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SCHOOL OF ENGINEERING

SYLLABUS AND COURSE STRUCTURE

M. TECH (STRUCTURAL ENGINEERING)

ACADEMIC YEAR 2015-16

M.Tech. (Structural Engineering)

Code & Subject Scheme

Semester I

Code	Subject	Contact Hours/week			Total Credits	
		L	T	P		
MCI024A	Structural Dynamics	4	0	0	4	C
MCI025A	Concrete Technology and Special Concretes	4	0	0	4	C
MCI026A	Design of Plates and Shells	4	0	0	4	C
MCI027A	Bridge Engineering	4	0	0	4	C
MCI028A	Structural Engineering Laboratory	0	0	2	2	C
MCI029A	Advanced Concrete Lab	0	0	2	2	C
MCI007A	Seminar	0	0	2	2	C
	Total	**16**	**0**	**6**	**22**	

Semester II

Code	Subject	Contact Hours/week			Total Credits	
		L	T	P		
MES001A	Research Methodology	3	0	0	3	F
MCI030A	Advanced Design of Steel Structures	4	0	0	4	C
MCI031A	Prestressed Concrete Design	4	0	0	4	C
MCI032A	Theory of Elasticity and Plasticity	4	0	0	4	C
MCI033A	Design Lab (SAP 2000)	0	0	2	2	C
MCI034A	Finite element Lab (MATLAB)	0	0	2	2	C
MES002A	Advanced Excel Lab	0	0	1	2	F
MCI013A	Seminar	0	0	2	2	C
	Total	**15**	**0**	**7**	**22**	

Semester III

Code	Subject	Contact Hours/week			Total Credits	
		L	T	P		
MCI035A	Plastic analysis and design	4	0	0	4	C
MCI036A	Neo Construction Materials	4	0	0	4	C
	Elective-I	4	0	0	4	S
	Elective-II	4	0	0	4	S
MCI016A	Dissertation Part – I	0	0	12	12	C
	Total	**16**	**0**	**12**	**28**	

Elective Subjects (one from each group)			
Elective I		**Elective II**	
MCI037A	Stability of structures	MCI039A	Repair and Rehabilitation of Structures
MCI038A	Earthquake resistant design	MCI040A	Advanced Foundation Design
MCI022A	Soil structure interaction	MCI041A	Design of Tall Buildings

Semester IV

Code	**Subject**	**Contact Hours/week**			**Total Credits**	
		L	**T**	**P**		
MCI023A	Dissertation Part – II	0	0	28	28	C
	Total	**0**	**0**	**28**	**28**	

SEMESTER-I

L-T-P	MCI024A – Structural Dynamics	Credits: 4
4-0-0		

Objective:

- Learn how to model discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems.
- Apply the methods learned to a realistic engineering vibration problem and write a report on the results.

Unit1

Dynamics of Structures: Objectives and importance. Types of dynamic loads, Dynamic degree of freedom, Mathematical modelling, Damping and stiffness, Torsional stiffness, Equivalent stiffness, Free and forced vibrations

Unit 2

Single Degree of Freedom (SDOF) Systems: Undamped free vibrations, formulation of differential equation of motion: Newton's law of motion, D'Alembert's principle and energy approach. Natural frequency. Vibration response.

Unit 3

Single Degree of Freedom (SDOF) Systems: damped free vibrations, critically damped, under damped & over damped systems, formulation of differential equation of motion: Natural frequency. Vibration response.

Unit 4

Forced vibration response of SDOF damped and undamped systems to harmonic loading, rotating and reciprocating unbalance, support motion and impulsive type forcing function. Vibration isolation and transmissibility. Seismic Instruments.

Unit 5

Forced vibration response of SDOF damped and undamped systems to harmonic loading, rotating and reciprocating unbalance, support motion and impulsive type forcing function. Vibration isolation and transmissibility. Seismic Instruments.

Outcome:

- An understanding of space structures by discussing vibration problems unique to large flexible structures.

