**CE3501 DESIGN OF REINFORCED CONCRETE STRUCTURAL ELEMENTS L T P C**
**3 0 0 3**

**COURSE OBJECTIVE:**

- To introduce the different design philosophy for reinforced concrete and discuss the limit state method of design of RC rectangular beams and to learn the concept in the design of RC flanged beams and design for shear and torsion and design of RC slabs and staircase, short RC columns, RC footing for walls, pad, sloped and combined rectangular footings.

**UNIT I METHODS OF DESIGN OF CONCRETE STRUCTURES 9**

Concept of Elastic method, ultimate load method and limit state method – Working stress method as detailed in IS code - Design of Singly Reinforced beam by working stress method - Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly and doubly reinforced rectangular beams by limit State Method.

**UNIT II LIMIT STATE METHOD - FLANGED BEAM, SHEAR & TORSION 9**

Analysis and design of flanged beams – Use of design aids for Flexure - Behaviour of RC members in bond and Anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion - serviceability.

**UNIT III LIMIT STATE DESIGN OF SLABS AND STAIRCASE 9**

Analysis and design of cantilever, one way, two way and continuous slabs subjected to uniformly distributed load for various boundary conditions- Types of Staircases – Design of dog-legged Staircase –Introduction to Flat Slab.

**UNIT IV LIMIT STATE DESIGN OF COLUMNS 9**

Types of columns – Design of short Rectangular and circular columns for axial, uniaxial and biaxial bending.

**UNIT V LIMIT STATE DESIGN OF FOOTING 9**

Design of wall footing – Design of axially and eccentrically loaded rectangular pad and sloped footings – Design of combined rectangular footing for two columns only.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of the course the student will be able to

**CO1** Know the various design concepts and design RC rectangular beams by working stress and limit state methods

**CO2** Understand the design of flanged beams, design for shear and torsion, and anchorage and development length.

**CO3** Design a RC slabs and staircase and draw the reinforcement detailing.

**CO4** Design short columns for axial, uni-axial and bi-axial eccentric loadings

**CO5** Design wall footings, isolated footings and combined rectangular footing.

**TEXT BOOKS:**


1. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
2. Krishnaraju.N " Design of Reinforced Concrete Structurres ", CBS Publishers & Distributors Pvt. Ltd., New Delhi.


**REFERENCES:**


1. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017
2. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2021
3. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete",Laxmi Publication Pvt. Ltd., New Delhi, 2016
4. Shah V L Karve S R., "Limit State Theory and Design of Reinforced Concrete", Structures Publilcations, Pune, 2013

**COs- PO's & PSO's MAPPING**

| PO/PSO | | Course Outcome | | | | | Overall Correlation of CO s to POs |
|---|---|---|---|---|---|---|---|
| | | CO1 | CO2 | CO3 | CO4 | CO5 | |
| **PROGRAM OUTCOMES(PO)** | | | | | | | |
| PO1 | Knowledge of Engineering Sciences | 3 | 3 | 3 | 3 | 3 | 3 |
| PO2 | Problem analysis | 3 | 3 | 3 | 3 | 3 | 3 |
| PO3 | Design / development of solutions | 3 | 3 | 3 | 3 | 3 | 3 |
| PO4 | Investigation | 3 | 3 | 3 | 3 | 3 | 3 |
| PO5 | Modern Tool Usage | 1 | 1 | 1 | 1 | 1 | 1 |
| PO6 | Engineer and Society | 3 | 3 | 3 | 3 | 3 | 3 |
| PO7 | Environment and Sustainability | 1 | 1 | 1 | 1 | 1 | 1 |
| PO8 | Ethics | 1 | 1 | 1 | 1 | 1 | 1 |
| PO9 | Individual and Team work | 3 | 3 | 3 | 3 | 3 | 3 |
| PO10 | Communication | 2 | 2 | 2 | 2 | 2 | 2 |
| PO11 | Project Management and Finance | 1 | 1 | 1 | 1 | 1 | 1 |
| PO12 | Life Long Learning | 2 | 2 | 2 | 2 | 2 | 2 |
| **PROGRAM SPECIFIC OUTCOMES(PSO)** | | | | | | | |
| PSO1 | Knowledge of Civil Engineering discipline | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO2 | Critical analysis of Civil Engineering problems and innovation | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO3 | Conceptualization and evaluation of engineering solutions to Civil Engineering Issues | 3 | 3 | 3 | 3 | 3 | 3 |

**CE3502 STRUCTURAL ANALYSIS I L T P C**
**3 0 0 3**

**COURSE OBJECTIVE:**

- To introduce the students to the basic theory and concepts of classical methods of structural analysis

**UNIT I ANALYSIS OF TRUSSES 9**

Determinate and indeterminate trusses - analysis of determinate trusses - method of joints - method of sections - Deflections of pin-jointed plane frames - lack of fit - change in temperature method of tension coefficient - Application to space trusses.

