Savitribai Phule University of Pune

M. E. Civil (Structures)

COURSE STRUCTURE (2017Course)

(w.e.f. June 2017)

University of Pune, Document on Rules and Regulation for P.G. Courses be referred for the detailed information

SEMESTER I

Code	Subject	Teaching scheme	Examination scheme					Credit
		Lect / practical	Paper		TW	Oral / presentation	Total	
			In Sem	End Sem				
501001	Theory of Elasticity & Plasticity	04	50	50	--	--	100	04
501002	Structural Dynamics	04	50	50	--	--	100	04
501003	Advanced Design of Steel Structures	04	50	50	--	--	100	04
501004	Numerical Methods in Structural Engineering	04	50	50	--	--	100	04
501005	Elective I	05	50	50	--	--	100	05
501006	Lab Practice I	04	--	--	50	50	100	04
Total		**25**	**250**	**250**	**50**	**50**	**600**	**25**

SEMESTER II

Code	Subject	Teaching scheme	Examination scheme					Credit
		Lect / practical	Paper		TW	Oral / presentation	Total	
			In Sem	End Sem				
501007	Finite Element Method	04	50	50	--	--	100	04
501008	Theory of Plates & Shells	04	50	50	--	--	100	04
501009	Advanced Design of Concrete Structures	04	50	50	--	--	100	04
501010	Elective II	05	50	50	--	--	100	05
501011	Lab Practice II	04	--	--	50	50	100	04
501012	Seminar I	04	--	--	50	50	100	04
Total		**25**	**200**	**200**	**100**	**100**	**600**	**25**

SEMESTER III

Code	Subject	Teaching scheme	Examination scheme					Credit
		Lect/practical	Paper		TW	Oral/presentation	Total	
			In Sem	End Sem				
601013	Research Methodology	04	50	50	--	--	100	04
601014	Analysis and Design of Earthquake Resistant Structures	04	50	50	--	--	100	04
601015	Elective III	05	50	50	--	--	100	05
601016	Seminar II	04	--	--	50	50	100	04
601017	Project Stage I	08	--	--	50	50	100	08
Total		**25**	**150**	**150**	**100**	**100**	**500**	**25**

SEMESTER IV

Code	Subject	Teaching scheme	Examination scheme					Credit
		Lect/practical	Paper		TW	Oral/presentation	Total	
			In Sem	End Sem				
601018	Seminar III	05	--	--	50	50	100	05
601019	Project Stage II	20	--	--	150	50	200	20
Total		**25**	**--**	**--**	**200**	**100**	**300**	**25**

Note: The Contact Hours for the calculation of load of teacher: Seminar - 1 hr /week/student &

Project - 2 hr/week/ student

501 001: Theory of Elasticity and Plasticity

Teaching Scheme
Lectures: 4 hours/week
Credits: 4

Examination Scheme
In semester Exam. : 50 marks
End Semester Exam. : 50 marks
Duration of End term. Exam: 3 hrs

Unit 1: Analysis of Stress and Strain

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.

Unit 2: Stress-Strain Relations

Generalized Hook's law, plane stress, plane strain Problems in 2D Cartesian coordinate system, Airy's stress function, 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.

Unit 3: Axisymmetric Problems

Equilibrium equations, Strain displacement relations, Stress-strain relationship, Stress compatibility equations, Plane stress and Plane strain conditions. Cylinders subjected to internal and external pressure.

Unit 4: Torsionof Non-Circular Section

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 bar, torsion of thin-walled structures by membrane analogy, torsion of rolled sections and shear flow.

Unit 5: Introduction to Plasticity

Stress - strain diagram - Ideal plastic body - Illustration of plastic Analysis - Yield criteria - Rankine's theory - St.Venant's theory - Tresca Criterion - Beltramis theory - Von Mises criterion - Mohr's theory of yielding - Yield surface - Flow rule (stress - strain relation for perfectly plastic flow)- Prandtl Reuss equality - plastic work - stress - strain relation based on Tresca - plastic potential - uniqueness of a stress distribution - strain hardening.

Unit 6: Plastic analysis of Thick Cylinder

Elasto-plastic problems of beams in bending – thick hollow spheres and cylinders subjected to internal pressure - General relations - plastic torsion –Nadai's sand heap analogy.

References

1. Timoshenko and Goodier, Theory of Elasticity, McGraw-Hill Publications.
2. Irving H. Shames and James M.Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India Pvt. Ltd.
3. Sadhu Singh, Theory of Elasticity, Khanna Publishers.
4. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill Publications.
5. S M A Kazimi, Solid Mechanics, Tata McGraw-Hill Publications.
6. Chakrabarty J, Theory of Plasticity, McGraw-Hill Publications.
7. Slater R. A. C, Engineering Plasticity, John Wiley and Son, New York.

501 002: Structural Dynamics

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam. : 50 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I: Fundamental concepts of vibrations, dynamic equilibrium of motion, stiffness and damping, degrees of freedom, mathematical modelling, solution to single degree of freedom systems subjected to free vibrations – undamped and damped.

Unit II: Solution to single degree of freedom systems subjected to forced vibrations-undamped and damped, resonance, transmissibility.

Unit III: Response to general forcing conditions, convolution integral, pulse loadings, step and ramp functions, response to ground motion, response spectrum.

Unit IV: Numerical evaluation of Duhamel's Integral, direct integration of the equations of motion, piece-wise linear acceleration method, constant acceleration method, average acceleration method, Newmark's β method, Wilson – θ method.

Unit V: Solution to multi degrees of freedom systems, fundamental frequency, Eigen values and Eigen vectors, orthogonality of modes.

Unit VI: 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.

References

1. Humar J. L., Dynamics of Structures, CRC Press
2. Chopra A. K., Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications
3. Clough R.W. and Penzin J., Dynamics of Structures, McGraw Hill Publications
4. Mario Paz, Structural Dynamics Theory and Computation, CBS Publications

501 003: Advanced Design of Steel Structures

Teaching Scheme
Lectures: 4 hours/week
Credits: 4

Examination Scheme
In semester Exam. : 50 marks
End Semester Exam. : 50 marks
Duration of End term. Exam: 3 hrs

Unit I

a) Hoarding Structures: Analysis and design of hoarding structures under dead, live and wind load as per the latest IS:875 by limit state method.

b) Castellated beams: Concept, fabrication of the castellated beam from rolled steel section, design of castellated beam for bending and shear as per latest code by limit state method.

Unit II

a) Microwave Towers: Introduction, structural configuration, function, analysis and design.

b) Tubular Structures: Design of tubular Trusses and scaffoldings using circular hollow, rectangular hollow sections as per code, detailing of joints.

Unit III

Transmission Towers: Introduction, structural configuration, bracing systems, analysis and design as per code. Use working stress method.

Unit IV

Cold form light gauge section: Advantage, type of cross section, stiffened, multiple stiffened and un-stiffened element, flat-width ratio, effective design width, design of light gauge compression, tension and flexural members as per code.

