**

Elective-I(501405)		**Elective-II(501410)**		**Elective-III(501415)**	
Section-I (Credits = 2) Technical	***Section-II (Credits 3) Inter-Disciplinary***	***Section-I (Credits = 2) Technical***	***Section-II (Credits =2) Inter-Disciplinary***	***Section-I (Credits = 2) Technical***	***Section-II (Credits =2) Inter-Disciplinary***
1.Optimization technique 2.Soil structure Interaction 3.Plastic Analysis and Design of Steel Structure. 4.Design of Precast Components and Ferrocrete	Cyber Security/Information security	1.Design of Foundations 2.Non linear Analysis of structure. 3.Mechanics of Modern materials. 4.Theory of Plasticity	Human Rights ***Section-III (Credits =1)*** A)Yoga and Meditation B)Building Services & Maintenance C)Green Building Design &construction D)Foreign Language	1.Bio Mechanics& Bio Materials 2 .Adv analysis of steel frames 3.Design of Concrete shell structures. 4.Design of Composite Construction.	1)Foreign Language 2)Restoration and conservation of old structures. 3)Sustainable development. 4)Safety Practices in construction ***Section-III (Credits =1)*** E)Yoga and Meditation F)Building Services & Maintenance G)Green Building Design &construction H)Foreign Language
Total 2+3 = 5 Credits		Total 2+2+1 = 5 Credits		Total 2 +2+1 = 5Credit	

501401: ADVANCED MECHANICS OF SOLIDS

Teaching Scheme | **Examination Scheme**
Lectures: 4 hours/week | **In semester Exam: 50 Marks**
Credits 4 | **Theory Examination: 50 marks**
Duration:2Hrs

SECTION -I

Unit 1: Analysis of Stresses and Strains

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions, Relations between Elastic Constants, Problems on Navier Lame's Equilibrium Equations, Problems on Beltrami-Michell compatibility equations, Boundary value problems in Elasticity.

Unit 2: Stress-Strain Relationship

Generalized Hook's law for Isotropic, Orthotropic, plane stress, plane strain and axisymmetric problems, Problems in 2D and 3D Cartesian coordinate system, Airy's stress function, bending of beams.

Unit 3: Polar Coordinate System

Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions, Stress concentration problems such as stress concentration due to circular hole in stressed plate(Kirsch's Problem), stresses under concentrated load such as concentrated load acting on the vertex of a wedge (Michell's Problem) and Concentrated load acting on the free surface of a plate (Flamant's Problem), Axisymmetric Problems such as stresses in thick cylinders subjected to internal and external uniformly distributed pressures (Lame's Problem).

Section II

Unit 4: Beams Curved in Plan and Elevation

a. Analysis of Beams Curved in Plan such as cantilever circular arc, Semicircular beams fixed at two ends and subjected to central concentrated load, simply supported semicircular beam subjected to UDL supported on three equally spaced columns, Analysis of circular ring beam.
b. Analysis of Beams Curved in Elevation, Application to curved circular and elliptical Rings and Crane hooks

Unit 5: Torsion

Assumptions and Torsion equation for general prismatic solid bars, Warping of Non-circular sections and St. Venant's theory, Prandtle's stress function approach, Torsion of Circular, Elliptical and Triangular cross-section, Torsion of thin-walled structures by membrane analogy, Torsion of rolled sections and shear flow.

Unit 6: Beams on Elastic Foundation

Differential equation, Infinite beams with concentrated load, concentrated moment, and finite uniformly distributed load. Semi-Infinite beams with free & hinged ends subjected to finite uniformly distributed load, hinged end. Finite beams with free end and hinged end.

Reference Books

1. Timoshenko and Goodier - Theory of Elasticity, McGraw-Hill Publications
2. Enrico Volterra and J. H. Gaines – Advanced Strength of Materials, Prentice Hall
3. S. Crandall, N. Dahl and T. Lardner - Mechanics of Solids, McGraw Hill Publications
4. Wang - Applied Elasticity, Dover Publications
5. Irving Shames, Mechanics of deformable solids, Prentice Hall
6. Scholer, Elasticity in Engineering, McGraw-Hill Publications
7. Sadhu Singh – Theory of Elasticity, Khanna Publishers
8. L.S.Sreenath – Advanced Mechanics of Solids, Tata McGraw-Hill Publications
8. S M A Kazimi – Solid Mechanics, Tata McGraw-Hill Publications
9. N. K. Bairagi- Advanced Solid Mechanics- Khanna Publishers, New Delhi.

501402: DYNAMICS OF STRUCTURES

Teaching Scheme
Lectures: 4 hours/week
Credits 4

Examination Scheme
In semester Exam: 50 Marks
Theory Examination: 50 marks

SECTION -I

Unit 1:
Nature of exciting forces, degrees of freedom and mathematical modelling of dynamic systems. Single degree freedom system (SDOF): An undamped and damped free vibrations, Viscous and Coulomb's damping.

Unit 2:
SDOF system: Undamped and damped Forced Vibrations to harmonic excitations, Fourier analysis of periodic forces. Response to unit impulse and arbitrary loading by Duhamel's integral.

Unit 3:
SDOF system: Step and Ramp forces, Pulse loadings, Response to ground motion and transmissibility. Non-linear analysis by step-by-step method with linear acceleration.

SECTION -II

Unit 4:
Multiple degrees of freedom (MDOF) system: Free vibrations of a shear building, fundamental frequencies and mode shapes, Orthogonality of mode shapes, Power and Stodola methods. Concept of Tuned Mass Dampers.

Unit 5:
MDOF System: Forced Vibrations of shear building, transformation of coordinates and mode superposition method, Response to ground motion. Non-linear analysis by Wilson-Theta method.

Unit 6:
Continuous system: Free transverse vibrations of beams for various boundary conditions. Free vibration analysis of a cantilever beam by Rayleigh Ritz and Finite Element Method.

Reference Books

1. Dynamics of structures--Poultre, Wiley India
2. Mario Paz – Structural Dynamics Theory and Computation, CBS Publications
3.Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications
4.R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications
5.R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications.
.Madhujit Mukhopadhyay – Structural Dynamics Vibrations and Systems, Ane Books India Publishers

501403:ADVANCED DESIGN OF STEEL STRUCTURES

Teaching Scheme
Lectures: 4 hours/week
Credits 4

Examination Scheme
In semester Exam: 50 Marks
Theory Examination: 50 marks

SECTION- I

Unit 1 :
Hoarding Structures – Analysis and design of hoarding structures under dead live and wind loadConditions. Introduction to fatigue failure, Code provisions.

Unit 2:
Castellated beams – Fabrication of the castellated beam from rolled beam. Design of castellated beam for bending and shear, Code provisions

SECTION -II

Unit 3:
Microwave Towers – Introduction, structural configuration, function, analysis and design. Transmission Towers – Introduction, structural configuration, bracing systems, analysis and design, codal provision for design of tower and foundation.

Unit 4: Tubular Structures - Tubular Trusses, joint details, tubular scaffoldings, codal provisions, Circular Hollow ,Rectangular Hollow sections

Unit 5: Cold Form light gauge section- Type of cross section, Stiffened, multiple stiffened and unstiffened element, flat- width ratio, effective design width, Design of light gauge compression, tension and flexural members.Codal provisions

Unit 6: Review of Rigid and semi-rigid connections. Design of beam to column Moment resisting connections. End plate: Flush & extended, T-Stub connections. Combined tension & shear considerations in welded & bolted connection.

References Books

1. Ram Chandra - Design of steel Structures Vol II, Standard Book House, Delhi
2. Punmia and Jain- Comprehensive Design of steel structure.
3. Teaching resource materials by INSDAG, Kolkatta
4. IS: 800 – 2007 Code of Practice for General Construction in Steel 22/29
5. IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards(Revised)

501404: RESEARCH METHODOLOGY

Teaching Scheme **Examination Scheme**
Lectures: 4 hours/week **Theory Examination: 50 marks**
Credits 4 **Duration:2Hrs**

Section -I

Unit 1: Research Problem
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.

Unit 2: Basic instrumentation
Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

Unit 3: Applied statistics
Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis.

Section -II

Unit 4: Modelling and prediction of performance
Setting up a computing model to predict performance of experimental system, Multiscale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Unit 5: Developing a Research Proposal
Format of research proposal, Individual research proposal, Institutional proposal Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only. Other faculty members may attend and give suggestions relevant to topic of research.