Text Book:

1. "Dynamics of Structures: Applications to Earthquake Engineering" by A. K. Chopra

Reference book:

1. "Dynamics of Structures" by R.W. Clough and J. Penzien

2. Fundamentals of Structural Dynamics, 2nd Edition, by Roy R. Craig, Andrew J. Kurdila

L-T-P	MCI025A – Concrete Technology and Special Concretes	Credits: 4
4-0-0		

OBJECTIVES

- To familiarize with the fundamentals of concrete
- To study the different concreting methods
- To understand the basic concepts of special concretes, types, properties and their applications
- To study the application of different concretes

Unit 1

Characteristics of concrete and mix design: Properties of fresh and hardened concrete - strength, elastic properties, creep and shrinkage – variability of concrete strength - quality control – Principles of concrete mix design, methods of concrete mix design - High Strength Concrete Mix Design - Super - Plasticizers - Principles involved in mix design of high performance concrete with fly ash or GGBS replacements.

Unit 2

Concreting methods: Process of manufacturing of concrete-methods of transportation-placing and curing - extreme weather concreting - special concreting methods – vacuum dewatering - under water technology-special form work-Ready mix Concrete.

Unit 3

Polymer and fibre concretes: Polymer concrete-Types, Properties and Applications - Blended cement concretes-Fibre-reinforced Concrete-Different types of metallic and non metallic fibres - Types, Properties and Applications, Slurry-infiltrated fibre reinforced concrete.

Unit 4

Ferrocement, low and high density concretes: Ferrocement and its applications, Light Weight concrete - concrete - Roller compacted concrete - Types, Properties and Applications.

Unit 5

Other concretes: Bacterial concrete - Born again concrete (Recycled Aggregate concrete) Electric concrete (Smart concrete) description - applications. Performance concrete-Production and applications-Self compacting concrete - Reactive powder concrete - Description, Properties and Applications.

Outcomes:

- To get exposed to behavioural aspects of concrete and to get exposed to different types of concretes and their characteristics and applications.

Text Book

1. Fintel, *"Hand book of Concrete EnssiVannostrand"*, CBS Publishers &Distributors, 2004

Refrence Book

2. Metha P.K. and Monterio P.J.M. *"Concrete-Structures"*, Properties andMaterials, 3rd Edition, McGraw Hill Professional, 2006.

3. M.S. Shetty, *"Concrete Technology"* S.Chand and Company Ltd, Delhi,2000.

4. Neville.A.M. *"Properties of Concrete"*, Pitman Publishing Limited,London, 1990

L-T-P	MCI026A – Design of Plates and Shells	Credits: 4
4-0-0		

Objectives

- Study the behaviour and design of shells, folded plates, space frames

Unit 1

Plate equation in cartesian and polar coordinates for isotropic plates - Analysis of rectangular and circular plates with different boundary conditions and loadings

Unit 2

Design and analysis of plates by various method, Orthotropic plates - Plates on elastic foundation.

Unit 3

Classification of shells - Membrane and bending theory for singly curved and doubly curved shells - Various approximations - Design of cylindrical shells, HP shells, conoids

Unit 4

Design and Analysis of folded plates by various approximate method

Unit 5

Design of diaphragms - Detailing of reinforcements for shells Framework for shells and folded plates.

Outcomes

- Able to design plate and shell structure for different kind of loading and different kind of support condition

TEXT BOOK

1. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co.,New York, 1982.

REFERENCES:

1. Santhakumar.A.R and Senthil.R, "Proceedings of International Conference onSpace Structures", Anna University, Chennai, 1997.
2. Subramanian.N ,"Principles of Space Structures", Wheeler Publishing Co.1999.
3. Ramasamy, G.S., "Design and Construction of Concrete Shells Roofs", CBSPublishers, 1986.
4. ASCE Manual No.31, "Design of Cylindrical Shells".

L-T-P	MCI027A – Bridge Engineering	Credits: 4
4-0-0		

Objective:

- To study the loads, forces on bridges and design of several types of bridges

Unit 1

Introduction - Classification and components of bridges, historical perspective, layout and planning, investigations for Bridges, choice of type of the bridges, conceptual bridge design, bridge aesthetics. Bridge appurtenances.

Unit 2

Loads on bridges - loading standards for highway and railway bridges (IRC, IRS) Analysis and design of RC and PSC bridge decks: slab culvert bridges, slab and beam bridges, load distribution in slabs and beams, bowstring girder bridges, behaviour of skew bridge decks.