Unit V

Design of chimneys: Introduction, type, joints, lining, ladder, forces acting on chimney, design of thickness of steel plates for self supporting chimney.

Unit VI

Design of base plate of chimney, design of anchor bolt, design of foundation and stability of steel chimneys.

References

1. Ram Chandra, Design of steel Structures, Volume II, Standard Book House, New Delhi.
2. Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, New Delhi.
3. M Raghupathi, Design of steel structures, Tata McGraw Hill, New Delhi.
4. S K Duggal, Limit state design of steel structures, Tata McGraw Hill Education.
5. N Subramanian, Design of steel structures, Oxford University Press.
6. IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi.

7. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi.
8. IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural members in general building construction, BIS, New Delhi.
9. IS: 802 (Part I and II)-1978, Code of practice for use of structural steel in overhead transmission line towers, BIS, New Delhi.
10. IS:806-1988, Code of practice for use of steel tubes in general building construction, BIS, New Delhi.
11. IS: 811-1987, Specification for cold formed light gauge structural steel sections, BIS, New Delhi.
12. IS: 875 (Part 1, 2 and 3) – 1987, Code of practice for design loads for buildings and structures, BIS, New Delhi.

501 004: Numerical Methods in Structural Engineering

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam. : 50 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1: Matrix operations

Flexibility and stiffness matrices, numerical examples of application of stiffness method to beams and plane trusses, concept of transformation matrix, stiffness matrix for plane frame and space frame.

Unit 2: Solution of linear equations

Gauss elimination method, Gauss – Jordan method, Choleski's factorization method, Jacobi's method and Gauss – Seidel method.

Unit 3: Solution of differential equations

Review of Taylor's series and Euler's method. Runge – Kutta fourth order method, predictor – corrector method. Solution of Eigen value problems by Power method.

Unit 4: Numerical integration

Trapezoidal and Simpson's methods, Gauss quadrature method, Newton's – Cotes method.

Unit 5: Finite difference method

Forward, backward and centered finite difference approximations to the derivatives. Applications to indeterminate beams, columns and plates.

Unit 6: Regression analysis

Least square method, polynomial functions, curve fitting. Interpolation – Polynomial approximation, Lagrange's method, spline interpolation.

References

1. E. Ward Cheney, David R. Kincaid, Numerical Methods and Applications, Brooks Cole / Cengage Learning India

2. S. C. Chapra & R. P. Canale, Numerical Methods for Engineering, TMH Publications

3. E. Balgurusamy, Numerical Methods, TMH Publications

4. Krishna Raju, Numerical Methods in Civil Engineering, CBS

501 005 a: Optimization Technique: Elective I (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I: Introduction to optimization techniques, Applications to various civil engineering problems, Statement of optimization problem, Constraints of, LP, NLP problems.

Unit II: Classical optimization methods: Single and multiple problems with equality and inequality constraints, Hessian matrix and its use, Lagrangian method, Convex and concave functions.

Unit III: Linear programming: Standard LP problem, Assumptions in LP, Geometry and graphical solutions of LP problem, Canonical form of linear simultaneous equations, Simplex method to solve LP problems, Use of big M and two phase methods.

Unit IV: Additional topics in LP: Duality in LP, Transportation problem, Assignment problem, Mathematical methods of transportation and assignment problem, Methods of solution, Variation in transportation and assignment problems such as unbalanced problem, degeneracy.

Unit V: Numerical iterative methods: One dimensional non linear functions without constraints, Dichotomous, Fibnocci and golden section search methods.

Unit VI: Dynamic programming: Introduction and its applications to various civil engineering problems, Terminology, Optimum decision policy, Bellmann's principle, Recursive relations and its use to solve DP problems with certainty, Shortest route problems.

References

1. Engineering Optimization: Theory & Practice, S. S . Rao., Wiely.
2. Engineering Optimization: Methods and Applications, Ravindran, Wiely
3. Operation Research, Taha Hamdey A.
4. Principles of Operation Research, Wagner, Prentice Hall.
5. Operation Research, Hira and Gupta, S.Chand
6. Operation Research—Ravindran-- Wiely.

501 005 b: Structural Design of Concrete Bridges: Elective I (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I: Classification of concrete bridges, components of bridge and related structures, economic spans. Factors affecting the selection of site, hydrological data, waterway, scour depth. IRC provisions, loading standards.

Unit II: Load distribution on deck slabs, isotropic plate, grillage analysis, distribution of loads to longitudinal girders, Little – Morrice – Rowe method, Courbon's method, Guy on Massonet method and Hendry Jaegar method. Design of slab and box culverts for highway loadings.

Unit III: Design of T-beam deck slab bridge: design of RC deck slab, design of post-tensioned longitudinal girder and cross girders.

Unit IV: Analysis and design of rigid frame bridges.

Unit V: Types of abutments, piers, loads acting on pier and abutments, design of abutments, piers

Unit VI: Functions of bearings, types, design of elastomeric bearings, design of PTFE-pot bearings.

References

1. Krishna Raju, Design of Bridges, Oxford and IBH Publishing
2. Rajagopalan N., Bridge Superstructure, Alpha Science International
3. D. Johnson Victor, Essentials of Bridge Engineering, Oxford and IBH Publishing
4. Relevant IRCs.

501 005 c: Design of Composite Construction: Elective I (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I: Introduction of composite constructions, benefits of composite construction, Introduction to IS, BS and Euro codal provisions. Composite beams, elastic behavior of composite beams, No and Full Interaction cases, Shear Connectors, Ultimate load behavior, Serviceability limits, Effective breadth of flange, Interaction between shear and moment, Basic design consideration and design of composite beams.

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

Unit III: 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 IV: Composite trusses, Design of truss, Configuration, Application range, Analysis and Design aspects and connection details.

Unit V: 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.

Unit VI: Design of Composite Construction in Bridges – IRC specifications and code of practice for loads and composite construction. Composite Deck Slab Design – Design of one way deck slab for Class AA and Class A loading, Design of Cantilever Portion of deck Slab. Design of longitudinal girders.

References

1. Johnson R. P., Composite Structures of Steel and Concrete, Vol I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.