Unit 6: **Computer Applications**
a)Computer applications for matrix operations, solution of ordinary and partial differential equations.
b)Computer applications for solution of transcendental equation, regression analysis and numerical integration.

Reference Books:
1. 'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard
2. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville
3. 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition
4. 'Research Methodology: Methods and Trends', by Dr. C. R. Kothari
5. 'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & co
6. Software Engineering by Pressman

501405: ELECTIVE –I :

Teaching Scheme

Lectures: 5 hours/week

Credits 5

Examination Scheme

In semester Assessment: 50 Marks

End Sem: Theory Examination : 50 marks

Duration:2Hrs

Modules of Credit 2: Any One	Module of Credit 3 : Compulsory Module
1.Optimization technique	
2.Soil structure Interaction	Cyber Security/Information security
3.Adv analysis of steel frames	**Teaching Load 3 Hr/week**
4.Design of Precast Components and Ferrocrete **Teaching Load 2 Hr/week**	

501405 Elective –I (A) OPTIMIZATION TECHNIQUES

Teaching Scheme
Lectures: 2 hours/week
Credits 2
Teaching load 2Hr/week

Examination Scheme
Theory Examination: 50 marks
Duration:2Hrs

Unit 1:Linear Programming I: Introduction to Optimization techniques, Linear programming basic concepts, graphical method, Simplex method

Unit 2:Linear Programming II: Big M Method, Two phase method, Duality, sensitivity analysis. Application of Linear Programming to Hydraulics & Water Resource

Unit 3:Non Linear Programming: Unconstrained one Dimensional search methods: Dichotomous search method, Fibonacci, Golden section, Multivariable unconstrained techniques: Steepest ascent and Descent methods, Newton's methods, Constrained technique: Lagrangian Multiplier

Unit 4:Dynamic Programming:

Principle of optimality, recursive equations.

Reference Books

1. Engineering Optimazation Theory & Practice – S.S. Rao., Wiely.
2. Operation Research – Taha Hamdey A.
3. Principles of Operation Research – Wagner, Prentice Hall.
4. Operation Research – Hira and Gupta, S.Chand

501405 Elective –I (B) Design of Concrete Plate &shell structures

Teaching Scheme
Lectures: 2 hours/week
Credits 2
Teaching load 2Hr/week

Examination Scheme
Theory Examination: 50 marks
Duration:2Hrs

UNIT I:
Types of plates, scope and assumptions, Simpson and Iteration method of analysis and design, Ridge load resolution, edge shear, stress distribution, deflection and rotations, joint moment effect, design of north-light folded plate

UNIT II:
Design of flat and concave plate circular in shape resting on ring beam, Continuous folded plate design

UNIT III:
Membrane and bending theory of shells,Theories in Matrix form, Boundary conditions, Shell Parameter selection, Stress resultant calculation, Reinforcement parameters and details, composition of Ferro-cement shells

UNIT IV:
Design by Beam theory, Beam and arch analysis, modified beam method, Design of Multiple bay cylindrical shell, Design of North light cylindrical shell, continuous cylindrical shell, hyperbolic paraboloid shell, Design of Pre-stressed cylindrical shell and dome, selection of optimum pre-stressing force, effect of pre-stressing force on stress distribution in shell

Term Work
- Two assignments based on syllabus.

Text Books :
1.G. S. Ramaswamy, 'Design and construction of concrete shell roofs', CBS publication
2.Naaman `Ferrocement Construction `
3.S. Timoshenko and W. Krieger, Theory of Plates and Shells, McGraw Hill.

Reference Books :
1.Ansel C. Ugural'Stresses in Plates and Shells', McGraw Hill
2.Chandrashekhara K., 'Analysis of Concrete Shells', New Age International Edition
3.Chandrashekhara K., 'Analysis of Plates', New Age International Edition
4.S. S. Bhavikatti, 'Theory of plates and shells', New Age International Publication
5.T.Y. Lin & Ned H. Burns – Design of Prestressed Concrete Structures, John Wiley Publication
6.N. Krishna Raju – Prestressed Concrete, Tata McGraw Hill Publication Co

Codes:
IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
IS: 1343: Indian Standard code of practice for Prestressed concrete, Bureau of Indian Standards, New Delhi.
IS: 1893: Indian Standard Code of practice for criteria for Earthquake resistant design of structures, Bureau of Indian Standards, New Delhi.
IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards.

501405 (C) THEORY OF PLASTICITY

Teaching Scheme
Lectures: 2 hours/week
Credits 2
Teaching load 2Hr/week

Examination Scheme
Theory Examination: 50 marks
Duration:2Hrs

SECTION -I

Unit 1:
Basic equations of theory of elasticity: Index notation, equations of equilibrium, constitutive relations for isotropic bodies, strain-displacement relations, compatibility, displacement and traction boundary conditions, admissibility of displacement and stress fields, plane stress and plane strain problems.

Unit 2:
Plastic behaviour in simple tension, generalisation of results in simple tension, yield surfaces, uniqueness and stability postulates, convexity of yield surface and normality rule, limit surfaces.Initial Yield Surfaces for Polycrystalline Metals: Summary of general form of plastic constitutive equations, hydrostatic stress states and plastic volume change in metals, shear stress on a plane, thevon Mises initial yield condition, the Tresca initial yield condition, consequences of isotropy.

Unit 3:
Plastic Behaviour under Plane Stress Conditions: Initial and subsequent yield surfaces in tension-torsion, the isotropic hardening model, the kinematic hardening model, yield surfaces made of two or more yield functions, piecewise linear yield surfaces, elastic perfectly plastic materials. Plastic Behaviour of Bar Structures - Behaviour of a three bar truss, behaviour of a beam in pure bending, simply supported beam subjected to a central point load, fixed beams of an elastic perfectly plastic material, combined bending and axial force.

Unit 4:
Theorems of Limit Analysis - Alternative statement of the limit theorems, the specific dissipation function, cold bending of bar beyond elastic limit, spring back, plastic bending with strain hardening material, plastic bending of wide plate.
Limit Analysis in Plane Stress and Plane Strain: Discontinuities in stress and velocity fields, the Tresca yield condition in plane stress and plane strain, symmetrical internal and external notches in a rectangular bar, the punch problem in plane strain, remarks on friction.

Reference Books
1. Martin, J.B., Plasticity, Fundamentals and General Results, MIT Press, London.
2. Kachanov, L.M., Fundamentals of the Theory of Plasticity, Mir Publishers, Moscow.
3. Chakrabarty, J, Theory of Plasticity, McGraw Hill, New York.
4. Hill, R., Mathematical Theory of Plasticity, Oxford University Press.
5. Chen, W.F., and Han, D.J., Plasticity for Structural Engineers, Springer Verlag.
6. Timoshenko, Theory of Plasticity, McGraw Hill

501405 (C) STRUCTURAL MECHANICS OF MODERN MATERIALS

Teaching Scheme
Lectures: 2 hours/week
Credits 2
Teaching load 2Hr/week

Examination Scheme
Theory Examination: 50 marks
Duration:2Hrs

Unit 1:

Introduction to Modern Materials: Fiber-Reinforced Polymer Composite (FRPC) Materials:Types and classification of composite materials, properties, advantages over conventional materials. Piezoelectric Materials: Shape Memory Alloys (SMA), Functionally Graded Materials (FGM): definition and applications.

Engineering Properties of Modern Materials: FRPC Composite Lamina: Micromechanics approach, methods. Longitudinal and transverse elastic properties of composite lamina, in-plane shear modulus for continuous fibers. Stress-strain relationship, compliance and stiffness matrices for generally anisotropic, specially orthotropic material, transversely isotropic material,orthotropic, isotropic materials, Plane stress condition for thin lamina, transformation of stress and elastic properties. Three dimensional transformations. Stress-Strain: Force Equilibrium, Strain Compatibility, Constitutive Laws of materials. Introduction to Fracture Mechanics.

Unit 2:

Design of Steel Fiber Concrete elements – flexure, shear, ductility etc., smeared concept, constitutive models for FRC, codal provisions for FRC (ACI, RILEM etc.), Hybrid Fiber composites, behaviour of macro-micro fiber matrix.

Macro and Micro mechanics of fibers.Stiffness matrix for Functionally Graded Materials.Pultruded Rod,GFRComposite,flexural members,Self healing Materials.