Unit 3

Behaviour, analysis and design of RC and PSC box girder bridge decks. Behaviour, analysis and design of steel bridge decks: girder bridges, truss bridges, arch bridges, composite construction.

Unit 4

Design of bearings, substructure and foundations - piers and abutments of different types, shallow and deep foundations-design and constructional aspects.

Unit 5

Modern methods of construction of concrete, steel and composite bridges, their impact on analysis and design. Introduction to analysis and design of long span bridges: suspension.

Outcomes:

- Able to design different type of bridge member

Text Book:

1. Swami Saran, "Analysis and Design of Substructures", Oxford & IBH Publishing Co., 1996.

Reference book:

1. J.E. Long, "Bearings in Structural Engineering", Newnes Butterworth & Co., 1974.
2. R.E. Rowe, "Concrete Bridge Design", 1st Edition, Elsevier Science and Technology, 1962.
3. L.G. Hendry and A.W. Jaeger, "The Analysis of Grid Frameworks and Related Structures", Chatto&Windus, 1958.

L-T-P	MCI028A – Structure Engineering Lab	Credits: 2
0-0-2		

List of Experiments:

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever steel beam
    a. To determine the damping coefficients from free vibrations.
    b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames and evaluate
    a. Drift of the frame.
    b. Stiffness of the frame.
    c. Energy dissipation capacity of the frame.
6. Determination of in-situ strength and quality of concrete using
    i) Rebound hammer and
    ii) Ultrasonic Pulse Velocity Tester

L-T-P	MCI029A – Advanced Concrete Lab	Credits: 2
0-0-2		

List of Experiments:

1. Compressive strength of Cement
2. Mix Design of Concrete and Casting of Specimen.
3. Young's Modulus of Concrete
4. Non destructive test on concrete.
5. Mix design of high strength concrete including casting and testing of specimens.
6. Mix design of fly ash concrete including casting and testing of specimens.
7. Determination of coefficient of permeability of concrete.
8. Determination of drying shrinkage of concrete.
9. Bending test on a RCC beam under.
    a) Single point load
    b) Three point load

L-T-P	MCI007A – Seminar	Credits: 2
0-0-2		

SEMESTER-II

L-T-P	MES001A – Research Methodology	Credits: 3
3-0-0		

Objectives:

- To learn progress from the beginning stage to the end of a research project with the research methodology for each step.
- To learn the quantitative and qualitative methodologies.

Unit 1

Nature and Objectives of research; Methods of research: historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal.

Unit 2

Introduction to statistical analysis: Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis.

Unit 3

Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution. Basic ideas of testing of hypotheses; Tests of significance based on normal, t and Chi-square distributions.

Unit 4

Design of experiments: basic principles, study of completely randomized and randomized block designs. Analysis of variance technique.

Unit 5

Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography. Use of common softwares like SPSS, Mini Tab and/or Mat Lab. For statistical analysis.

Outcomes:

- At the end of the course students will be able to understand formulation of a research problem with a research design and data collection for the research.

Text Books:

1. *Borth, Wayne C, et.Al. - The Craft of Research: Chicago Guides to Writing Edition and Publishing.*

Reference Books:

2. *Meyer, P.L. - Introduction to Probability & Statistical, Applications, Oxford, IBH.*
3. *Hogg, R.V. & Craig, A.T., Introduction to Mathematical Statistics, MacMillan.*
4. *Goon, A.M., Gupta, M.K. & Dasgupta - Fundamentals of Statistics, Vol.I: World Press.*
5. *Gupta, S.C. & Kapoor, V.K. - Fundamentals of Mathematical Statistics, Sultan Chand & Sons.*
6. *Johnson, R.A. - Probability and Statistics, PHI, New Delhi.*

L-T-P	MCI030A – Advanced Design of Steel Structures	Credits: 4
4-0-0		

Objective:

- Perform Limit state design of trusses and frames.
- Perform Minimum weight design of steel structures.

Unit 1

Limit States Load and Resistance Factor Design methods. Behaviour and design of members under tension, compression, bending, and combined forces (shear bending, axial force bending).

Unit 2

Fasteners: Methods of installation and behaviour of rivets, bolts and welds. Screws and rivets in cold formed steel construction Connections, Types of fasteners, Behaviour of local elements, Analysis, Design and Detailing of Connections. Design for Earthquake Forces.