2. INSDAG teaching resources for structural steel design Vol II, Institute for Steel Development and Growth Publishers, Calcutta

3. INSDAG Handbook on Composite Construction: Multi-Storey Buildings, Institute for Steel Development and Growth Publishers, Calcutta

4. INSDAG Design of Composite Truss for Building, Institute for Steel Development and Growth Publishers, Calcutta

5. INSDAG Handbook on Composite Construction: Bridges and Flyovers, Institute for Steel Development and Growth Publishers, Calcutta

6. INSDAG Design Guide for Composite Highway Bridges (Steel Bridges), Institute for Steel Development and Growth Publishers, Calcutta

7. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

8. N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

9. IS:11384, 1985 Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi.

10. IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83

501 005 d: Design of Foundations: Elective I (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I: Introduction and Soil Structure Interaction

a. Foundation objectives and their importance, Classification of foundations, Soil classification, Geotechnical design parameters, bearing capacity, Foundation settlements.

b. Loads for design, Depth of foundation, and depth of soil exploration, parameters for design of foundation on various types of soil, Introduction to Soil Structure Interaction.

c. Review of IS Code Provisions: IS 1892, IS 1904, IS 6403, IS 8009 (Part-I & II)

Unit II: Design of Raft Foundations

a. Types of rafts, Relative Stiffness considering: Superstructure-Foundation-Soil system, Soil-Structure Interaction approach, raft on Clayey and Sandy soils

b. Review of IS Code Provisions: IS 2950 (Part-I)

c. Design of Flat slab raft foundation (Rigid Method/Elastic Line Method)

Unit III: Machine Foundation

a. Introduction, machine vibrations, vibration characteristics, design consideration for machine foundations.

b. Review of IS Code Provisions: IS 2974 (Part-II, III & IV)

c. Design of foundations for rotary machines / impact machine

Unit IV: Pile Foundation

a. Function and Classification of piles, Static point and skin resistance capacity of a Pile,Negative skin friction, Vertically and Laterally loaded piles, Pile settlements

b. Pile Cap, Pile group, Efficiency of piles in a group

c. Review of IS Code Provisions: IS 2911 (all related parts)

Unit V: Design of Drilled Shaft (Caissons/Well) Foundations -

a. Drilled Shafts (Caissons/Well) Foundations: Introduction, types and applications of drilled shafts, construction procedures – dry, wet and casing methods of construction

b. Soil-Structure interaction considerations, Design considerations under Axial and Lateral forces, ASD/LRFD method of design-General principles and steps.

Unit VI: Case Studies and Failures of Foundations -

a. Review of Case Studies of – Shallow and Deep Foundations

b. Review of Failures of - Shallow and Deep Foundations

References

1. Kurain N.P, Modern Foundations: Introduction to Advance Techniques: Tat aMcGraw Hill,1982

2. Kurain N. P, Design of foundation systems Principles and Practice, Narosa Publishing house, New Delhi, 2005.

3. Nayak N. V., Foundation Design Manual, Dhanpat Rai and Sons, Delhi.

4. Shah H. J., Reinforced Concrete, Vol II, Charotar Publishing House.

5. Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van-Nostrand Reynold, 1975

6. Bowles J. E., Foundation Analysis and Design (4th Ed.), Mc. Graw –Hill, NY, 1996

7. Poulose H. G. and Davis E. H., Pile foundation Analysis and Design, John-Wiley Sons, Neyork, 1980.

8. Leonards G. Ed., Foundation Engineering, Mc. Graw-Hill, NY, 1962

9. Shamsher Prakash, Soil Dynamics, McGraw Hill

10. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill

11. O'Neil, M.W. and Reese, L.C. "Drilled Shafts: Construction Procedures and Design Methods", FHWA Publication No. FHWA-IF-99-025, Federal Highway Administration, Washington, D.C., USA, 1999.

12. P. C. Varghese, "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., New Delhi, 2009.

13. IS 1892, IS 1904, IS 6403, IS 8009 (Part-I & II); IS 2950 (Part-I); IS 2974 (Part-II, III & IV); IS 2911 (all related parts)

501 005 e: Structural Stability: Elective I (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1: Fundamental concepts, elastic structural stability, structural instability, analytical methods for the stability analysis, equilibrium, imperfections and energy methods.

Unit II: Elastic buckling of columns, assumptions, critical load for various boundary conditions, columns with geometric imperfection, large deflection theory of columns, Southwell plot, Orthogonality of buckling modes, eccentrically loaded columns, numerical techniques – Finite difference and Finite element approach.

Unit III: Elastic buckling of beam-column, differential equations of beam-column, beam-column with concentrated point load, several point loads, continuous lateral load, single couple, uniformly distributed load, end couples.

Unit IV: Elastic buckling of frames, triangular, partial, multistory portal and box frames with symmetric & anti symmetric buckling, stiffness method approaches, approximate method, buckling of open sections, torsional buckling.

Unit V: Elastic buckling of thin plates, equilibrium approach, rectangular plate with axial load in one and two directions, various boundary conditions, Energy methods – Rayleigh Ritz and Gelerkin, large deformation theory of plates and effective width concept, post buckling behavior of plates.

Unit VI: Structural Design for stability of Members, Lateral torsional buckling of beams, lateral torsional buckling of cantilever and S.S. beams, stability design of beam-column member.

References

1. Timoshenko S. P. and Gere J. M., Theory of Elastic Stability, Mc Graw Hill, Singapore
2. George Gerard, Introduction to Structural Stability Theory, Mc Graw Hill, New York
3. Iyenger N. G. R., Elastic Stability of Structural elements, Mc Millan, India
4. Ashwini Kumar, Stability of Structures, Allied Publishers, New Delhi
5. Gambhir, M. L.: Stability Analysis and Design of Structures, Springer-Verlag (2004)

501 005 I: Economics and Finance for Civil Engineering: Elective I (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

Unit I: Introduction & Basics of Economics & Finance
Meaning & necessity of: Economics, costing & finance, history & fundamentals of economics, basics of finance & accounting, rates of interest, basics of financial statement, financial analysis, inflation, etc.

Unit II: Principles of Costing, Estimation & Valuation
Basics of costing, activity based costing & case studies, basics of estimation & valuation, present & future values of properties, profitability & financial decisions, inventory management

Reference

1. As specified by the instructor

501 005 I: Green Buildings: Elective I (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

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

References

1. C. J. Kibert, Sustainable Construction: Green Building Design and Delivery, 3rd Ed., John Wiley, Hoboken, New Jersey.

2. G. T. Miller, Living in the Environment: Principles, Connections, and Solutions, 14th Ed., Brooks Cole, Pacific Grove, California

3. Energy Conservation Building Code (ECBC)

501 005 III: Human Rights: Elective I (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

Unit 1

Human Rights – Concept, Development, Evolution

Philosophical, sociological and political debates, benchmarks of human rights movement.

Human Rights and the Indian Constitution

Constitutional framework, Fundamental Rights & Duties, Directive Principles of State Policy, Welfare State & Welfare Schemes

Human Rights & State Mechanisms

Police & Human Rights, Judiciary & Human Rights, Prisons & Human Rights, National and State Human Rights Commissions

Unit 2:

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

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

Human Rights and the international scene –Primary Information with reference to Engineering Industry, UN Documents, International Mechanisms (UN & Regional), International Criminal Court, Fundamental Rights & Duties, Directive Principles of State Policy, Welfare State & Welfare Schemes

References

1. Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing
2. Human Rights in India: A Mapping, Usha Ramanathan: free download from http://www.ielrc.org/content/w0103.pdf
3. Study material on UNESCO, UNICEF web site
4.Information, by Toby Mendel - UNESCO**,** 2008

501 006: Lab Practice I

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**Term work: 50 marks**
Credits: 4	**Oral/ Presentation: 50 marks**

Term work consists of the following:

1. Theory of Elasticity & Plasticity: One assignment from each unit.

2. Structural Dynamics

a) One assignment from each unit.

b) Write a program to determine the Eigen values and Eigen vectors for a multi degree of freedom system.

c) Performance of shake table experiments to determine the natural frequencies and the mode shapes for various shear building frames subjected to harmonic base excitations. The results from the experiments should be reported in a standard format.

