Minor Program in Structural Engineering (MC)

S. No.	*Course Code*	*Course Name*	*Semester*	*Credits*	*Course Type*	*Recommended Class Strength*
1		Analysis of Structures (2 1 0)	V	3	Core	10 to 20
2		Dynamics of Structures (2 1 0)	V	3	Core	10 to 20
3		Advanced Structural Analysis (2 1 0)	VI	3	Core	10 to 20
4		Advanced Foundation Design (2 1 0)	VI	3	Core	10 to 20
2		Prestressed Concrete (2 1 0)	VII	3	Elective*	10 to 20
6		Fundamentals of Earthquake Behaviour of Buildings (2 1 0)	VII	3	Elective*	10 to 20
7		Design of Steel Structural Systems (2 1 0)	VIII	3	Elective*	10 to 20
8		Earthquake Design of Structures (2 1 0)	VIII	3	Elective*	10 to 20
* Students will have a choice between Course #5 and #6 in the 7th semester and between Course #7 and #8 in the 8th Semester.						

UG/PG: UG	Department: Civil Engineering
Course Code:	Course Name: Analysis of Structures
Credit: 3	L-T-P: 2-1-0
Course Type: MC	
Pre-requisite Course:	

Syllabus

Slopes and deflections in determinate beams using conjugate beam method and moment area method; Generalized coordinate system; Principles of real and virtual work; Maxwell's reciprocal theorem; Betti's theorem; Castigliano's theorems; Strain energy expressions; Strain energy method and virtual work (unit load) method for slopes and deflections in statically determinate frames and trusses; Static indeterminacy and released structure; Force method – method of consistent deformation for analysis of statically indeterminate beams, frames and trusses; Three moment theorem; Column analogy method; Moving loads and influence lines; Application to statically determinate structures; Muller Breslau's principle.

Text Books

1. Mechanics of Structures, Vol. I & II by S.B. Junnarkar & H.J. Shah
2. Theory of Structures, Vol. I& II by G.S. Pandit and S.P. Gupta
3. Structural Analysis by C.K. Wang
4. Structural Analysis (6/e) by R.C. Hibbeller

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Dynamics of Structures
Credit: 3	**L-T-P: 3-0-0**
Course Type: HA + HB + MC	
Pre-requisite Course: Structural Analysis	

Syllabus

Fundamental theory of vibration, Degree of freedom (DOF); Single degree of freedom (SDOF) system- Free and Forced vibrations of Undamped and Damped systems subjected to Harmonic loading, periodic loading, impulsive loading and Machine Vibration. Vibration Isolation; Concepts of elastic response spectra, Introduction to dynamics of Multi-degree of freedom (MDOF) systems; Two degree of freedom (TDOF) system- Free and Forced vibrations of Undamped and Damped systems subjected to Harmonic loading; MDOF systems- Natural frequencies and mode shapes, Orthogonal relationship; Dynamic response by mode superposition method; Approximate Methods for Vibration Analysis - Rayleigh quotient, Rayleigh-Ritz method, Holzer Method. Introduction to dynamics of continuous systems.

Text Books

1. Jain, A.K., "Dynamics of Structures With MATLAB® Applications", Pearson
2. Chopra, A.K., "Dynamics of Structures, (5/e)", Pearson
3. Humar, J.L., "Dynamics of Structures, (3/e)", CRC Press
4. Paz, M. and Kim, Y.H., "Structural Dynamics, (6/e)", Springer
5. Shabana, A.A., "Theory of Vibration: An Introduction, (3/e)", Springer
6. Clough, R.W. and Penzien, J., "Dynamics of Structures, (3/e)", Computers and Structures, Inc.

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Advanced Structural Analysis
Credit: 3	**L-T-P: 2-1-0**
Course Type: HB + MC	
Pre-requisite Course: Structural Analysis	

Syllabus

Degree of Kinematic indeterminacy and restrained structure; Displacement approach of analysis – Slope deflection method, Moment distribution method for analysis of continuous beams and rigid – jointed plane frame; Use of symmetry; Three hinged and two hinged arches; Matrix method using system approach – flexibility and stiffness method for analysis of pin-jointed plane frame, continuous beams and rigid – jointed plane frame; Introduction to Direct Stiffness method; Assembly of stiffness and load vectors; Boundary condition and solutions; Application to planer structures – trusses beams and frames & its computer formulations.