Unit 3:

Strength of Composite Lamina: Introduction. Failure theories, Maximum stress theory, Maximum strain theory, Energy based interaction theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu), Failure mode based theory (Hasin-Rotem). Computation of lamina strength by Tsai-Wu theory for plane stress condition. Comparison of various failure theories.

Unit 4:

A)Elastic behaviour of Composite Laminates: Basic assumptions, Laminate configurations, Strain-displacement relationship, Stress-strain relationship, Force and moment resultants, Laminate compliances and stiffness matrices, Transformation of matrices. Load deformation relationship for symmetric laminates, symmetric cross-ply, symmetric angle-ply, balanced, antisymmetric cross-ply and angle ply, orthotropic, quasi-isotropic laminates.

B)Experimental Methods of Testing of Composite Materials: Characterisation of constituent materials, fiber, matrix, thermal fiber, interface/interphase characterisation, Fiber volume ratio, void volume ratio. Determination of hygrothermal expansion coefficients, tensile, compressive and shear properties of unidirectional laminates. Testing of interlaminar fracture toughness, Biaxial testing. Introduction to stress concentration in laminates.

Reference Books

1. Isaac M. Daniel and Ori Ishai - Engineering Mechanics of Composite Materials, Oxford University Press, Second Edition, New Delhi.
2. Michael W. Hyer - Stress Analysis of Fiber-Reinforced Composite Materials, WCB/McGraw-Hill, Singapore.
3. Jones R. M. – Mechanics of Composite Materials, McGraw-Hill, New York
4. Roman Solecki and R Jay Conant – Advanced Mechanics of Materials, Oxford University Press, New York, Special Edition for sale in India.

Assignment:

Technical review and critique of a research article/paper on any one of the above topics –
A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

501405 (D) ADVANCED ANALYSIS OF STEEL FRAMES

Teaching Scheme
Lectures: 2 hours/week
Credits 2
Teaching load 2Hr/week

Examination Scheme
Theory Examination: 50 marks
Duration:2Hrs

SECTION I

UNIT I:
Elastic stability & structural Instability, Review of critical loads of long columns for various boundary conditions; beam-columns, critical load of simple rectangular frames. Columns with initial imperfection.

UNIT II:
First order elastic (FOE) & first order inelastic(FOIE) (Plastic) analysis of rectangular portal frames. Elastic & limit state of strength of frame.

UNIT III:
Second order considerations in elastic analysis of frames P-δ & P-Δ effect. Critical load of single bay, single storey portal frame using P-δ & P-Δ effect; classical & semi geometrical approach.
Direct second order elastic analysis (SOE), international codal provisions, application for simple frame.

UNIT IV:
Second order inelastic (SOIE) analysis of frames, elastic plastic hinge analysis, plastic zone method, use of finite element method Refined plastic hinge analysis, reduction in stiffness of member due to plasticity at hinge. Advantages of advanced analysis.
Design of frame using advanced analysis. Use of suitable software illustrating difference in analytical results among all methods such as FOE, FOIE, SOE, SOIE.

Term Work
•Two assignments, one on first section & second on Unit VI
Text Books :
1 “Stability Analysis & design of Structures” M.L. Gambhir, Springer, SIE
2 “Stability of structures” , Ashwini Kumar, Allied Publishers Ltd.

Reference Books :
1.“Advanced Analysis of steel frames, Theory Software and application”, W F Chen, S. Toma, CRC press, Tokyo
2.“ Plastic Analysis and Design of Steel Structures”, M Bill Wong, Elsevier
3.“ LRFD steel design using Advanced Analysis”, W F Chen, S. Kim, CRC press.

General Reading Suggested:
Codes:
1.IS: 800 - 2007 Code of Practice for General Construction in Steel
2.AISC Steel Construction Manual

501405 (E) Cyber Security/Information security (Credit3)

Teaching Scheme
Lectures: 2 hours/week
Credits 3

Examination Scheme
In -sem Examination: 50 marks
Duration:2Hrs

Unit 1:
Basic Concepts of Technology and Law: Basics of Information Technology, Basics of Indian Legal System, Information Technology Act 2000 (Amended), Relevant Amendments in all other laws

E-Contract: The essence of digital contracts, Law of Contract, Construction of E-contracts, Issues of security, Employment contracts, Consultant Agreements and Digital signature

Intelligent Property Issues in Cyber space: Doman names and related issues, Copyright in digital media, Patents in cyber world.

Rights of Neitzens and E- Governance: Privacy and freedom issues in cyber world, E-Governance, Cyber crimes and Cyber laws.

Unit 2:
Information Security Fundamentals: Background, Importance, Statistics, National and International Scenario, Goals of security, Confidentiality, Privacy, Integrity, Non-repudiation, Availability.
Essentials of computer security - Sources of security threats – Intruders, Viruses, Worms and related threats - Threat identification - Threat analysis - Vulnerability identification and Assessment.

Unit3:
Security Investigation: Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues

Security Policies and Management: Security Policy Design, Designing Security Procedures, Risk Assessment Techniques, Security standards, Security Models.

Reference Books:

1) Bakshi P M and Sri R K, Cyber and E-commerce Laws, Bharat Publishing House, 1st Edn, 2002
2) Syed shakil Ahmed, Rajiv Raheja, A handbook on Information technology: Cyber law and E-Commerce, Capital Law House, 2004
3) Rodney D Ryder, Business Process Outsourcing, Date Protection and Information Security, Wadhwa & Co., 1st Edn, 2001
4) Vakul Sharma, Information Technology Law and Practice, Delhi Law House, 3rd Edn, 2011
5) Lipton, K., Cyberspace Law Cases and Materials, 2nd edition. Aspen Publishers. NY: New York, 2006
6) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003
7) Micki Krause, Harold F. Tipton, Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2004.
8) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003

501406 FINITE ELEMENT METHOD

Teaching Scheme **Examination Scheme**
Lectures: 4 hours/week **In semester Exam: 50 Marks**
Credits 4 **Theory Examination: 50 marks**

SECTION- I

Unit 1:

a)Background on variational calculus. Galerkin methods, Collocation methods, Leastsquares methods. Variational methods of approximation- Rayleigh-Ritz method

b) Variational theorem; Principle of minimum potential energy, Use of polynomial displacement function. Variational approach for formulation of element stiffness matrix for truss & beam elements.

Unit 2:

a)Two dimensional elements in plane stress /plane strain problems. CST, LST & Rectangular elements, modelling considerations; aspect ratio, Use of polynomial displacement functions, Pascal triangle. Requirements for convergence, Geometric Invariance, Grid refinement

b) Standard stiffness and load vector formulation procedure using variational principle.

Unit 3:

a)Shape functions in cartesian & natural coordinate systems, shape functions for one dimensional element such as truss & beam. Shape function for two dimensional elements.

b)Three dimensional elements such as Tetrahydron, Hexahydron, shape functions, stress strain relations

SECTION -II

Unit 4:

a)Axisymmetric elements in axisymmetric problems, stress strain relations, triangular and Quadrilateral elements.

b)Concept of isoparametric elements and isoparametric mapping, Jacobian Matrix, Formulation procedure for 2 D quadrilateral isoparametric element in plane elasticity problem, 3-D isoparametric elements.

Unit 5:

a)Thin Plate bending elements, various Triangular and Rectangular elements, ACM (Adini, Clough, Melosh) and BFS (Bogner, Fox, Schimdt) elements

b)Conforming & nonconforming elements, Concept of four noded & eight nodded isoparametric elements, Mindlin's hypothesis for plate bending element.

Unit 6:

a)Flat & curved shell element, elements for cylindered shells, curved solid element

b)Ahmad's degenerated solid element, Pawsey's eight noded shell element.

Reference Books

1. J.N. Reddy – An Introduction to the finite element method – Tata McGraw Hill Publishing Co. Ltd
2. C.S. Krishnamoorthy – Finite Element Analysis – Theory & Programming – Tata McGraw Hill Publishing Co. Ltd
3. Zienkiewicz & Taylor - The Finite Element Method 4th Edition – Vol – I & II – McGraw Hill International Edition
4. G.R. Buchanan – Finite Element Analysis Schaum's outlines - Tata McGraw Hill Publishing Co. Ltd
5. S.S. Bhavikatti - Finite Element Analysis – New Age International Publishers, Delhi
6. S.S. Rao - The Finite Element Method in Engineering 4th Edition – ELSEVIER Publication

7. Robert D. Cook, D.S. Malkus, M.E. Plesha – Concepts & Applications of Finite Element Analysis – John Wiley & Sons.
8. Segerlind L.J. – Applied Finite Element Analysis - John Wiley & Sons.