3. Advanced Design of Steel Structures

A mini-project to be completed individually which shall be based on design of transmission tower and steel chimney.

4. Numerical Methods in Structural Engineering

One assignment from each unit, the assignments should be completed using any computer language / program / spreadsheets.

5. Elective I: One assignment on each unit.

6. Site visits: Report based on three site visits.

501 007: Finite Element Method

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam. : 50 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I: Background on variational calculus, Galerkin method, collocation method, least squares methods, Variational methods of approximation, Rayleigh-Ritz method, Variational theorem, principle of minimum potential energy, use of polynomial displacement function, variational approach for formulation of element stiffness matrix for truss and beam elements, Strong and Weak formulation.

Unit II: Two dimensional elements in plane stress / plane strain problems. CST, LST and rectangular elements, modelling considerations, aspect ratio, use of polynomial displacement functions, Pascal's triangle. Requirements for convergence, geometric invariance, grid refinement. Standard stiffness and load vector formulation procedures using variational principle. Condensation of internal degrees of freedom-Summary of analysis procedure.

Unit III: Shape functions in Cartesian and natural coordinate systems, shape functions for one, two and three dimensional elements. Higher order elements- Lagrange –Serendipity – Interpolation-formulation of element stiffness.

Unit IV: Concept of isoparametric elements and isoparametric mapping, Jacobian matrix, formulation of two dimensional quadrilateral isoparametric element in plane elasticity problem, 3-D isoparametric elements.

Unit V: Thin Plate bending elements, various triangular and rectangular elements, ACM (Adini, Clough, Melosh) and BFS (Bogner, Fox, Schimdt) elements. Conforming and non-conforming elements, concept of four noded and eight nodded isoparametric elements, Mindlin's hypothesis for plate bending element.

Unit VI: Axisymmetric elements in axisymmetric problems, stress strain relations, triangular and Quadrilateral elements. Flat and curved shell element, elements for cylindered shells, curved solid elements.

References

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. Daryl L. Logan, A First Course in Finite Element Method, Cengage Learning
6. S. S. Bhavikatti, Finite Element Analysis – New Age International Publishers, Delhi
7. S. S. Rao, The Finite Element Method in Engineering 4th Edition – Elsevier Publication.

501 008: Theory of Plates and Shells

Teaching Scheme
Lectures: 4 hours/week
Credits: 4

Examination Scheme
In semester Exam. : 50 marks
End Semester Exam. : 50 marks
Duration of End term. Exam: 3 hrs

Unit 1

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. Analysis of rectangular plates: Navier solution for plates with all edges simply supported, distributed loads, point loads and rectangular patch load.

Unit 2

Levy's Method: Distributed load and line load, plates under distributed edge moments. Raleigh- Ritz approach for simple cases in rectangular plates. Introduction to shear deformation theories, Reissener - Mindlin theory, moment curvature relationship for First order shear deformation theory.

Unit 3

Circular Plates: Analysis of circular plates under axi-symmetric loading, moment curvature relations, governing differential equation in polar co-ordinates. Simply supported and fixed edges, distributed load, ring load, a plate with a central hole.

Unit 4

Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations. Shells of revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.

Unit 5

Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions. Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions and application to pipes and pressure vessels.

Unit 6

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

References

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

501 009: Advanced Design of Concrete Structures

Teaching Scheme
Lectures: 4 hours/week
Credits: 4

Examination Scheme
In semester Exam. : 50 marks
End Semester Exam. : 50 marks
Duration of End term. Exam: 3 hrs

Unit 1

Yield line theory for analysis of slabs, various patterns of yield lines, assumptions in yield line theory, characteristics of yield lines, equilibrium and virtual work method of analysis.

Design of various slabs such as rectangular, triangular, circular with various edge conditions using yield line theory, Design for limit state of strength and serviceability of orthotropically reinforced slabs

Unit 2

Grid and coffered slabs, general features, rigorous and approximate method of analysis, design of grid floor by approximate method.

Unit 3

Flat slabs, types, design methods, column and middle strip, proportioning of flat slab element, total design moment, distribution of moments, effect of pattern loading, design for shear, design of intermediate and end panel by direct method only

Unit 4

Elevated service reservoir: Rectangular and circular type only flat bottom, Design of staging for wind and earthquake forces.

Unit 5:

Design of bunkers, and Silos, square and circular bunkers, silos shallow and deep beams.

Unit 6

Design of raft foundations, pile foundations, single pile, group of piles, Pile cap, design of form work for slabs, girders and, columns.

References

1. Advance R. C. C. Design, S. S. Bhavikatti, New Age International Publishers

2. B.C. Punmia, Ashok K. Jain, Arun K. Jain, Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi

3. N. C. Sinha, S.K. Roy, Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, NewDelhi

4. P. C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi

5. Dr .H.J.Shah, Reinforced Concrete design, Charotar publishing house

6. Design of R. C. C, S. Ramaamruthum, Dhanpat Rai publications

7. IS: 456-2000, Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.

8. IS: 1893:-2017, Indian Standard Code of practice for criteria for Earthquake resistant design of Structures, Bureau of Indian Standards, New Delhi.

9. IS: 3370, Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi

501 010 a: Structural Design of Steel Bridges: Elective II (Module I)

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	In semester Exam. : 25 marks
Credits: 4	End Semester Exam. : 50 marks
	Duration of End term. Exam: 3 hrs

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

Analysis and design of beam and plate girder bridges, analysis of through type and deck type bridges

Unit 3

Design of plate girder bridges, main plate girder, shape limitation based on local buckling, lateral torsional buckling, web buckling, shear moment interaction, fatigue effect, Lateral bracing

Unit 4

Design of truss bridges, optimum depth of truss girder, design of compression chord member, design of tension chord member, design of vertical and diagonal member, Lateral bracing

Unit 5

Design of cable supported steel bridges, design of steel box girder, design of suspension cables, Suspension bridges.