**UNIT II SLOPE DEFLECTION METHOD 9**

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements - symmetric frames with symmetric and skew-symmetric loadings.

**UNIT III MOMENT DISTRIBUTION METHOD 9**

Stiffness - distribution and carry over factors –- Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew-symmetric loadings.

**UNIT IV FLEXIBLITY METHOD 9**

Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.

**UNIT V STIFFNESS METHOD 9**

Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

Students will be able to

**CO1** Analyze the pin-jointed plane and space frames.

**CO2** Analyse the continuous beams and rigid frames by slope defection method.

**CO3** Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway.

**CO4** Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method.

**CO5** Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames.

**TEXTBOOKS:**


1. Bhavikatti, S.S,Structural Analysis,Vol.1,& 2, Vikas Publishing House Pvt.Ltd.New Delhi-4, 2014.
2. Punmia.B.C, Ashok Kumar Jain & Arun Kumar Jain, Theory of structures, Laxmi Publications, New Delhi, 2004.


**REFERENCES:**


1. William Weaver, Jr and James M.Gere, Matrix analysis of framed structures, CBS Publishers & Distributors, Second Edition, Delhi, 2004
2. Reddy .C.S, "Basic Structural Analysis", Tata McGraw Hill Publishing Company, 2005.
3. Negi L.S. and Jangid R.S., Structural Analysis, Tata McGraw Hill Publishing. Co. Ltd. 2004
4. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing House Pvt.Ltd.,New Delhi-4, 2014.


**COs- PO's & PSO's MAPPING**

| PO/PSO | | Course Outcome | | | | | Overall Correlation of CO s to POs |
|---|---|---|---|---|---|---|---|
| | | CO1 | CO2 | CO3 | CO4 | CO5 | |
| **PROGRAM OUTCOMES(PO)** | | | | | | | |
| PO1 | Knowledge of Engineering Sciences | 3 | 3 | 3 | 3 | 3 | 3 |
| PO2 | Problem analysis | 3 | 3 | 3 | 3 | 3 | 3 |
| PO3 | Design / development of solutions | 3 | 3 | 3 | 3 | 3 | 3 |
| PO4 | Investigation | 3 | 3 | 3 | 3 | 3 | 3 |
| PO5 | Modern Tool Usage | 1 | 1 | 1 | 1 | 1 | 1 |
| PO6 | Engineer and Society | 3 | 3 | 3 | 3 | 3 | 3 |
| PO7 | Environment and Sustainability | 1 | 1 | 1 | 1 | 1 | 1 |
| PO8 | Ethics | 1 | 1 | 1 | 1 | 1 | 1 |
| PO9 | Individual and Team work | 3 | 3 | 3 | 3 | 3 | 3 |
| PO10 | Communication | 2 | 2 | 2 | 2 | 2 | 2 |
| PO11 | Project Management and Finance | 1 | 1 | 1 | 1 | 1 | 1 |
| PO12 | Life Long Learning | 2 | 1 | 1 | 1 | 1 | 1 |
| **PROGRAM SPECIFIC OUTCOMES(PSO)** | | | | | | | |
| PSO1 | Knowledge of Civil Engineering discipline | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO2 | Critical analysis of Civil Engineering problems and innovation | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO3 | Conceptualization and evaluation of engineering solutions to Civil Engineering Issues | 3 | 3 | 3 | 3 | 3 | 3 |

**CE3503 FOUNDATION ENGINEERING L T P C**
**3 0 0 3**

**COURSE OBJECTIVE:**

- To impart knowledge to plan and execute a detail site investigation programme, to select geotechnical design parameters and type of foundations. Also to familiarize the students for the geotechnical design of different type of foundations and retaining walls.

**UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9**

Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters and Evaluation of Liquefaction potential - Selection of foundation based on soil condition- Bore log report.

**UNIT II BEARING CAPACITY OF SHALLOW FOUNDATION 9**

Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.

**UNIT III FOOTINGS AND RAFTS 9**

Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum depth for rigid behaviour – Applications – Floating foundation – Special foundations – Seismic force consideration – Codal provision

**UNIT IV PILE FOUNDATION 9**

Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT, SCPT) – Negative skin friction – Uplift capacity- Group capacity by different methods (Field's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift – Codal provision.