Lab Practice:

1.Three assignments based on FEM by using coding tools such as EXCEL, MATLAB etc for

a) Formulation of stiffness matrix for any 1-D element
b) Formulation of stiffness matrix for any 2-D element
c) Formulation of stiffness matrix for any 3-D element
d) Assembly procedure using Jacobian matrix

2.Finite Element Method – Software applications of any one of following cases

a) Plane stress / plane strain problem
b) Axisymmetric problem
c) Three dimensional problem
d) Plate or shell structures

501407 THEORY OF PLATES AND SHELLS

Teaching Scheme **Examination Scheme**
Lectures: 4 hours/week **In semester Exam: 50 Marks**
Credits 4 **Theory Examination: 50 marks**

SECTION- I

UNIT I:

a)Introduction: Thin and thick plates, small and large deflections. Small deflection theory of thin plates: Assumptions, Moment Curvature relations. Stress resultants. Governing differential equation in Cartesian co-ordinates, various boundary conditions. Pure Bending of Plates

b)Analysis of Rectangular Plates: Navier solution for plates with all edges simply supported. Distributed loads, point loads and rectangular patch load.

UNIT II:

a) Levy's Method: Distributed load and line load. Plates under distributed edge moments. Raleigh-Ritz approach for simple cases in rectangular plates.

b) Introduction to shear deformation theories. Reissener - Mindlin Theory, Moment curvature relationship for First order shear deformation theory.

UNIT III:

a)Circular Plates: Analysis of circular plates under axi-symmetric loading. Moment Curvature relations.Governing differential equation in polar co-ordinates.

b)Simply supported and fixed edges. Distributed load, ring load, a plate with a central hole.

SECTION- II

UNIT IV:

a) Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations.

b)Shells of Revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.

UNIT V:

a)Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions.

b)Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions. Application to pipes and pressure vessels.

UNIT VI:

Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, application to cylindrical roof shells.

Term Work

The term work shall consist of a journal giving details of at least 8 out of 12 of the following experiments / assignments of which Sr.No 11 and 12 are compulsory.

1. Assignment based on Section I
2. Assignment based on Section II

Reference Books

1. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.
2. Ansel C. Ugural Stresses in Plates and Shells, Mc Graw Hill
3. G. S Ramaswamy, Design and Construction of Concrete Shell Roofs, CBS Publications
4. Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition
5. Chandrashekhara K., Analysis of Plates, New Age International Edition

501408 ADVANCE DESIGN OF CONCRETE STRUCTURES

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam: 50 Marks**
Credits 4	**Theory Examination: 50 marks**

SECTION -I

UNIT-I

Yeild line theory for analysis of slabs, Various patterns of yield lines , Assumptions in yield line theory, Equilibrium and virtual work method of analysis , Design of various slabs such as rectangular, triangular, circular with various edge conditions , Design for limit state of strength and serviceability orthotropically reinforced slabs,

UNIT-II

- Grid and coffered floors, general features , rigorous and approximate method of analysis design of grid floor by approximate method, Design of flat slab, column and middle strip, proportioning of flat slab element, design methods for flat slabs , Design by direct method only of intermediate and end panel , total design moment , distribution of moments , effect of pattern loading, Design for shear.

UNIT-III

Elevated service reservoir – Rectangular and Circular type only flat bottom, Design of staging for wind and earthquake forces, Effect of joint reactions and continuity

UNIT-IV

Design of Bunkers, Silos, and chimney—Square and circular bunkers, silos shallow and deep

UNIT-V

Design of raft foundations, Pile foundations, single pile, group of piles, Pile cap

UNIT-VI

Design of Shear wall, design of form work for slabs, girders, columns etc.

References :

1. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi
2. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi
3. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi
4- Reinforced Concrete design ---Dr.H.J.Shah—Charotar publishing house
5- Design of R.C.C—S.Ramaamruthum -- Dhanpat Rai publications
6. IS: 456-2000 Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
7. IS: 1893:-2002 Indian Standard Code of practice for criteria for Earthquake resistant design of Structures, Bureau of Indian Standards, New Delhi.
8. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi

5014010: ELECTIVE –II

Elective-II(501410)	
Section-I *(Credits = 2)* *Technical*	***Section-II*** ***(Credits =2)*** ***Inter-Disciplinary***
1.Design of Foundations	Human Rights
2.Non linear Analysis of structure.	***Section-II*** ***(Credits =1)***
3.Mechanics of Modern materials.	
4.Theory of Plasticity	A)Yoga and Meditation B)Building Services & Maintenance C)Green Building Design &construction D)Foreign Language

Draft Syllabus of elective subject of 2 credit :

502110 : HUMAN RIGHTS

Teaching Scheme: **Examination Scheme:**
Lectures : 2Hrs/Week **In semester assessment: 50 marks**
Credits: 2

Module 1. a: Human Rights – Concept, Development, Evolution
- Philosophical, Sociological and Political debates
- Benchmarks of Human Rights Movement.

Module 1. b: Human Rights and the Indian Constitution
- Constitutional framework
- Fundamental Rights & Duties
- Directive Principles of State Policy
- Welfare State & Welfare Schemes

Module 2: Human Rights & State Mechanisms
- Police & Human Rights
- Judiciary & Human Rights
- Prisons & Human Rights
- National and State Human Rights Commissions

-**Module 3: Human Rights of the Different Sections** and contemporary issues
- Unorganized Sector ,
- Right to Environment, particularly Industrial sectors of Civil Engineering and Mechanical Engineering .

-Globalization and Human Rights
- Right to Development,

Module 4. a: Citizens' Role and Civil Society
- Social Movements and Non-Governmental Organizations
- Public Interest Litigation

-Role of Non Government organizations in implementation of Human rights.
- Right to Information
Module 4. b: Human Rights and the international scene –Primary Information with reference to Engineering Industry.(2 hrs)
- UN Documents
- International Mechanisms (UN & Regional)
- International Criminal Court

Referances:
1.Study material on UNESCO,UNICEF web site
2.HUMAN RIGHTS IN INDIA A MAPPING,Usha Ramanathan: free download from http://www.ielrc.org/content/w0103.pdf
3.Introduction to International Humanitarian Law **by** Curtis F. J. Doebbler - CD Publishing **,** 2005 .
4.Freedom of Information**,**by Toby Mendel - UNESCO **,** 2008
Internal assessment :
i) Assignments based on topics from syllabus and case studies as applicable to relevant discipline of Engineering.
ii)Power point and oral presentation based on of selected topic from syllabus.

5014010 ELECTIVE –II (A) SOIL STRUCTURE INTERACTION

Teaching Scheme
Lectures: 2 hours/week
Credits 2

Examination Scheme

End semester Assesment :50 Marks
Duration:2Hrs

SECTION-I

UNIT I:

Introduction, Importance and Applications of SSI

a) Introduction to SSI, Importance of SSI, Applications and examples of SSI for structural engineer, Effects of structure roughness/smoothness on soil behaviour.

b)General soil-structure interaction problems – Shallow Foundations, Sheet piles, Mat/Raft foundations etc., Contact pressures and soil-structure interaction for shallow Foundations, Fixed/Flexible Base.

UNIT II:

Soil Structure Interaction - Parameters

a) Concept of sub grade modulus, effects/parameters influencing sub grademodulus, Flexiable and Rigid Foundations – Rigidity calculations, Static and Dynamic Spring Constants – Winkler Model, Estimation of soil spring constants/stiffness for foundations design.

b)SSIModels - Elastic Continuum, Winkler Model, Multi-Parameter Models, Hybrid Model. Structure Contact Interface,

UNIT III:

Soil Behaviour

a)Arching in soils. Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits/pipes in soils. Beams on elastic foundation concept, introduction to the solution of beam problems.

b)Seismic Soil-Structure Interaction - Dynamic response of soil, strain-compatibility, and damping characteristics of soil-structure. Shake-table tests.

UNIT IV:

A)SSI in Retaining Structures:Curved failure surfaces, their utility and analytical/graphical predictions from Mohr-Coulomb envelope and circle of stresses. Earth pressure computations by friction circlemethod. Earth pressure distribution on walls with limited/restrained deformations,Dubravo's analysis. Earth pressures on sheet piles, braced excavations. Design ofsupporting system for excavations.