Unit 6

Box section flexural members, diaphragm requirements at support, bearing, top lateral bracing in tube girder, horizontally curved boxes, single boxes, closed boxes, proportioning limits

References

1. Owens. G. W., Knowles. P. R., Dowling. P. J., Steel Designers Manual, Fifth edition, Blackwell Scientific Publications.
2. Chatterjee S.,, The Design of Modern Steel Bridges, First edition, BSP Professional books.
3. Demetrios E. T., Design, Rehabilitation and Maintenance of Modern Highway Bridges, McGraw-Hill Publishers.
4. Victor. D. J. Essentials of Bridge Engineering, Oxford and IBH Publishers.
5. IRC: 6 - 1966 – Section II, Indian Standard for loads and stresses on Highway Bridges.
6. Bridge rules - 1982, Specifications for Indian Railway loading.
7. T. R. Jagadeesh and M. A. Jayaram, Design of Bridge Structures, Prentice-Hall of India
8. N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
9. David Lee, Bridge Bearings and Expansion Joints, E & FN Spon
10. V. K. Raina, Concrete Bridge Practice Analysis, design and Economics, Tata McGraw Hill
11. IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83

501 010 b: Plastic Analysis of Steel Structures: Elective II (Module I)

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	In semester Exam. : 25 marks
Credits: 4	End Semester Exam. : 50 marks
	Duration of End term. Exam: 3 hrs

Unit 1

Plasticity in ductile materials, actual and idealized stress-strain graph for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge.

Unit 2:

Plastic collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, basic and combined mechanisms. Determination of plastic collapse loads, bending moment diagram at collapse.

Unit 3:

Plastic collapse loads of frames with inclined members such as gable portal frames, various mechanisms.

Unit 4:

Philosophy of Limit State deign, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance

Unit 5:

Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force.

Unit 6:

Design of rectangular and gable portal frames, design of corner connection with and without haunches.

References

1. Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1995), Bureau of Indian Standards.
2. SP: 6 (6), 1972, Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures
3. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi.
4. A. S. Arya and J. L. Ajmani, Design of Steel Structures, Nemchand & Bros., Roorkee
5. Teaching Resource for Structural Steel Design , INSDAG Kolkata
6. Ramchandra, Design of Steel Structures Vol – II, Standard Book House, Delhi
7. B. G. Neal, Plastic Method of Structural Analysis, Chapman & Hall
8. L. S. Beedle, Plastic Design of Steel Frames, John Willey & Sons
9. Steel Designers Manual, ELBS
10. Mrazik, M. Skaloud, M. Tochacek, Plastic Design of Steel Structures, Ellis Horward Limited, John Willey & Sons

501 010 c: Design of Industrial Steel structures: Elective II (Module I)

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1

Analysis and design of knee braced trussed bent with hinged, fixed and partially fixed bases without gantry, design of knee brace, roof column and its base.

Unit 2

Various types of column configurations in case of knee braced trussed bent with gantry loads, design of stepped columns and bases under various load combinations.

Unit 3

Analysis and design of gable portal frame with and without gantry loads, design of bracket supporting gantry loads.

Unit 4

Open web frames for industrial shed, trussed purlins.

Unit 5

Mobile gantry structure, machine foundations

Unit 6:

Analysis and design of various bracing systems in industrial shed structure and industrial flooring.

References

1. Ramchandra, Design of Steel Structures Vol – II, Standard Book House, Delhi
2. A. S. Arya and J. L. Ajmani, Design of Steel Structures, Nemchand & Bros., Roorkee
3. Teaching Resource for Structural Steel Design, INSDAG Kolkatta
4. IS: 800 – 1984, Code of Practice for General Construction in Steel
5. IS: 875 – 1964, Code of Practice for Structural Safety of Building: Loading Standards (Revised)
6. IS: 4137 – 1967, Code of practice for Heavy Duty electric Overhead Traveling Crane
7. Steel Designers Manual, ELBS
8. John E. Lotheres, Advanced Design in Structural Steel, Prentice Hall

501 010 d: Design of Precast Concrete Structures: Elective II (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1: Introduction

a) 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.

b) 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: Ferrocement

a) Definition, basic concept like bond increase, comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement, special types of ferrocement. Ferrocement as substitute for conventional building materials. typical characteristics and their applications.

b) Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

Unit 3: Prefabricated Components and its Behaviour

a) 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.

b) 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 4: Design of Ferrocrete Structures

a) 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

b) Hydraulic structures, Water retaining structures, Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

Unit 5: Joints and Connections

a) Joints and connections in precast construction; classification and their requirements. Design of Concrete bracket and corbels; Cantilever beam-design method, Strut-and-tie method.

B) Introduction to Hanger Connections. Design of bearing pads, column bases and moment connections. Typical connection designs for lateral load resisting systems.

Unit 6

Space structures and precast products :

a) Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries.

b) Precast ferrocement products : Why ferrocement for precasting ? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

References

1. Ferrocement and laminated cementitious composites, A E Naaman, Techno-press, Ann Arbor, Michigan, U S A.
2. PCI Design Handbook, Precast and Prestressed Concrete (6th Edition
3. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH
4. Ferrocement Construction Mannual, D. B. Divekar
5. CBRI, Building materials and components, India, 1990
6. Gerostiza C. Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
7. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
8. 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
9. Ferrocement--- B R Paul and R P Pama. Published by International Ferrocement Information Centre. A.I.T.Bangkok, Thailand.
10. Ferrocement- Materials and applications-- Publication SP 61, A C I Detroit. U S A
11. Concrete Technology by Kulkarni & Ghosh, New Age International Publishers
12. Ferrocement code -ACI 549.1R

501 010 e: Design of Pre-stressed Concrete Structures: Elective II (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1

Design of Pre-tensioned Flexural members: Design of pole, sleepers and lintels.

Unit 2

Design of Post tensioned Flexural members: Design Tee, 'I' and box section girders

Unit 3

Design of Post tensioned Prestressed Concrete Slabs: Introduction, Design of one way, two way and flat slabs.

Unit 4

Composite Beams: Composite sections of Prestressed concrete beam and cast in-situ RC slab - Analysis of stress, Differential shrinkage, Deflections, Flexural and Shear strength of composite sections, Design of composite sections.

Unit 5

Statically Indeterminate Structures: Analysis and Design of continuous beams and Frames including choice of cable profile, linear transformations, concordance of cable and shift calculations.

Unit 6

Prestressed Concrete Pipes and Tanks: Circular prestressing, types of Prestressed concrete pipes.

Prestressed Concrete tanks: General features, Analysis and design of circular tanks.

References

1. T. Y. Lin & Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley

2. N. Krishna Raju, Prestressed Concrete, Tata Mc Graw Hill Publication Co

3. Edward Nawy, Prestressed Concrete, A Fundamental Approach, Prectice Hall International

4. B. C. Punmia, A. K. Jain and Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi

5. N. C. Sinha, and S.K. Roy, Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi

6. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.

501 010 I: Building Services and Maintenance: Elective II (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

Unit 1: 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.

References

1. Buiding Services, S. M. Patil

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

501 010 II: Structural Audit: Elective II (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

Unit 1

Structural Health, factors affecting health of structures, effect of leakage, age, creep, corrosion, fatigue on life of structure. Structural health monitoring. Various measures, regular maintenance, structural safety in alteration. Quality control & assurance of materials of structure, durability of concrete, Factors affecting durability of concrete, Corrosion in structures, Testing and prevention of corrosion.