Text Books

1. Structural Analysis- A Matrix Approach by G.S. Pandit and S.P. Gupta
2. Structural Analysis by C.K. Wang
3. Basic Structural Analysis by Reddy

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Advanced Foundation Design
Credit: 3	**L-T-P: 2-1-0**
Course Type: HB + HC + MC	
Pre-requisite Course: Geotechnical Engineering – II	

Syllabus

Introduction, Foundation Choice, Definitions, Requirements, Types of foundations, Shallow foundations, Types of failures, bearing capacity, Settlement analysis, Contact stress beneath foundations, Beams on elastic foundations, Modulus of subgrade reaction, Special foundations, Foundations in expansive soils (CNS concept), Underreamed pile foundations, Remedial measures for cracked buildings. Foundation of transmission line towers, Underpinning of foundations, Importance and situations for underpinning, methodology, Typical examples of underpinning, Pile Foundation, Bridge substructures, Maximum depth of scour, Depth of foundation, Allowable bearing pressure, loads to be considered, Well Foundation, Lateral stability of well foundation, Design of pier cap, Design of pier, Sinking stresses in wells, Design of well components, Reinforced earth.

Text Books

1. A.P.S. Selvadurai, "Elastic Analysis of Soil-Foundation Interaction", Elsevier Scientific Publishing Company
2. B. M. Das, "Principles of Foundation Engineering", PWS Publishing Company
3. Joseph Bowles, "Foundation Analysis and Design", McGraw-Hill.
4. V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors, New Delhi.
5. Tomlinson, M.J. " Foundation Design and Construction", English Language Book Society, Longman.
6. Swami Saran, "Analysis and Design of Substructures", Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Prestressed Concrete
Credit: 3	**L-T-P: 3-0-0**
Course Type: HB + MC	
Pre-requisite Course:	

Syllabus

Basic philosophy of prestressing; various techniques of prestressing; different systems of prestressing; Prestressing of concrete structures; losses in prestress; deflection of prestressed concrete members; analysis and design of prestress beams; camber; deflection; cable layouts; stretching in stages, ultimate strength in flexure and shear. Design of end blocks; Statically indeterminate structures; concordant cables; linear transformation, Analysis and design of continuous beams. Tension members; circular prestressing-prestressed tanks and prestressed pipes. Compression members; piles. Partial prestressing; composite construction, analysis of composite beams, prestress slabs; Introduction to pre-cast prestressed elements like poles, railway sleepers, beams, slabs and wall panels etc. planning and economical aspects of prestressed structures, construction of prestressed concrete structures-techniques, materials and management

Text Books

1. Prestressed Concrete Structures by T.Y. Lin
2. Prestressed Concrete Structures by Krishnaraju
3. Prestressed Concrete Structures by G.S. Pandit & S.P. Gupta.

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Fundamentals of Earthquake Behaviour of Buildings
Credit: 3	**L-T-P: 2-1-0**
Course Type: HB + MC	
Pre-requisite Course:	

Syllabus

Dynamic actions on buildings wind versus earthquake. Basic Aspects of Seismic Design, Four Virtues of Earthquake Resistant Buildings- Seismic Structural Configuration, Structural Stiffness, Strength and Ductility. Earthquake Demand versus Earthquake Capacity. Force-based Design to Displacement-based Design. Seismic Design Force. Dynamic Characteristics of Buildings, Ground Motion Characteristics. Earthquake Capacity of Buildings – Elastic Behaviour, Earthquake Capacity of Buildings – Inelastic Behaviour, Distribution of Damage in Buildings, The Open Ground Storey Buildings, Strong Column - Weak Beam Design Strength Hierarchy, Structural Plan Density, Ductility, Earthquake-Resistant Design Methods