B)Soil-Pile Behaviour:Introduction, axial and laterally loaded piles, load-displacement behaviour,Modified Ramberg Osgood Model, pile group, interaction effect in pile group, soil-pile modeling in FEM, Elastic continuum and elasto-plasticanalysis of piles and pile groups. Non-linear load-deflection response.

(8 hours)

Assignment:

Technical review and critique of a research article/paper on any one of the topics from the above syllabus –

A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

Reference Books:

1. Bowels J.E., "Analytical and Computer Methods in Foundation", McGraw Hill Book Co. New York.

2.Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York.

3. Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers, 1989.

4.Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co.
5. Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice."John Wiley & Sons, New York, 1990.

General Reading Suggested:

Codes/Hand books:

1)"Foundation Engineering Handbook," H.-Y. Fang, Editor, Van Nostrand Reinhold, 2nd Ed., New York, USA.

e-Resources:

1)http://trb.metapress.com/home/main.mpx ... … (Free Online Research Reports)

5014010 (b) DESIGN OF PRECAST COMPONENTS AND FERROCRETE

Teaching Scheme **Examination Scheme**

Lectures: 2 hours/week

Credits 2 **End semester Assesment :50 Marks**

Duration:2Hrs

SECTION-I

UNIT 1: INTRODUCTION

History and Development of Precast concrete construction, Advantages and disadvantages of precast concrete construction; different types of units involved in general building construction, including residential, factory and industrial framed structure; their general principles of design; mechanical handling of large projects like stadium, bridges etc.

Materials viz. Concrete, Self Compacting Concrete, Grout, Reinforcement and structural welded wire cages.Requirements of industrialized buildings, standardization of precast elements and unification of building design. Influence of manufacture, transport and erection technologies on design solution (Modular and Tilt-Up); expansion and contraction joints.

UNIT 2: PREFABRICATED COMPONENTS AND ITS BEHAVIOUR

Design of Precast Concrete Components and Behaviour of structural components, large panel constructions, Construction of roof and floor slabs, Wall panels, Beams, Columns, Shear walls.

Design for Flexure: Strength Design (Depth of Stress block, Flanged Elements, Strength reduction factor, Limitations on reinforcement, Critical sections), Service load design.

Design for Shear: Horizontal and vertical shear resistance.

UNIT 3: JOINTS AND CONNECTIONS

Joints and connections in precast construction; classification and their requirements.

Design of Concrete bracket and corbels; Cantilever beam-design method, Strut-and-tie method. Introduction to Hanger Connections. Design of bearing pads, column bases and moment connections. Typical connection designs for lateral load resisting systems.

UNIT 4: DESIGN OF FERROCRETE STRUCTURES

Design, analysis and optimization, Special design considerations, Typical features of ferrocrete affecting design, Design criteria, Rational method of design ferrocrete structure.

Strength through shape, Shape and form of a structure, various structural forms and their behaviour, Comparative study of various forms

TEXT BOOKS

Ferrocement Construction Mannual-Dr. D.B.Divekar-1030,Shivaji Nagar,Model Colony, Pune

--.CBRI, Building materials and components, India, 1990
--Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
---.PCI Design Handbook – Precast and Prestressed Concrete (6th Edition), ISBN – 0-937040-71-1.
---Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
---.Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.

-- State-of-the-art report and guide for Design,Construction and Repairs of Ferrocement;
ACI committee Report. No ACI549R- 88 and ACI 549.1R.88.
Published by American Concrete Institute, Detroit, USA
--- Ferrocement
Authors: B R Paul and R P Pama.
Published by International Ferrocement Information Centre. A.I.T.Bangkok, Thailand.
---Ferrocement and laminated cementitious composites
Author: A E Naaman.
Publisher: Techno-press, Ann Arbor, Michigan, U S A.
--Ferrocement- Materials and applications;
Publication SP 61, A C I Detroit. U S A

5014010 (c) ADVANCED FOUNDATION DESIGN

Teaching Scheme
Lectures: 2 hours/week
Credits 2

Examination Scheme

End semester Assesment :50 Marks
Duration:2Hrs

UNIT 1: SOIL STRUCTURE INTERACTION

Foundation objectives and their importance, Classification of foundations, Soil classification. Geotechnical design parameters, bearing capacity, settlements and factors affecting settlement.
Loads for design, depth of foundation and depth of soil exploration. Parameters for design of foundation on various types of soil, soil structure interaction.

UNIT 2: DESIGN OF RAFT FOUNDATIONS

Types of rafts, Design of Flat slab raft foundation
Design of beam and slab raft foundation.

UNIT 3: PILE FOUNDATION –I

Function and Classification of piles, Concrete piles, Precast and cast-in-situ piles. Static point and skin resistance capacity of a Pile, Pile settlements.
Laterally loaded Piles. Various pile group patterns, Efficiency of Pile in group, Negative skin friction.
Shell Foundations: Types and applications, Soil structure interaction, Membrane analysis for
Hyper and Conical RC shells with and without edge beams, detailing of critical sections.

UNIT 4: PILE FOUNDATION-II

IS code recommendations for structural design for various piles. Design of RC cast-in-situ and precast pile by IS code method. Pile group analysis by rigid and flexible methods, Design of pile cap.

REFERENCES BOOKS

1.Kurain N.P, Modern Foundations: Introduction to Advance Techniques: TataMcGraw Hill,1982
2.Kurain N. P, Design of foundation systems Principles and Practice, Narosa Publishing house, New Delhi, 2005.
3.Dr. H.J.Shah, Reinforced Concrete, Vol II, Charotar Publishing House.
4.Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van-Nostrand Reynold, 1975
5.Bowles J.E., Foundation Analysis and Design (4th Ed.), Mc.Graw –Hill, NY, 1996
6.Poulose H.G. and Davis E.H., Pile foundation Analysis and Design, John-Wiley Sons, NY, 1980.
7.Leonards G. Ed., Foundation Engineering, Mc.Graw-Hill, NY, 1962
8.Shamsher Prakash, Soil Dynamics, McGraw Hill
9.Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill
10.O'Neil, M.W. and Reese, L.C. "Drilled Shafts: Construction Procedures and Design Methods", FHWA Publication No. FHWA-IF-99-025, Federal HighwayAdministration, Washington, D.C., USA, 1999.
11.P. C. Varghese, "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., New Delhi, 2009.
12.IS 1904: 1986 Code of practice for design and construction of foundations in soils: general requirements (Third Revision)
13.IS 2911: Part 1 : Sec 1 to3 : 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles
14.IS 2911: Part 1: Sec 4 : 1984 Code of practice for design and construction of pile foundations: Part 1 Concrete piles
15.IS 2911: Part 3: 1980 Code of practice for design and construction of pile foundations: Part 3 Under-reamed piles
16.IS 2950: Part 1: 1981 Code of Practice for design and construction of raft foundations: Part 1: Design

17.IS 2974: Part 1to 5: 1982 Code of practice for design and construction of machine foundations

GENERAL READING SUGGESTED:

CODES:

1)Reese, L.C. and O'Neill, M.W., 1988. "Drilled Shafts: Construction and Design." FHWA, Publication No.HI-88-042, USA.

2)FHWA-NHI-10-016, "Drilled Shaft: Construction Proceduresand LRFD Design Methods,"2010, U.S. Department of TransportationFederal Highway Administration, Washington, D.C., USA. (http://www.fhwa.dot.gov/engineering/geotech/foundations/nhi10016/nhi10016.pdf)

Hand books:

1)"Foundation Engineering Handbook," H.-Y. Fang, Editor, Van Nostrand Reinhold, Kulhawy, F.H. (1991). "Drilled Shaft Foundations." Chapter 14, 2nd Ed., New York, pp. 537-552.

e-Resources:

1)http://www.fhwa.dot.gov/engineering/geotech/library_listing.cfm … … (Free Reports)

2)www.Wikipedia.com

Assignment:

Technical review and critique of a research article/paper on any one of the topics –

(1) Drilled Shaft (2) Caisson - Construction, Analysis, Design, Problems, Case Study

A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

501410 (d) NON LINEAR STRUCTURAL ANALYSIS

Teaching Scheme **Examination Scheme**

Lectures: 2 hours/week

Credits 2 **End semester Assesment :50 Marks**

Duration:2Hrs

SECTION -I

UNIT 1:

Types of Nonlinearities - Geometric Nonlinearity, Material Nonlinearity, Nonlinear Governing Equation for Beams: Moment-curvature Nonlinearity, Geometric Nonlinearity Due to Strectching, Material Nonlinearity, Geometrically Nonlinear Beam Problems - Moment-Curvature Nonlinearity-Cantilever Beam, Centrally
Loaded beam with two supports, Cantilever Beam subjected to Tip Load

UNIT 2:

Nonlinear Analysis of Columns- Post buckling of cantilever column, Large deflection of column with both ends hinged

UNIT 3:

Nonlinear Analysis of Trusses and Nonlinear Elastic Analysis of Frames - Derivation of non linear stiffness matrix, Matrix displacement method for nonlinear analysis of structures, Nonlinear analysis of plane
frames.