**UNIT V RETAINING WALLS 9**

Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provision.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to be able to

**CO1** Graduate will demonstrate an ability to plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation

**CO2** Graduate will demonstrate an ability to design shallow foundations, its component or process as per the needs and specifications.

**CO3** Graduate will demonstrate an ability to design combined footings and raft foundations, its component or process as per the needs and specifications.

**CO4** Graduate will demonstrate an ability to design deep foundations, its component or process as per the needs and specifications.

**CO5** Graduate will demonstrate an ability to design retaining walls, its component or process as per the needs and specifications.

**TEXTBOOKS:**

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2015.
2. Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International (P) Ltd, New Delhi,2006.

**REFERENCES:**

1. Das, B.M. "Principles of Foundation Engineering" (Eigth edition), Thompson Asia Pvt. Ltd., Singapore, 2017.
2. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2017.
3. Varghese, P.C.,"Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2012.
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd., New Delhi, 2017.

**COs- PO's & PSO's MAPPING**

| PO/PSO | | Course Outcome | | | | | Overall Correlation of CO s to POs |
|---|---|---|---|---|---|---|---|
| | | CO1 | CO2 | CO3 | CO4 | CO5 | |
| **PROGRAM OUTCOMES(PO)** | | | | | | | |
| PO1 | Knowledge of Engineering Sciences | 2 | 2 | 2 | 3 | 3 | 2 |
| PO2 | Problem analysis | 3 | 3 | 3 | 3 | 3 | 3 |
| PO3 | Design / development of solutions | 3 | 3 | 3 | 3 | 3 | 3 |
| PO4 | Investigation | 3 | 3 | 3 | 3 | 3 | 3 |
| PO5 | Modern Tool Usage | 1 | 1 | 1 | 1 | 1 | 1 |
| PO6 | Engineer and Society | 2 | 2 | 2 | 1 | 2 | 2 |
| PO7 | Environment and Sustainability | 1 | 2 | 1 | 1 | 1 | 1 |
| PO8 | Ethics | 1 | 1 | 1 | 1 | 1 | 1 |
| PO9 | Individual and Team work | 1 | 1 | 1 | 1 | 1 | 1 |
| PO10 | Communication | 1 | 1 | 1 | 1 | 1 | 1 |
| PO11 | Project Management and Finance | 1 | 1 | 2 | 2 | 2 | 2 |
| PO12 | Life Long Learning | 3 | 3 | 3 | 3 | 3 | 3 |
| **PROGRAM SPECIFIC OUTCOMES(PSO)** | | | | | | | |
| PSO1 | Knowledge of Civil Engineering discipline | 3 | 2 | 2 | 2 | 2 | 2 |
| PSO2 | Critical analysis of Civil Engineering problems and innovation | 2 | 3 | 3 | 3 | 3 | 3 |
| PSO3 | Conceptualization and evaluation of Engineering solutions to Civil engineering issues | 3 | 2 | 2 | 3 | 3 | 3 |

**CE3511 HIGHWAY ENGINEERING LABORATORY L T P C**

**0 0 4 2**

**COURSE OBJECTIVE:**

- To learn the principles and procedures of testing of materials used in the construction of highways.

**EXCERCISES:**

**I TEST ON AGGREGATES**

1. Specific gravity determination of the coarse aggregate sample
2. Determination of abrasion value of the coarse aggregate sample.
3. Determination of water absorption capacity of the coarse aggregate sample.

**II TEST ON BITUMEN**

4. Specific gravity determination of the bitumen/asphalt sample.
5. Determination of consistency of the bituminous material.
6. Viscosity determination of bituminous binder.
7. Determination of softening point of the asphalt/bitumen sample
8. Determination of ductility value of the bitumen sample
9. Estimation of loss of bitumen on heating
10. Determination of optimum binder content by Marshall method

**III BITUMINOUS MIXES**

11. Determination of stripping value of the bituminous mix Demonstration
12. Determination of bitumen content in the bituminous mix by cold solvent extraction method

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES**

**CO1** Characterize Pavement Aggregate through relevant test.
**CO2** Ascertain the Quality of Bitumen.
**CO3** Determine the Optimum Binder Content Using Marshall Method.
**CO4** Evaluate the Consistency and Properties of Bitumen.
**CO5** Determine the Bitumen Content in the Bituminous Mixes