Structural Audit, Assessment of health of structure, study of structural drawings, nature of distress, visual observations, Collapse and investigation, limitations on investigator, tools for investigation, Various NDT Methods for assessing strength of distressed materials, investigation management, review of assimilated information, interviews and statements, evaluation and reporting, presentation of report, communication gap among client, architect, consulting engineer & contractor.

Unit 2

Retrofitting of Structures, parameters for assessment for restoration strategies, selection of construction chemicals during restoration, Specification for important items of work in restoration, Structural detailing for restoration and various techniques of retrofitting.

Safety during construction, formwork and staging, Modular formwork, Structural aspects for formwork in buildings & bridges. Fire safety. Demolition of Structure, study of structural system and structural drawings, outline of various demolition methods and their evaluation, partial and controlled demolition, role of safety measures, temporary support structures in demolition. Recycling of demolished materials.

References

1. Handbook of material management by Deananmmer, McGraw Hills

2. Fundamentals of material management by Gopalkrishnan, Tata McGraw Hills.

3. Financial Management by M Y Khan and Jain, Tata McGraw Hills

4. Properties of Concrete by A M Neville, Longman

5. R. N. Raikar, Learning from Failures, R & D Centre, (SDCPL.

6. R. N. Raikar, Diagnosis and treatment of structures in Distress, R & D Centre, (SDCPL)

7. Jayakumar J. Shah, A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures).

8. Formwork Construction and Practice by Richardson. J. G.

9. Formwork For Concrete Structures by Peurifoy, Tata McGraw-Hill

10. Formwork To Concrete, by Austin. C. K, Chapman and Hall

11. Design & Construction of Formwork For Concrete Structures, by Wynn.A. E.

12. Demolition and reuse of concrete, by Y Kasai, Chapman and Hall

13. Demolition of Structures, Report by Mr. Girish Kulkarni, Mumbai

14. Structural Audit, Report by Mr. Umesh Dhargalkar, Mumbai

501 010 III: Cyber Security: Elective II (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

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.

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

Access Control, Intrusion Detection and Server Management, Firewalls:

Overview of Identification and Authorization, Overview of IDS, Intrusion, Detection Systems and Intrusion Prevention Systems, User Management, Overview of Firewalls, Types of Firewalls, DMZ and firewall features

Security Policies and Management: Security Policy Design, Designing Security Procedures, Risk Management and Assessment Techniques, Security standards, Security Models. Security Management Practices, Security Laws, Information Classification Process, Risk Management, Security Procedures and Guidelines, Business Continuity and Disaster Recovery, Ethics and Best Practices, Security Assurance,

References

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

501 011: Lab Practice II

Teaching Scheme	Examination Scheme	
Lectures: 4 hours/week	**Term work**	**: 50 marks**
Credits: 4	**Oral/ Presentation**	**: 50 marks**

1. Finite Element Method: Any three assignments on the following topics using coding tools.

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. Use of software to obtain stress resultants for any three following problems.

a) Plane stress / plane strain problem

b) Axisymmetric problem

c) Three dimensional problem

d) Plate or shell structures

3. Theory of Plates and Shells: One assignment from each unit.

4. Advanced Design of Concrete Structures

A mini-project to be completed individually which shall be based on the analysis and design of a G + 4 storeys building having a plan area not less than 150 m^2. The analysis shall be done using any commercially available software and the design of all structural members shall be done manually. The detailing shall be prepared using any commercially available drafting software.

5. Elective II: One assignment on each unit.

6. Site visits: Report based on three site visits.

501 012: Seminar I

Teaching Scheme	Examination Scheme	
Lectures: 4 hours/week	**Term work**	**: 50 marks**
Credits: 4	**Oral/ Presentation**	**: 50 marks**

Seminar I: Shall be on state of the art topic of student's own choice approved by an authority. The student shall submit the duly certified seminar report (printed on both sides) in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

The contents of report are as follows.

1. Introduction
2. Literature Survey
3. Theoretical contents
4. Relevance to the present national and global scenario of construction industry
5. Strengths and weaknesses of the particular area of seminar
6. R & D in the particular area
7. Field Applications/case studies/Experimental work/software application
8. Vendors associated
9. Conclusions
10. References

Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.

501 013: Research Methodology

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 50 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1: Introduction to Research

Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses**.** Search for causation. Developing a Research Proposal Format of research proposal, Individual research proposal, Institutional research proposal, Significance, objectives, methodology, Funding for the proposal, Different funding agencies. Framework for the planning

Unit 2: Literature survey

Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.

Unit 3: Data collection, Measuring, Sampling and Scaling

Classification of data, benefits and drawbacks of data, evaluation of data, qualitative methods of data collection, methods of qualitative research, Sampling, sample size, sampling strategy, attitude measurement and scaling, types of measurements, criteria of good measurements, classification of scales.

Unit 4: Preliminary data analysis

Testing of hypothesis- concepts and testing, analysis of variance techniques, introduction to non-parametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis.

Unit 5: Advanced data analysis techniques

Correlation and regression analysis, Introduction to factor analysis, discriminant analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, Multi-dimensional measurement and factor analysis

Unit 6: Report writing

Need of effective documentation, importance of report writing, types of reports, report structure, report formulation, Plagiarism. Research briefing, presentation styles, impact of

presentation, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure.

References

1. Research Methodology: concepts and cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House Pvt. Ltd.

2. Research Methods for Business, Sekaran Uma and Rogure Boudie, Wiley, India.

3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age International Publishers.

4. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor &Francis Group)/ Cambridge University Press India Pvt. Ltd.

5. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.

6. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar

7. Research in Education, John Best and James Kahn, Prentice Hall of India Pvt. Ltd.

501 014: Analysis and Design of Earthquake Resistant Structures

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam. : 50 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1: Basic seismology and earthquake effects

Definition of earthquake, causes of earthquakes, theories of earthquakes, seismic zones, generation of seismic waves and its composition, measurement of earthquakes. Seismic effects on structures, liquefaction and its effect on structure. Peak ground acceleration, peak velocity, peak displacement, response spectra, tripartite plot, soil – structure interaction.

Unit 2: Earthquake design philosophy

Effect of irregularities and architectural planning, center of mass and center of rigidity, philosophy of earthquake resistant design, maximum considered earthquake, design based earthquake, concept of stiffness, flexibility and ductility, $P - \Delta$ effect.

Unit 3: Methods of analysis

Equivalent linear static analysis (with numerical), modal spectrum analysis (with numerical), linear time history analysis, static push over analysis, capacity based design, performance based design, IS 1893 code provisions.

Unit 4: Design of RC members

Load combinations, concept of strong column weak beam design, design and detailing of beams, columns and beam-column joint as per IS 1893 and IS 13920.