Unit 3

Cold formed Steel Sections - Types of cross sections - Local buckling and post buckling - Design of compression and Tension members - Beams - Deflection of beams - Combined stresses and connections.

Unit 4

Design for ductility, R factor, concentrically and eccentrically braced frames, non-buckling bracings.

Unit 5

Estimation of wind load - Design of industrial stacks - Self-supporting and guyed stacks lined and unlined – along wind and across wind vibration. Principles of analysis and design of Industrial buildings and bents - Gantry girders and crane

Outcome:

- Able to prepare detailed structural drawings of steel structures.

Textbooks:

1. N. Subramanian: Design of steel structure.

References:

1. L.S. Beedle, "Plastic Design of Steel Frames", John Wiley & Sons, 1958.
2. B.G. Neal, "Plastic Methods of Structural Analysis", 3rd Edition, Chapman and Hall, 1977.
3. R. Narayanan et al, "Teaching Resource for Structural steel design" Institute for Steel Development and Growth, 2003.
4. J.F. Baker, "Steel Skeleton", University Press, 1953.
5. W.F. Chen, D.J. Han, "Plasticity for Structural Engineer", J Ross Publishing, 2007.

L-T-P	MCI031A – Prestressed Concrete Design	Credits: 4
4-0-0		

Objective:

- This subject is thought to give the concepts of pre stress
- To impart the knowledge about analysis and design of pre stressed concrete members.

Unit 1

Introduction to prestressed concrete: types of prestressing, systems and devices, materials, losses in prestress.

Unit 2

Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions in IS 1343. Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, and flexure combined with axial compression or tension.

Unit 3

Analysis and design for shear and torsion, code provisions. Transmission of prestress in pretensioned concepts, crack-width members. Anchorage zone stresses for posttensioned members.

Unit 4

Statically indeterminate structures Analysis and design continuous beams and frames, choice of cable profile, linear transformation and concordancy. Composite construction with precast PSC beams and cast insitu RC slab Analysis and design, creep and shrinkage effects. Partial prestressing principles, analysis and design calculations

Unit 5:

- Analysis and design of prestressed concrete pipes, tanks and spatial structures slabs.

Outcome: Upon completion of this course, the student will be able to

- Know the concepts, methods and materials of pre stressing systems.
- Design the pre stressed concrete members and calculate the deflections in pre stressed concrete members.
- Design anchorage zones and composite pre stressed concrete members.

Text Book:

1. Krishna Raju.N, (2004), Pre stressed Concrete, Third Edition, Tata McGraw Hill Co.

Reference Books:

1. Rajagopal.N, (2005), Prestressed Concrete, Second Edition, Narosa Publishing House.
2. Dayarathnam P, (2004), Prestressed Concrete Structures, S.Chand Publishers.
3. Sinha.N.C and Roy.S.K, (2000), Fundamentals of Pre-stressed Concrete, S.Chand& Company limited.

L-T-P	MCI032A – Theory of Elasticity and Plasticity	Credits: 4
4-0-0		

Objective:

- This subject is taught to impart knowledge on theory of elasticity and plasticity

Unit 1

Introduction: Elasticity - notation for forces and stresses - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain – differential equations of equilibrium - boundary conditions - compatibility equations - stress function – boundary condition.

Unit 2

Two dimensional problems in rectangular coordinates - solution by polynomials - Saint- Venant's principle - determination of displacements - bending of simple beams. Two dimensional problems in polar coordinates – strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two- dimensional problem in polar coordinates - application of general solution in polar coordinates.

Unit 3

Analysis of stress and strain in three dimensions - principal stresses - stress ellipsoid - director surface - determination of principal stresses - max shear stresses – homogeneous deformation - principal axes of strain rotation. General Theorems: Differential equations of equilibrium – conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem.

Unit 4

Torsion method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes, bars etc. Bending of Prismatic Bars: Stress function - bending of cantilever – circular cross section - elliptical cross section - rectangular cross section - bending problems by soap film method – displacements of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections – other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy

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Unit 5

Theory of Plasticity: Introduction - concepts and assumptions - yield criterions.

Outcome:

- Analyze the stresses and strains for two dimensional and three dimensional elements.
- Understand the equilibrium and compatibility conditions.
- Solve the problems on Torsion for different shaped bars.
- Understand the concept of plasticity.