UNIT4: Nonlinear Static Analysis of Plates - Geometric and Material Nonlinearities, Governing Nonlinear Equations of Plates: Stress Function Approach, Displacement Equations Approach.
Nonlinear Static Analysis of Plates - Boundary Conditions and method of solution, Large Deflection of Rectangular Plates.

Reference Books

1. M.Sathyamoorthy, 'Nonlinear Analysis of Structures', CRC Press, New York
2. K.I. Majid, 'Non Linear Structures', Butter worth Publishers, London.
3. N G R Iyengar, 'Elastic Stability of Structural elements', Macmillan India Ltd

501411 Earthquake Engineering and Disaster management

Teaching Scheme
Lectures: 4 hours/week
Credits 4

Examination Scheme
In Sem Assesment : 50 marks
End semester Assesment :50 Marks
Duration:2Hrs

SECTION I

Unit 1: Introduction to Disaster and its Management

Definition of Disaster, Types of Disasters i.e. Natural and Man Made Disasters. Natural: Earthquake, Volcanoes and TsunamisMan Made: Fire, Blast etc. Develop an understanding of why and how the modern disaster manager is involved with pre-disaster and post-disaster activities.Effect on structural elements.

Unit 2: Design of RCC Structures

Design of multi-story RC structure with foundation as per latest IS: 1893 by Equivalent static lateral load method and Response Spectrum Method.

Unit 3: Design of Steel Structures

Introduction to Time history method,Capacity based design of soft story RC building, design of Shear Walls. Ductile detailing as per latest IS:13920.

SECTION II

Unit 4: Blast Loading

Introduction to Blast Loading, Blast Wind, Clearance Time, Decay Parameter, Drag Force, Ductility Ratio, Dynamic Pressure, Equivalent Bare Charge, Ground Zero, Impulse, Mach Number, Overpressure, Reflected Overpressure,Shock Wave Front, Side-on Overpressure Transit Time,Yield. General Characteristics of Blast and Effects on structures, Blast force, Blast load on above and below ground structures, Response of structural elements, Time period of structural members, Design Stresses for Steel and Reinforced Concrete, Load combinations, Design of structure for blast loading.

Unit 5: Fire

Analysis of steel structure subjected to fire, Design consideration of structural steel members as per IS-800: 2007.

Unit 6: Post Disaster Measures

Retrofitting of Structures, Sources of weakness in framed buildings, Classification of retrofitting techniques, Conventional and non-conventional methods, Comparative study of various methods and case studies. Introduction to Base Isolation systems. IS code provisions for retrofitting of masonry structures, failure modes of masonry structures and repairing techniques.

Reference Books:

i. P. Agarwal and M. Shrikhande – Earthquake Resistant Design of Structures, Prentice-Hall Publications.
ii. Earthquake resistant design of building strucures building----Hosure, Wiley India**.**
iii. Seismic Design of Reinforced Concrete and Masonry Buildings---Paulay, Wiley India
iv. IS:1893 – Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
v. IS:13935 – Repair and Seismic Strengthening of Buildings – Guidelines, 1993
vi. IS: 4326 – Earthquake Resistant Design and Construction of Buildings – Code of Practice, 1993
vii. IS: 13828 – Improving Earthquake Resistance of Low Strength Masonry Buildings, 1993

viii. IS : 4991 – 1968 - Criteria For Blast Resistant Design of Structures for Explosions above ground.
ix. IS: 800 2007 - *Code* for general construction in steel structures
x. IS:13827 - Improving Earthquake Resistance of Earthen Buildings, 1993
xi. IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Force, 1993
xii. IS: 3370- Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.
xiii. Clough and Penzin – Dynamics of Structures, Mc-Graw Hills Publications.
xiv. Jai Krishna, A.R. Chandrashekharan and B Chandra – Elements of Earthquake Engineering, South Asian Publishers Pvt. Ltd.
xv. Joshi P S et al. - Design of Reinforced Concrete Structures for Earthquake Resistance Published by Indian Society of Structural Engineers, 2001

501412 STRUCTURAL DESIGN OF CONCRETE AND PRESTRESSED BRIDGES

Teaching Scheme
Lectures: 4 hours/week
Credits 4

Examination Scheme
In Sem Assesment : 50 marks
End semester Assesment :50 Marks
Duration:2Hrs

Section I

Unit 1:
Introduction to bridge engineering, classification and components of bridges, layout, planning.Structural forms of bridge decks, beam and slab decks, cellular decks. Standard specification for bridges, IRC loadings for road bridges, loading standards for railway bridges.

Unit 2:
Design of slab culvert, box culvert and skew bridge.

Unit 3:
Introduction to Courbon's method, Henry-Jaegar method and Guyon-Massonet method. Design of T-beam PC bridges using Courbon's method.

Section II

Unit 4:
Structural classification of Rigid Frame bridge, analysis and design of Rigid Frame bridge.

Unit 5:
Classification and design of bearings. Expansion joints. Forces acting on abutments and piers, analysis and design, types and design of wing walls.

Unit 6:
Bridge foundations, design of open well, pile and caisson foundation.

Reference Books

1. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
2. T.R. Jagadeesh, M.A. Jayaram - Design of Bridge Structures, Prentice-Hall of India
3. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
4. David Lee – Bridge Bearings and Expansion Joints,E & FN Spon
5. V.K. Raina – Concrete Bridge Practice Analysis, design and Economics, Tata McGraw Hill
6. IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83
7. Joseph E. Bowles – Foundation Analysis and Design, McGraw-Hill International Edition
8. Nainan P. Kurian – Design of Foundation Systems, Narosa Publishing House

Elective III

Elective-III(501415)	
Section-I *(Credits = 2)* *Technical*	***Section-II*** ***(Credits =2)*** ***Inter-Disciplinary***
1.Bio Mechanics& Bio Materials 2.Plastic Analysis and Design of Steel Structure. 3.Design of Concrete shell structures. 4.Design of Composite Construction	A)Foreign Language B)Restoration and conservation of old structures C)Legal Aspects & Arbitration in Civil Engg D)Sustainable development E)Safety Practices in construction
	Section-II ***(Credits =1)***
	F)Yoga and Meditation G)Building Services & Maintenance H)Green Building Design &construction I)Foreign Language

Elective-III(501415)
(A)PLASTIC ANALYSIS& DESIGN OF STEEL STRUCTURE

Teaching Scheme
Lectures: 2 hours/week
Credits 2

Examination Scheme

End semester Assesment :50 Marks
Duration:2Hrs

SECTION I

UNIT I:
Plastic collapse loads of gable portal frames, various mechanisms.

Analysis of Multi Bay- Multi Storey rectangular portal frame, Joint & Various mechanisms
(Two bays - Three storeys)

UNIT II:

Secondary design considerations: Effect of axial force, shear, residual stresses and brittle fracture on moment capacity. Design of beams with high shear, interaction of bending & axial force: section and member strength.Design of rectangular and gable portal frames,

UNIT III: Design of corner connection with and without haunches.
Review of semi-rigid connections. Design of beam to column Moment resisting connections. End plate: Flush & extended, T-Stub connections. Combined tension & shear considerations in welded & bolted connection.