Unit 5: Lateral load resisting systems

Types of lateral load resisting systems, computation of design lateral forces on RC shear walls, design of RC shear walls.

Unit 6: Analysis of elevated water tanks

Mathematical models, IS 3370 code provisions, analysis of elevated water tanks.

As part of In-sem assessment, other than Class Test 1 & 2, a term project must be completed individually which will be based on Units 3, 4, and 5. The project shall include the complete analysis and design of all structural elements using any commercially available software.

It shall also include the detailing as per industry standards.

References

1. Bungale S. Taranath, Wind and Earthquake Resistant Buildings: Structural Analysis and Design, CRC Press
2. Pankaj Agrawal, Manish Shrikhande, Earthquake Resistant Design of Structures, PHI
3. Shashikant K. Duggal, Earthquake Resistant Design of Structures, OUP India
4. BIS, IS 1893: Criteria for Earthquake Resistant Design of Structures
5. BIS, IS 13920: Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice.

501 015 a: Bio Mechanics and Bio Materials: Elective III (Module I)

Teaching Scheme
Lectures: 4 hours/week
Credits: 4

Examination Scheme
In semester Exam. : 25 marks
End Semester Exam. : 50 marks
Duration of End term. Exam: 3 hrs

Unit 1

Structure of biomaterials, classification of bio materials, mechanical properties, Hookean elasticity, elasticity of non-Hookean materials. Elasticity models for bio materials. Structure of Hard tissue.

Unit 2

Materials for replacements, Metallic Biomaterials and ceramic biomaterials steps involved in the fabrication of metallic implants, stainless steel Co-Cr-alloys Ti & its alloys, medical applications, corrosion of metallic implants.

Unit 3

Polymeric Biomaterials and composite biomaterials, Polymerization, polyolefins, Polyamides, acrylic polymers, high strength thermoplastics for medical applications, deterioration of polymers. Structure, bounds on properties, anisotropy of composites, particulate composite fibrous composites, porous materials. On-absorbable or relatively Bio inert bio-ceramics Bio-degradable or resorbable ceramics. Bio active or surface reactive ceramics, deterioration of ceramics.

Unit 4

Mechanical properties of cartilage. Diffusiac properties of articular cartilage, mechanical properties of bone. Internal fracture fixation devices, joint replacements, dental implants.

Unit 5

Joint structure ,Kinetics and kinematics of joints, elbow, Hip, Knee joint; Evaluation of joint forces and moments. Equilibrium of joint ,fundamental concepts of Gait analysis, Link mechanism of human body.

Unit 6

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.

References

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.

501 015 b: Mechanics of Modern Materials: Elective III (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

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 and elastic properties. Three dimensional transformations. Stiffness matrix for Functionally Graded 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

Elastic behavior 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, anti-symmetric cross-ply and angle ply, orthotropic, quasi-isotropic laminates.

Unit 5

Hygrothermal Expansion and Design of Composite Structure: Coefficients of thermal and moisture expansion of various unidirectional lamina, load deformation relationship, residual

stresses for cross ply symmetric laminates. Design methodology, design of pressure vessel for various laminate configurations.

Unit 6

Experimental Methods of Testing of Composite Materials: Characterization 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, iIntroduction to stress concentration in laminates.

References

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. Ronald F.Gibbson ,Mechanics of Fiber Reinforced composites. McGraw-Hill

501 015 c: Retrofitting and Strengthening of R C Structures: Elective III (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1

Introduction: Needs for repair and rehabilitations of R C structure, degradation of reinforced concrete structure, major causes and sign, deterioration of concrete structures, causes of deterioration, cracking-type, causes and characteristics.

Unit 2

Evaluation of concrete structures: Conditional evaluation- definition, objectives and stages of conditional assessment, preliminary investigation-scope, methodology and output, detailed investigation-scope and methodology, In situ and laboratory testing such as nondestructive, semi destructive, corrosion test, chemical test and NDT for cracks, flaws and voids in concrete.

Unit 3

Repair system, material and techniques: Repair methodology, compatibility of repair material and concrete, material for repair-cement base, polymer modified, resin base, micro concrete and composite, repair techniques.

Unit 4

Retrofitting and strengthening of concrete structures: Design philosophy of strengthening, strengthening technique-section enlargement, composite construction, post tensioning, stress reduction, strengthening by reinforcement, strength by FRP.

Unit 5

Strengthening of R C members: Strengthening of beams: flexural and shear, slab, columns, footings and seismic retrofitting of R C structures using FRP.

Unit 6

Quality control in concrete construction, maintenance, water leakage-detection and mitigation, fire damage-detection and reparation, corrosion-detection and mitigation, demolition of concrete structures and structural health monitoring.

References

1. Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.
2. Repairs and Rehabilitation – Compilation from Indian Concrete Journals
3. Management of Deteriorating Concrete Structures, George Somerville, Taylor and Francis, Publication.
4. Concrete Building Pathology, Susan Macdonald, Blackwell Publishing
5. Durability of Cement and Cement Composites, C. L. Page, M M Page, Wood Head, Publishing.
6. ACI 440.2R-08, Guide for the design and construction of externally bonded FRP systems for strengthening concrete structures, American Concrete Institute.
7. Xilin lu (2010), Retrofitting design of building structures, Science Press, New York.
8. Strengthening and Rehabilitation of Civil Infrastructures Using Fibre-Reinforced Polymer (FRP) Composites, L. *C. Hollaway and J.G. Teng*, Woodhead Publishing Series in Civil and Structural Engineering
9. Maintenance, Repair & Rehabilitation & Minor Works of Building, by P C Varghese, PHI

501 015 d: Structural Reliability: Elective III (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I

Concepts of structural safety: Design methods, statistics and probability: Data reductions,Histograms, Sample correlation. Random variable, Discrete and continuous variables and commonprobability distribution.

Unit II

Resistance distribution and parameters: Statistical analysis of materials: steel, concrete bricks andmortar, Dimensional variations, characterization of variables and allowable stresses based onspecified reliability.Probabilistic Analysis for live load, gravity load and wind load.

Unit II

Computation of basic structural reliability, Reliability analysis of simple element such as beamand column Reliability methods, basic variables, first order second moment methods (FOSM) andconcept of reliability index. Reliability of structural systems: Redundant and non-redundantsystems,series, parallel and mixed systems.

Unit IV

Monte Carlo Methods of Analysis: Study of structural safety-generation of random numberscontinuous,discrete and jointly distributed variables-Application to reliability analysis of concrete structures.

Unit V

Reliability based design: Load and resistance factors of design, safety checking formats and codecalibrations, I.S. code provision, Introduction to stochastic process.

Unit VI

Decision Analysis: Introduction, simple risk decision problems, decision problems, decisionmodel,decision tree, decision criteria, decision based on existing information, Prior analysis

References

1. R. Ranganathan, Reliability Analysis and Design of Structures, Mc Graw Hill.
2. Edward Haugen, Probabilistic Approaches to Design, John Wiley and Sons, London.
3. R. E. Melchers, Structural Reliability-Analysis and Prediction, Ellis Horwood Ltd. Chichester, UK.