Text Book:

1. Theory of Elasticity by Timeshanko, McGrawhill Publications.

REFERENCES

1. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
2. Theory of Elasticity by Y.C.Fung.
3. Theory of Elasticity by Gurucharan Singh.

L-T-P	MCI033A –Design Lab (SAP 2000)	Credits: 2
0-0-2		

Experiment

Linear and non linear Analysis of structures

1. 2D/3D Analysis based on state-of-the-art Matrix method to handle extremely large job.
2. Beam, Truss, Tapered Beam, Shell/Plate Bending/Plane Stress. Full/Partial Moment Releases.
3. Design of Concrete Beam/Column/Slab/Footing as per all major international codes
4. Numerical and Graphical Design Outputs with complete reinforcement details. IS 456-2000 for RCC design implemented.
5. RC detailer as per IS 456-2000 has been implemented which has given a new dimension

L-T-P	MCI034A – Finite Element Lab	Credits: 2
0-0-2		

List of Experiments:

1. Computer programming for analysis of continuous beam
2. Computer programming for analysis of Plane trusses
3. Computer programming for analysis of Plane frame
4. Computer programming for analysis of Grid
5. Computer Programming for analysis of space truss

L-T-P	MES002A – Advanced Excel Lab	Credits: 1
0-0-1		

Various Methods and Uses of Advance Excel Formulas: Vlookup, Hlookup, Sumif, Sumifs, Sumproduct, Dsum, Countif, Countifs, If, Iferror, Iserror, Isna, Isnumber, Isnontext, Isblank, Istext, Getpivotdata, Dcount, Dcounta, Or, And, Search, Index, Match Etc

Various Methods and Uses of IF Conditions: When should use the "IF" Conditions?, Creation of Multiple IF Conditions in One Cell,Use the IF Conditions with the Other Advance Functions, How to use nested IF statements in Excel with AND, OR Functions

ADVANCED EXCEL OPTIONS : Various Methods of Filter and Advance Filter options, Creating and Updating Subtotals, Various Methods of Text to Column options, Uses of Data Grouping and Consolidation options, Uses of Goal Seek and Scenarios Manager, Various Method of Sorting Data, Creating, Formatting and Modifying Chart, Data Validation, Creating drop down lists using different data sources, Linking Workbooks and Uses of Edit Link options, Excel Options, Customizing the Quick Access Tool Bar, Formula Auditing features and Trace formula error

Pivot Tables & Charts : Various Methods and Options of Pivot Table, Using the Pivot Table Wizard, Changing the Pivot Table Layout, Subtotal and Grand total Options, Formatting, Grouping Items, Inserting Calculated Fields, Pivot Table Options, Calculation in Pivot Table, Display and Hide Data in Field, Select, Move & Clear Pivot Data, Creating and Modifying Pivot Chart

Advance Use of Function: Mixing Function to get Various MIS Outputs, Creating Data Table, Advance Data Validation, Using conditional formatting with Formulas and Function, Using Name Manager, Array Formulas

Importing Data from External Sources: Macros, What is a Macro?, Creating Excel Macro, Running Macros and Editing, Automating Tasks with Macro

L-T-P	MCI013A - Seminar	Credits: 2
0-0-2		

Semester III

L-T-P	MCI035A – Plastic Analysis and Design	Credits: 4
4-0-0		

Objectives:

- To study the plastic methods which are used extremely by engineers for the design of steel structure, including simple beams, continuous beam, simple portal frames.
- To analysis based on either virtual work formulation or sophisticated plastic theory contained in specialist computer packages.

Unit 1

Analysis of Structures for Ultimate Load: Fundamental Principles – statical method of Analysis Mechanism method of analysis – Method of analysis, Moment check – Carry over factor –Moment Balancing Method.

Unit 2

Design of Continuous Beams: Continuous Beams of uniform section throughout – Continuous Beams with different cross-sections.

Unit 3

Secondary Design Problems: Introduction – Influence of Axial force on the plastic moment – influence of shear force – local buckling of flanges and webs – lateral buckling – column stability.

Unit 4

Design of Connections: Introduction – requirement for connections – straight corner connections– Haunched connection – Interior Beam-Column connections.