Term Work (If Any)
Two assignments, one on each section.
Text Books :
1)"Limit state Design of Steel Structures" , S K Duggal , McGraw Hill education, 2010
2)"Limit State Design of Steel Structures", Dr. M R Shiyekar, PHI Publication, 3rd Print
Reference Books :
1.. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemchand& Bros., Roorkee
2. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi
3. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall
4. L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons
5. Steel Designers Manual – ELBS

General Reading Suggested:

Codes: IS: 800 - 2007 Code of Practice for General Construction in Steel
Hand books:
1) SP: 6 (6) – 1972 Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures
2) Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1995) – Bureau of Indian Standards.
e-Resourses: 1)Teaching Resource for Structural Steel Design – INSDAG Kolkatta
2) NPTEL

Elective-III(501415)
(B)Design of Composite Construction

Teaching Scheme **Examination Scheme**
Lectures: 2 hours/week
Credits 2 **End semester Assesment :50 Marks**
Duration:2Hrs

SECTION- I

Unit 1:
Introduction of Composite Constructions. Benefits of Composite Construction, Introduction to IS, BS and Euro codal provisions. Composite beams, elastic behaviour of composite beams, No and Full Interaction cases, Shear Connectors, Ultimate load behaviour, Serviceability limits, Effective breadth of flange, Interaction between shear and moment, Basic design consideration and design of composite beams.

Unit 2:
Composite floors, Structural elements, Profiled sheet decking, Bending resistance, Serviceability criterion, Analysis for internal forces and moments

Unit 3:
Composite Columns, Materials, Concrete filled circular tubular sections, Non-dimensional slenderness, local buckling of steel sections, Effective elastic flexible stiffness, resistance of members to axial compressions, Composite Column design, Fire Resistance.

Unit 4:
Design of Multi-storeyed commercial and residential composite building, Design basis, load calculations, Design of composite slabs with profile decks, composite beam design, design for compression members, vertical cross bracings, design of foundation.

Reference Books
1). Johnson R. P. – Composite Structures of Steel and Concrete, Vol I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.
2)Composite Structures of Steel and Concrete: Beams, Slabs Columns and Frames for Buildings, 3ed Johnson, -Wiley India.
3). INSDAG teaching resources for structural steel design Vol – 2, Institute for Steel Development and Growth Publishers, Calcutta
4). INSDAG Handbook on Composite Construction – Multi-Storey Buildings, Institute for Steel Development and Growth Publishers, Calcutta.

Elective-III(501415)

(C)**Bio Mechanics and Bio Materials**

Teaching Scheme **Examination Scheme**

Lectures: 2 hours/week

Credits 2 **End semester Assesment :50 Marks**

Duration:2Hrs

Unit 1:

A)Structure of biomaterials, classification of bio materials, mechanical properties, isoelasticity, elasticity of non-Hookean materials..

B)Metallic Biomaterials and ceramic biomaterials ,Polymeric Biomaterials, Composite Biomaterials, Bio degradable Polymeric Biomaterials. stainless steel Co-Cr-alloys Ti & its alloys, medical applications, corrosion of metallic implants. Non-absorbable or relatively

Unit 2:

Hard Tissue replacement, Preservation techniques for Biomaterials. Hip Joint Prosthesis fixation : Problems and possible solutions. Polymeric Biomaterials and composite biomaterials, medical applications, deterioration of polymers.

Unit 3:

Introduction to Biomechanics of Human movement. Fundamentals of Biomechanics .Mechanical properties of cartilage. Structure and properties of articular cartilage, mechanical properties of Bone tissue. Mechanics of musculoskeletal system, response of tissue to forces,stress,strain, stiffness, mechanical strength, viscoelasticity.

Unit 4:

Biomecnics of Bone tissue Linear Kinetics and kinematics of joints elobow, Hip, Knee joint; Evaluation of joint forces and moments. Equilibrium of joint, fundamental concepts of Gait analysis Design of artificial fixation devices. Orthopedic fixation devices. Fundamentals of design of joint prosthesis. Mechanical testing of joint prosthesis Principles involved in study of rehabilitation engineering.

Reference books

1. Y. C. Fung, Bio-mechanics,Mechanical Properties of Living Tissues Edition 2, 1993.
2. Dowson D.V., Wright, Introduction to Biomechanics of joints and joint replacement, Mechanical Engineering Publication 1987.
3. Van. C.Mow, Antony Ralcliffe, Savio, Bio-mechanics of diarthrodial joints, Springer Verlag 1990.
4. Frederick H.Silver, Bio-materials Medical Devices and Tissue Engineering, Chapman & Hall
5. Park Joon Bu, Bio-Materials Science & Engineering, Plenum Press 1990.
6. Buddy D. Ratner & Allen S.Hoffman, Bio-Materials Science an Introduction to Materials in Medicine, Academic Press 1996.
7. Hand book of Biomedical Engineering, Kline Jacob Academic Press 1988.

Elective-III(501415)
(D) STRUCTURAL MECHANICS OF MODERN MATERIALS

Teaching Scheme **Examination Scheme**

Lectures: 2 hours/week

Credits 2 **End semester Assesment :50 Marks**

Duration:2Hrs

Unit 1:

Introduction to Modern Materials: Fiber-Reinforced Polymer Composite (FRPC) Materials: Definition, Historical development, applications. Fibers and Matrix, types and their properties.

Manufacturing process and methods for composites. Types and classification of composite materials, properties, advantages over conventional materials. Piezoelectric Materials: History,crystal structure, applications. Shape Memory Alloys (SMA), Functionally Graded Materials (FGM): definition and applications.

Unit 2:
Engineering Properties of Modern Materials: FRPC Composite Lamina: Micromechanics approach, methods. Longitudinal and transverse elastic properties of composite lamina, in-plane shear modulus for continuous fibers. Stress-strain relationship, compliance and stiffness matrices for generally anisotropic, specially orthotropic material, transversely isotropic material, orthotropic, isotropic materials, Plane stress condition for thin lamina, transformation of stress
a) and elastic properties. Three dimensional transformations. Stress-Strain: Force Equilibrium, Strain Compatibility, Constitutive Laws of materials. Introduction to Fracture Mechanics.
b) Design of Steel Fiber Concrete elements – flexure, shear, ductility etc., smeared concept, constitutive models for FRC, codal provisions for FRC (ACI, RILEM etc.), Hybrid Fiber composites, behaviour of macro-micro-nano fiber matrix.
Stiffness matrix for Functionally Graded Materials.Pultruded Rod,GFRComposite,flexural members,Self healing Materials,Nano Composites.

Unit 3:
Strength of Composite Lamina: Introduction. Failure theories, Maximum stress theory, Maximum strain theory, Energy based interaction theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu), Failure mode based theory (Hasin-Rotem). Computation of lamina strength by Tsai-Wu theory for plane stress condition. Comparison of various failure theories.

Unit 4:
Elastic behaviour of Composite Laminates: Basic assumptions, Laminate configurations, Straindisplacement relationship, Stress-strain relationship, Force and moment resultants, Laminate compliances and stiffness matrices, Transformation of matrices. Load deformation relationship for symmetric laminates, symmetric cross-ply, symmetric angle-ply, balanced, antisymmetric cross-ply and angle ply, orthotropic, quasi-isotropic laminates.
Experimental Methods of Testing of Composite Materials: Fiber volume ratio, void volume ratio. Determination of, tensile, compressive and shear properties of unidirectional laminates. Testing of interlaminar fracture toughness, Biaxial testing. Introduction to stress concentration in laminates.

Reference Books

1. Isaac M. Daniel and Ori Ishai - Engineering Mechanics of Composite Materials, Oxford University Press, Second Edition, New Delhi.
2. Michael W. Hyer - Stress Analysis of Fiber-Reinforced Composite Materials, WCB/McGraw-Hill, Singapore.
3. Jones R. M. – Mechanics of Composite Materials, McGraw-Hill, New York
4. Roman Solecki and R Jay Conant – Advanced Mechanics of Materials, Oxford University Press, New York, Special Edition for sale in India.

Assignment:
Technical review and critique of a research article/paper on any one of the above topics –
A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

Elective-III(501415)(A)Building Services and Maintenance

Teaching Scheme **Examination Scheme**
Lectures: 1 hours/week
Credits 1 **In semester Assessment**

UNIT I

Integrated design: factors affecting selection of services/systems, Provision of space in the building to accommodate building services, Structural integrity of building services equipment. Sound and vibration attenuation features, Provisions for safe operation and maintenance,

Building services engineering system for intelligent buildings: Introduction to information transmission systems, communication and protection system, call systems, public address system and Building automation/management systems.

UNIT II

The concepts and importance of energy conservation and energy efficiency for environmental protection, environmental protection and maintenance of building services systems, selection of environmentally friendly products and materials used in building services systems.