501 015 e: Non-linear Analysis of Structures: Elective III (Module I)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hours/week	**In semester Exam. : 25 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit I

Types of Nonlinearities: Geometric, Material, Nonlinear equations for beams: Moment-curvature nonlinearity, Geometric nonlinearity due to stretching, Material nonlinearity. Geo metric nonlinear beam problems: Moment curvature nonlinearity of cantilever beam, centrally loaded beam with two supports, Cantilever beam subjected to tip load.

Unit II

Nonlinear analysis of Columns: Double modulus theory, Tangent modulus theory, Empirical relations for short column, Post buckling of cantilever column, Large deflection of column with both ends hinged

Unit III

Nonlinear analysis of Trusses and Frames: Beam column, Triangulated frames, Derivation of nonlinear stiffness matrix, Matrix displacement method for nonlinear analysis of structures, nonlinear analysis of plane frame.

Unit IV

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.

Unit IV

Nonlinear Analysis of Shells: Derivation of governing equations, Circular cylindrical shells large deflections, Post buckling of shells: Circular cylindrical shells, Spherical shells with finite deflections.

Unit VI

Nonlinear analysis of structures with composite materials: Composite beams large deflection, Composite plates governing equations, Displacement equations, Laminated plates-cylindrical bending, symmetrically laminated plates.

References

1. M Sathyamoorthy, Nonlinear Analysis of Structures- CRC New York
2. K I Majod, Nonlinear Structures- Butter Worth, London

501 015 I: Safety practices in construction: Elective III (Module II)

Teaching Scheme **Examination Scheme**
Lectures: 1 hours/week **In semester Exam. : 25 marks**
Credits: 1

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-Retaini ng walls-Critical factors for failure-Regular Inspection and monitoring. Safety in Erection and closing operation - Construction materials –Specifications – suitability – Limitatio ns – 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.

Unit 2:

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.

501 015 II: Engineering ethics: Elective III (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

Unit I

Introduction : Meaning & scope of Ethics in general & for engineers in particular, Moralobligations and rules in engineering, Categories of moral, Work Culture, Corporate, local & global issues, Rights & responsibilities of Engineers, Conflicts in the profession, Mental Stresses & Emotional Intelligence.

Unit II

Code of Ethics for Engineers: First principles of Engineering Ethics & Ethical terminology,Social Values, Character, considerations for general Individuals, Engineers & the Society, Recommendations of the Professional bodies (Code of Conduct), Introduction to Copyright, IPR (Intellectual Property Right), Plagiarism & Legal issues

Reference

1. Ethics in Engineering Practice and Research, Carolin Whitbeck, Cambridge University Press—ISBN—978-1-107-66847-8

501 015 III: Forensic Civil Engineering: Elective III (Module II)

Teaching Scheme
Lectures: 1 hours/week
Credits: 1

Examination Scheme
In semester Exam. : 25 marks

Unit I

Introduction to forensic engineering, Forensic investigations-tools and techniques, Failures-types, causes and mechanisms ,Monitoring and instrumentation, Mitigation of failure

Unit II

Professional practice and ethics, Legal issues, Repairs and remediation, Risk and risk assessment, Assessment of damage, Forensic analysis of R.C. frames, Case studies.

References

Proceedings, Conference on Forensic Civil Engineering, Association of Consulting Civil Engineers(I), Banglore, August,2013

501 016: Seminar II

Teaching Scheme	**Examination Scheme**	
Lectures: 4 hours/week	**Term work**	**: 50 marks**
Credits: 4	**Oral/ Presentation**	**: 50 marks**

The student is required to deliver a seminar in second semester on the topic relevant to latest trends in Civil Engineering (other than the topic of dissertation) preferably on the topic of sub specialization based on the Electives selected by him/her by authority. The student shall submit the seminar report (printed on both sides) in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/ Institute.

The contents of report are as follows.

1. Introduction
2. Literature Survey
3. Theoretical contents
4. Relevance to the present national and global scenario of construction industry
5. Strengths and weaknesses of the particular area of seminar
6. R & D in the particular area
7. Field Applications/case studies/Experimental work/software application
8. Vendors associated
9. Conclusions
10. References

Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.

501 017: Project Stage I

Teaching Scheme	**Examination Scheme**	
Lectures: 8 hours/week	**Term work**	**: 50 marks**
Credits: 4	**Oral/ Presentation**	**: 50 marks**

Project Stage-I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the students during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the students like to acquire specialized skills.

The student shall submit the report (printed on both sides) of project work completed partly in standard format approved by the University as per the following.

1. Introduction including aim and objective of the dissertation topic
2. Review of literature
3. Problem statement and methodology
4. Theoretical contents associated with the dissertation topic
5. Data collection from field or organization / experimental set-up developed if any / part analysis
6. Limitations of study / difficulties encountered if any
7. Progress achieved
8. Future plan of action
9. References

The candidate shall deliver a presentation as a part of the progress report of Project work Stage-I in front of panel of examiners.

501 018: Seminar III

Teaching Scheme	**Examination Scheme**	
Lectures: 5 hours/week	**Term work**	**: 50 marks**
Credits: 4	**Oral/ Presentation**	**: 50 marks**

Seminar III: Shall preferably be an extension of seminar II. The student shall submit the duly certified seminar report (printed on both sides) in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.

The contents of report are as follows.

1. Introduction
2. Literature Survey
3. Theoretical contents
4. Relevance to the present national and global scenario of construction industry
5. Strengths and weaknesses of the particular area of seminar
6. R & D in the particular area
7. Field Applications/case studies/Experimental work/software application
8. Vendors associated
9. Conclusions
10. References

Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.

501 019: Project Stage II

Teaching Scheme	Examination Scheme
Lectures: 20 hours/week	**Term work: 150 marks**
Credits: 4	**Oral/ Presentation: 50 marks**

In Project Work Stage II, the student shall complete the dissertation. The student shall prepare the final report of dissertation work in standard format duly certified for satisfactory completion of the work by the concerned guide and Head of the Department/Institute.

The report shall consist of the following as applicable:

1. Introduction including aim and objective of the dissertation topic
2. Review of literature
3. Problem statement
4. Theoretical contents associated with the dissertation topic
5. Methodology adopted
6. Data collection from field or organization / experimental set up preparation if any/analysis
7. Results and discussion
8. Validation of results if applicable
9. Conclusions and future scope of work
10. References

The final dissertation shall be submitted in hard bound copy as well as a soft copy on CD. The Term Work of Dissertation of semester IV shall be assessed jointly by the pair of internal and external examiners, along with oral examination of the same. The candidate shall deliver a presentation on report of Project work Stage-II (dissertation) in front of external and internal examiner.

It is recommended that at least one paper on the dissertation topic to be presented in a conference or published in a referred journal.