Unit 5

Design of Steel Frames: Introduction – Sinole span frames – simplified procedures for Sinole span frames – Design of Gable frames with Haunched Connection. Ultimate Deflections: Introduction –Deflection at ultimate load – Deflection at working load – Deflections of Beams and Sinole span frames.

Outcome:

- At the end of this course, the students will be able to analyze of structure, design of connections, and deflections.

Text book:

1. Plastic Design of Steel Frames, L.S.Beedle.

References:

1. Design of steel structure, S. Subramanyam.
2. Plastic Analysis, B.G.Neal.
3. Plastic Analysis, Horve.

L-T-P	MCI036A - Expansive and shrinkable soils	Credits: 4
4-0-0		

Objectives:

- To study the new construction materials, its properties, behaviours.
- To study the materials and its uses in construction.

Unit 1

Introduction, Historical back ground of Light weight aggregate concrete - Artificial aggregates, Physical properties of aggregates, Light weight aggregate concrete - Applications of light weight aggregate concrete.

Unit 2

Properties of green light weight aggregate concrete - Effect of size aggregate on the strength Recycled aggregate -High performance concrete –applications - Pre placed aggregate concrete - Fiber reinforced concrete.

Unit 3

Behaviour of steel fibers in concrete - Glass fiber reinforced concrete - Natural fiber reinforced concrete - High strength concrete - Self-Compacting Concrete, Concrete made with waste rubber.

Unit 4

Changes in concrete with respect to time - Corrosion in concrete and its protection, Corrosion of rebars in concrete - Influence of fly ash on the corrosion steel bar in concrete, Industrial waste materials in concrete.

Unit 5

Special Concretes, Sulfur Concrete, Ferro cement, Geo synthetics - Adhesives in construction industry, Acrylics - Bridge bearings - Rapid wall panels - Nano Concrete - Moisture Barriers.

Outcome

- At the end of this course, the students will be aware about new materials and they able to its utilization in constructions.

Text book:

1. Kumar Mehta. P and Paulo J M Monteiro, “Concrete Microstructure, Properties and Materials”, McGraw Hill, 2006.

References:

1. A.M. Neville, “Properties of Concrete”, 5th Edition, PHI, 2012.

L-T-P	MCI016A – Dissertation Part - I	Credits: 12
0-0-12		

Elective Subjects (one from each group)			
Elective I		**Elective II**	
MCI037A	Stability of Structures	MCI019A	Repair and Rehabilitation of Structures
MCI038A	Earthquake Resistant design	MCI020A	Advanced Foundation Design
MCI022A	Soil Structure Interaction	MCI021A	Design of Tall Buildings

Elective I

L-T-P	MCI037A – Stability of Structures	Credits: 4
4-0-0		

Objective:

- To study the stability of structure for different kind of loading
- To study for the different kind of buckling of structural element

Unit 1

Beam Columns: Differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load – application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

Unit 2

Elastic Buckling of bars and frames: Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns- Buckling of frames-large deflections of buckled bars-Energy methods- Buckling of bars on elastic foundations- Buckle line of bar with intermediate compressive forces - Buckling of bars with change in cross-section – Effect of shear force on critical load-built up columns.

Unit 3

In Elastic Buckling: Buckle line of straight bar- Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae for design – various end conditions

Unit 4

Torsion Buckling: Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section- Torsional buckling – Buckling by torsion and flexure.

Unit 5

Lateral buckling of simply supported Beams: Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

Outcome:

- Ability to analyze the structure for different kind of loading

TEXT BOOK

1. Theory of elastic Stability by Timshenko& Gere-Mc Graw Hill

REFERENCES

2. Stability of metallic structures by Blunch- Mc Graw Hill
3. Theory of Beam- Columns Vol I by Chem. &Atste Mc. Graw Hill

L-T-P	MCI038A – Earthquake Resistant Design	Credits: 4
4-0-0		

Objective:

- To deal with different aspect of earthquake forces
- Design of different type of member of building to resist the earthquake

Unit 1

Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India.

Unit 2

Conceptual design: Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations-basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method-dynamic analysis-response spectrum method-Time history method.

Unit 3

Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members- Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods- IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities- Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces-Equivalent lateral force procedure- Lateral distribution of base shear. Masonry Buildings: Introduction-Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls-Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses-Seismic design requirements- Lateral load analysis of masonry buildings.