Co-ordination and management of design and installation of various building services systems during the design and construction stages in particular the builder's works. Computer-aided design and installations of building services. Testing and commissioning of building services systems: fire safety systems, vertical transportation equipment ventilation systems, etc. Sick building syndrome. The impacts of life-cycle-cost on planning and implementation. An appreciation of capital and operating costs. Implication of low cost, inefficient equipment, poor installation, inadequate access for maintenance.

Reference book

Building Maintenance Management, 2ed,---Chanter, Wiley India

Elective-III(501415)
(B) FUNDAMENTALS OF GREEN BUILDING DESIGN &CONSTRUCTION

Teaching Scheme **Examination Scheme**
Lectures: 1 hours/week
Credits 1 **In semester Assessment**

Unit 1: Principles of Sustainability, Energy Conservation and Water Conservation

Introduction to Course, Sustainability, Major Environmental Challenges, Global Warming, Introduction to Green Buildings; LEED, Sustainable Urban Development.
Building energy system strategies, Energy Conservation in Buildings, HVAC Systems, Energy and Atmosphere - LEED Credits, eQuest Energy Simulations, Conducting an Energy Audit, Fossil Fuels vs. Renewable Energy.

Water Conservation in Buildings, Storm Water Harvesting and Management, Water cycle strategies

Unit 2: Green Materials and Green building codes

Green Construction Materials, Materials and Resources - LEED Credits, Building Deconstruction, C&D Recycling, Indoor Environmental Quality – Basic, IEQ - LEED Credits, Building Commissioning, Materials selection strategies

Green building codes and standards, International Green Construction Code,Carbon accounting, Green Building Specifications

Textbooks
1.C.J. Kibert (2008) "Sustainable Construction: Green Building Design and Delivery", 3rd Ed., John Wiley, Hoboken, New Jersey
2.G.T. Miller Jr. (2004) "Living in the Environment: Principles, Connections, and Solutions", 14th Ed., Brooks Cole, Pacific Grove, California
3. Energy Conservation Building Code (ECBC)

Elective-III (501415) Inter-Disciplinary
(C) SAFETY PRACTICES IN CONSTRUCTION

Teaching Scheme **Examination Scheme**
Lectures: 1 hours/week
Credits 1 **In semester Assessment**

UNIT1. INTRODUCTION TO CONSTRUCTION SAFETY AND SAFETY TECHNOLOGY

Introduction to construction safety; historical background and current perspective; Government's policy in industrial safety; safety & health legislation in India, Construction Sites (Safety) Regulations; Codes of practice; Potential hazards/risks associated with construction sites and high risk activities such as the use of hoist, Working at height and working in confined space. Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring. Safety in Erection and closing operation - Construction materials – Specifications – suitability – Limitations – Merits and demerits – Steel structures –Concrete structure.

Workplace ergonomics including display screen equipment and manual handling, personal protective equipment, first aid and emergency preparedness, fire safety, electrical hazards.

UNIT2. CONSTRUCTION SAFETY MANAGEMENT AND ACCIDENT PREVENTION

Safety training; safety policy; safety committees; safety inspection; safety audit; reporting accidents and dangerous occurrences.
Accident Prevention: Principles of accident prevention; job safety analysis; fault tree analysis; accident management

References
1. *Accident Prevention Manual for Industrial Operations,* NSC, Chicago, 1982.
2. Fulman, J.B., *Construction Safety, Security, and Loss Prevention,* John Wiley and Sons,1979.

ELECTIVE-II (501410) (D) YOGA AND MEDITATION

Teaching Scheme **Examination Scheme**
Lectures: 1 hours/week **In semester Assessment**
Credits: 1

Unit 1:Yoga:Sukshma (subtle) yoga techniques, Difference between physical exercises and yogasans, Impact of yogasans on human body, benefits of yogasans, Patanjali yoga sutras, technique of different yogasans like, Trikonasan, Ardhachandrasan, Padmasan, Akarnadhanurasan, Ardhamatsendrasan,

Vajrasan, Pachhimottasan, Bhujangasan, Shalbhasan, Dhanurasan, Naukasan, Makrasan, Pawanmuktasan, Halasan, Sarvangasan, Shavasan, Suryanamaskar(Sun Salutation), Yoga and Food.

Unit 2: Meditation: Breathing technique, Pranayama, Benefits of pranayama, Prcautions for pranayama, Kumbhak, Bandh(Locks), Chakras, Mudra, Technique of pranayama,Anulom-VilomPranayam, UjjayiPranayam, BhramariPranayam, BhastrikaPranayam, AgnisarPranayam, KapalbhatiPranayam, Meditation(Dhyan).

References Books:

1. Light on Yoga: by B.K.S. Iyengar, Harper Collins Publishers India
2. Light on Pranayama: by B.K.S. Iyengar, Harper Collins Publishers India
3. Yoga for Dummies by Georg Feuerstein and larry Payne, Wiley India publishing
4. Yoga, Pilates, Meditation & Stress Relief By Parragon Books Ltd
5. The Yoga Sutrasby Patanjali, Swami Satchidananda, Integral Yoga Publications
6. Meditation - Science and Practice by N. C. Panda, Publisher: D. K. Printworld
7. http://www.artofliving.org/in-en/yoga
8. http://www.artofliving.org/in-en/yoga/sri-sri-yoga/sukshma-yoga-relaxation
9. http://www.yogsansthan.org/
10. http://www.yogapoint.com/
11. http://www.divyayoga.com/
12. http://www.yogaville.org/about-us/swami-satchidananda/
13. www.yogaVision.net

http://www.swamij.com/

EXAMINATION SCHEME

A) **Compulsory subjects: Credits 4, Total marks: 100**

TO BE DONE AT INSTITUTE		**UNIVERSITY EXAM**	
In semester assessment	On 1-4 units	End semester assessment	On Units 1-6
Class tests1 Class tests2	20 Marks	Units 1-4 , Question 1 or Question 2	18 Marks
Assignment /Experiments 1,2,3	20 Marks	Unit 5- Question 3 or 4	16 marks
Industry visit/Site Visit/Quiz	10 Marks	Unit 6- Question 5 or 6	16 Marks
	Total 50 marks		Total 50 Marks

B) **Elective: Credits 5 (section I Technical + section II Non-tech)**

Total marks: 100 (entire assessment to be done at the institute level)
Elective subjects: Credits 2 (Technical)
Elective subjects: Credits 3 Compulsory module (Cyber Security)

To be done at Institute		**To be done at Institute**	
In semester assessment		**End semester assessment by Examination on Section I**	On Units 1-2
Based on section II Class tests1 Class tests2	20 Marks	Units 1: Question 1 or Question 2	18 Marks
Assignement based on Section II	20 Marks	Unit 2- Question 3 or 4	16 marks
presentation based on Section II	10 Marks	Unit 3- Question 5 or 6	16 Marks
	Total 50 marks		Total 50 Marks

C) **Elective-II: Credits 5 (section I Technical + section II,III Non-tech)**

Total marks: 100 (entire assessment to be done at the institute level)
Elective subjects: Credits 2 (Technical)+Credits 2 Compulsory module (Human Rights) +1 (Non-Technical)

To be done at Institute		**To be done at Institute**	
In semester assessment		**End semester assessment by Examination on Section I**	
Based on section II,III Class tests1 Class tests2	20 Marks	Units 1- Question 1 or Question 2	18 Marks
Assignement based on Section II,III	20 Marks	Unit 2- Question 3 or 4	16 marks
Industry visit/Site Visit/Quiz /presentation based on Section II,III	10 Marks	Unit 3- Question 5 or 6	16 Marks
	Total 50 marks		Total 50 Marks

D) **Elective III: Credits 5 (section I Technical + section II,III Non-tech)**

Total marks: 100 (entire assessment to be done at the institute level)

Elective subjects: Credits 2 (Technical)+Credits 2 module (Inter Disciplinary)+1 (Non-Technical)

To be done at Institute		**To be done at Institute**	
In semester assessment		**End semester assessment by Examination on Section I**	
Based on section II,III Class tests1 Class tests2	20 Marks	Units 1 Question 1 or Question 2	18 Marks
Assignement based on Section II,III	20 Marks	Unit 2- Question 3 or 4	16 marks
Industry visit/Site Visit/Quiz	10 Marks	Unit 3- Question 5 or 6	16 Marks

/presentation based on Section II,III			
	Total 50 marks		Total 50 Marks