Text Books

1. Ambrose,J., and Vergun,D. (1999). Design for Earthquakes, John Wiley & Son, Inc., USA.
2. Arnold,C., and Reitherman,R. (1982). Building Configuration and Seismic Design, John Wiley & Sons, Inc., NY, USA
3. Bachmann,H. (2003). Seismic Conceptual Design of Buildings – Basic principles for engineers, architects, building owners, and authorities, BBL Vertrieb Publikationen, Bern.
4. Dowrick,D.J. (1987). Earthquake Resistant Design for Engineers and Architects, 2nd Ed., John Willey & Sons, NY, USA.
5. IS: 13920 (1993). Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, Bureau of Indian Standards, New Delhi.
6. IS: 1893 (Part 1) (2007). Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
7. IS: 456 (2000). Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
8. CSI (2010). Structural Analysis Program (SAP) 2000, Version 14, Computers and Structures Inc., USA.

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Design of Steel Structural Systems
Credit: 3	**L-T-P: 2-1-0**
Course Type: HB + MC	
Pre-requisite Course: Design of Steel Structures	

Syllabus

Structural Steels, Brittle fracture and fatigue; Stability of Beam Columns, frames and plates, advanced Plastic design of Steel Structures, design of Gantry Girders, Plate Girder bridge, Truss Girder Bridge, Steel Tanks ,using latest IS codes.

Text Books

1. Plastic Analysis & Design Of Steel Structures : Wong
2. Design of Steel Structures: N Subramanium
3. Limit State Design of Steel Structures: S.K.Duggal
4. Design of Steel Structures: P Dayaratnam.

UG/PG: UG	**Department:** Civil Engineering
Course Code:	**Course Name:** Earthquake Design of Structures
Credit: 3	**L-T-P: 2-1-0**
Course Type: HB + MC	
Pre-requisite Course:	

Syllabus

Introduction to RC Structures-Need for ductility in structures: earthquake, impact and blast resistant designs, Nonlinear Design Philosophies, Earthquake-resistant design philosophy - contribution to ductility by four virtues, Blast resistant design philosophy - concept of structure toughness. Methods of Design, WSD, LSD, ULD, LRFD; Review of LSD - flexure, axial-flexure, shear, torsion, Capacity Design Concept, Confinement of concrete, concept of over-strength, Flexure design, shear design, strong-column weak-beam philosophy. Beam-column Joints, Loading, effects under seismic loading, beam bar anchorage, shear design Collapse Mechanisms-Levels of ductility (section, member and structure ductilities), Modeling non-linear response of structural components and systems, Demand-capacity ratios: incremental DCRs and pushover analysis, Storey and sway mechanisms Properties of Steel, Ductility Control, Basic Design Philosophy, Ground Motion Response Spectra, Methods of Analysis, Methods of Design, Material Ductility, Section Ductility, Member Ductility, Methods of Ductility Design.

Text Books

1. Paulay, T. and Priestley, M.J.N. (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, Inc
2. Penelis, G.G. and Kappos, A.J. (1997). Earthquake-resistant Concrete Structures, E & FN Spon
3. Priestley, M.J.N., Seible, F, and Calvi, G.M. (1996). Seismic Design and Retrofit of Bridges, John Wiley & Sons, Inc
4. Murty, C.V.R., Goswami, R., Viajanarayanan, A.R., and Mehta, V.V. (2012). Some Concepts in Earthquake Behaviour of Buildings, Gujarat State Disaster management Authority
5. Naeim, F. (Ed.) (2001). The Seismic Design Handbook, Kluwer Academic Pub
6. Eibl, J. (1988). Concrete Structures under Impact and Impulsive Loading, Bulletin d' Information No. 187, Comité Euro-International du Béton (CEB), Lausanne
7. Kassimali, A. Matrix Analysis of Structures, Brooks/Cole Publishing Co., 1999
8. Codes and Standards of India, US, Japan, New Zealand, EU.
9. Gaylord E. H. Jr., Gaylord C. N. and Stallmeyer J. E. (1992). Design of Steel Structures, Tata McGraw Hill Publication.