Unit 4

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls- sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non structures-Effects of non-structural elements on structural system- Analysis of non-structural elements-Prevention of non-structural damage- Isolation of non-structures.

Unit 5

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile

detailing considerations as per IS 13920. Behaviour of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes. Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

Outcome

- Able to design different type of structural member to resist earthquake forces.

Text BOOKS:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press

REFERENCE BOOK and CODES:

1. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
2. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
3. Masory and Timber structures including earthquake Resistant Design –Anand S. Arya, Nemchand & Bros
4. IS: 1893 (Part-1) -2002. “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.
5. IS: 4326-1993, “Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.
6 IS: 13920-1993, “Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.

L-T-P	MCI022A - Soil Structure Interaction	Credits: 4
4-0-0		

Objectives:

- The ability to identify the situations where the topic is relevant
- Should be able to apply the effects of interaction between soil and foundation
- The ability to apply the concepts for solving multi task applications

Unit 1

Scope of soil-foundation interaction analysis, Critical study of conventional methods of foundation design.

Unit 2

Nature and complexities of soil-foundation interaction, Interface behaviour, soil response models, Winkler, Elastic continuum. Contact pressures and soil-structure interaction for shallow and deep foundations.

Unit 3

Concept of sub grade modulus, effects/parameters influencing sub-grade modulus, Analysis of foundations of finite rigidity, Beams on elastic foundation concept, Interaction problems based on the theory of sub-grade reaction.

Unit 4

Concept of analysis of piles and pile groups, axially, laterally loaded piles and pile group interaction analysis, Elastic continuum and elasto-plastic analysis of piles and pile groups.

Unit 5

Application of advanced techniques of analysis such as the finite element method, finite differences and interaction for the evaluation of soil-foundation interaction for different types of foundations under various conditions of loading and subsoil characteristics.

Outcomes:

- Understand various theories involved in soil structure interaction
- Understand capabilities of various models used to simulate the interaction
- Understand the features of methods of analysis and apply them in real life applications

Text Book

1. Bowels J.E. - Analytical and Computer Methods in Foundation, McGraw Hill.

References

2. Selvadurai, A. P. S. - Elastic Analysis of Soil-Foundation Interaction, Elsevier.

3. Poulos H. G., & Davis E. H. - Pile Foundation Analysis and Design, John Wiley,

4. Bowles J.E. - Foundation analysis and design, McGraw Hill.

Elective II

L-T-P	MCI039A – Repair and Rehabilitation of Structures	Credits: 4
4-0-0		

Objective:

- The course seeks to recognize the mechanisms of degradation of concrete structures, provide the students with the knowledge of available techniques and their application for strengthening or upgrading existing structural systems.

Unit 1

Introduction: Deterioration of structures with aging, Need for rehabilitation, Effects due to climate, temperature, chemicals, wear and erosion , design and construction errors , corrosion mechanism , Effects of cover thickness and cracking, Method of corrosion production., corrosion inhibitors , corrosion resistant steels, coatings, cathodic production.

Unit 2

Structural Health Monitoring: An overview of Structural Health Monitoring, Structural Health Monitoring and Smart Materials, Health Monitoring versus Non Destructive Testing, A broad overview of smart materials, Overview of Application potential of SHM.

Unit 3

Maintenance and Repair Strategies: Definitions: Maintenance, Repair, Rehabilitation, Facets of maintenance, Importance of maintenance, preventive measures on various aspects, assessment procedure for evaluating damaged structure, causes of deterioration – Testing techniques.

Unit 4

Materials and Methods of Repair: Special concrete and mortar, Concrete chemicals, special elements for accelerator, strength gain, expansive cement , polymer concrete , sulphur infiltrated concrete , ferro-cement, fiber reinforced concrete. Shortcreting, Grouting, Epoxy-cement mortar injection, Crack ceiling

Unit 5

Seismic Retrofitting of reinforced concrete buildings: Introduction: Considerations in retrofitting of structures, Source of weakness in RC frame building – Structural damage due to the discontinuous load path, Structural damage due to lack of deformation, Quality of workmanship and materials, Classification of retrofitting techniques, Retrofitting strategies for RC buildings – Structural level (global) retrofits methods, Member level (local) retrofit methods; Comparative analysis of methods of retrofitting

Outcome:

- Ability to understand field monitoring and non-destructive evaluation of concrete structures.

Text Books:

1. Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.
2. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006.

Reference Books:

1. Shetty, M.S. (2005), Concrete Technology Theory and Practice, S.Chand and company, New Delhi.

2. Santha Kumar, A.R., (1996), Concrete chemical Theory and Applications, Indian society for construction engineering and technology, madras.
3. Garas, F.K,.Clarke, J.L, Armer, GST (1997), Structural assessment, Butterworths, UK.
4. R.T. Allen and S.C.Edwards, (1998), Repair of Concrete Structures, Blakie and Sons, UK.

L-T-P	MCI040A – Advanced Foundation Design	Credits: 4
4-0-0		

Objectives:

- This subject is taught to impart the knowledge in the area of analysis and design of foundations and earth retaining structures.

Unit 1

Shallow Foundation: Terzaghi's bearing capacity equation, General bearing capacity equation , Balla's & Meyerhof's theory, Effect of water table, special footing problems, I.S. Code, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's & westergaard methods, Computation of settlements (Immediate & Consolidation) Permissible settlements, Proportioning of footing, Inclined & Eccentric loads.

Unit 2

Pile Foundation: Timber, concrete, Steel piles, estimating pile capacity by dynamic formula, By wave equation & By static methods, Point Bearing piles, Pile loads tests, Negative skin friction, Modulus of subgrade reaction for laterally loaded piles, Lateral resistance.

Unit 3

Single Pile v/s Pile Groups, Pile group consideration, Efficiency, Stresses on underlying strata, Settlement of pile group, Pile caps, Batter piles, Approximate and exact analysis of pile groups, I.S code.

Unit 4

Well foundation: Types (open end & closed or box, pneumetic, drilled) shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Design of well foundation construction, Tilts & shifts.

Unit 5

Machine Foundations: Types, Analysis and design by Barkens methods, Determination of coeff. of uniform elastic compression, Pauw's analogy and design of a Block type M/C foundation, I.S.I method of design, Co- vibrating soil mass.

Outcome

- Understand the concepts of shallow foundations.
- Design the retaining walls and sheet piles.
- Know the types well foundations.
- Design pile foundation.

Text book:

1. B. M Das, *Principles of Foundation Engineering*, Thomson Brooks/Cole
2. Gopal Ranjan and ASR Rao, (2002), Basic and applied Soil Mechanics, Wiley Eastern Ltd.

References:

3. N.P. Kurien, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992
4. H. F. Winterkorn and H Y Fang, Foundation Engineering Hand Book, GalgotiaBooksource

L-T-P	MCI041A – Design of Tall Buildings	Credits: 4
4-0-0		

Objectives:

- This course is intended to teach the concept of tall structures.
- Various methods to analyze the tall structure will be explained in the classes.

Unit 1

Introduction - Classification of buildings according to NBC – Types of loads – wind load– Seismic load – Quasi static approach.

Unit 2

Plane Frame System - Calculation of wind load – Approximate method – Portal -Cantilever and factor methods – Kani's method – Substitute frame method for dead load and live loads.

Unit 3

Shear Wall System - Rosman's analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method.

Unit 4

In-filled Frame Systems - Importance – Methods of analysis – Equivalent truss and frame method – Force-displacement method – Effect of perforation in the in-filled frame.

Unit 5

Three Dimensional Analysis - Basic principles – Centre of rotation of a rigid floor – Force displacement method.

Outcome

- Know the types of tall buildings.
- Analyze the plane frame systems by different methods.
- Design the shear wall system and in filled frame systems.
- Do the three dimensional analysis.

Text book:

1. Ramachandra (2005), Design of Steel Structures–Vol.II, Standard Book House, 1750-a,NaiSarak, Delhi-6.

References:

1 SarwarAlamRaz, (2001), Analytical methods in Structural Engineering, Wiley Eastern Private Limited, New Delhi.

2. Ghali.A.,Neville.A.M and Brown.T.G, (2003), Structural Analysis – A unified classical and Matrix Approach (Fifth Edition), Span press.

L-T-P	MCI023A – Dissertation Part - II	Credits: 28