**REFERENCES**


1. Highway Materials and Pavement Testing, Nem Chandand Bros.,Roorkee, Revised Fifth Edition, 2009
2. N.L.Arora,A Textbook of Transportation Engineering, New India Publication,1997
3. http://vlabs.iitb.ac.in/vlabsdev/labs/nitk_labs/Transportation_Engineering_Lab/index.html
4. Laboratory Manual in Highway engineering published, Duggal,Ajay K 2017


**COs- PO's & PSO's MAPPING**

| PROGRAMOUTCOMES(PO)PO/PSO | | Course Outcome | | | | | Over all Correlation of COs to POs |
|---|---|---|---|---|---|---|---|
| | | CO1 | CO2 | CO3 | CO4 | CO5 | |
| **PROGRAM OUTCOMES(PO)** | | | | | | | |
| PO1 | Knowledge of Engineering Sciences | 3 | 3 | 3 | 3 | 3 | 3 |
| PO2 | Problem analysis | 1 | 1 | 1 | 1 | 1 | 1 |
| PO3 | Design / development of solutions | 3 | 3 | 3 | 3 | 3 | 3 |
| PO4 | Investigation | 2 | 2 | 2 | 2 | 2 | 2 |
| PO5 | Modern Tool Usage | 1 | 1 | 1 | 1 | 1 | 1 |
| PO6 | Engineer and Society | 1 | 1 | 1 | 1 | 1 | 1 |
| PO7 | Environment and sustainability | 1 | 1 | 1 | 1 | 1 | 1 |
| PO8 | Ethics | 1 | 1 | 1 | 1 | 1 | 1 |
| PO9 | Individual and Team work | 3 | 3 | 3 | 3 | 3 | 3 |
| PO10 | Communication | 3 | 3 | 3 | 3 | 3 | 3 |
| PO11 | Project Management and Finance | 1 | 1 | 1 | 1 | 1 | 1 |
| PO12 | Life Long Learning | 3 | 3 | 3 | 3 | 3 | 3 |
| **PROGRAM SPECIFIC OUTCOMES (PSO)** | | | | | | | |
| PSO1 | Knowledge of Civil Engineering discipline | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO2 | Critical analysis of Civil Engineering problems and innovation | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO3 | Conceptualization and evaluation of engineering solutions to Civil Engineering Issues | 2 | 2 | 2 | 2 | 2 | 2 |

**CE3512** **SURVEY CAMP (2 weeks)** **L T P C**
**0 0 0 1**

**COURSE OBJECTIVES:**

- The objective of the survey camp is to enable the students to get practical training in the field work. Groups of not more than six members in a group will carry out each exercise in survey camp. At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Traverse – using Theodolite / Total station
2. Contouring
   (i). Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line
   (ii). Block Level/ By squares of size at least 100 Meter x 100 Meter atleast 20 Meter interval
   (iii). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter atleast L.S at Every 30M and C.S at every 90 M
3. Offset of Buildings and Plotting the Location
4. Sun observation to determine azimuth (guidelines to be given to the students)
5. Use of GPS to determine latitude and longitude and locate the survey camp location
6. Traversing using GPS
7. Curve setting by deflection angle

Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.

**COURSE OUTCOMES**

- On completion of the course, the student is expected to be able to

**CO1** Handle the modern surveying instruments like Total station and GPS
**CO2** Apply modern surveying techniques in field to establish horizontal control.
**CO3** Understand the surveying techniques in field to establish vertical control
**CO4** Apply different survey adjustment techniques.
**CO5** Carry out different setting out works in the field

**COs- PO's & PSO's MAPPING**

| PO/PSO | | Course Outcome | | | | | Overall Correlation of CO s to POs |
|---|---|---|---|---|---|---|---|
| | | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** | |
| **PROGRAM OUTCOMES(PO)** | | | | | | | |
| PO1 | Knowledge of EngineeringSciences | 3 | 3 | 3 | 3 | 3 | 3 |
| PO2 | Problem analysis | 3 | 3 | 3 | 3 | 3 | 3 |
| PO3 | Design / development ofsolutions | | | 2 | 2 | 2 | 2 |
| PO4 | Investigation | 3 | 3 | 3 | | | 3 |
| PO5 | Modern Tool Usage | 3 | 3 | 3 | 3 | 3 | 3 |
| PO8 | Engineer and Society | 3 | 3 | 2 | 2 | 2 | 2 |
| PO10 | Environment and Sustainability | 2 | 2 | 2 | 2 | 2 | 2 |
| PO9 | Ethics | 2 | 2 | 2 | 2 | | 2 |
| PO6 | Individual and Team work | 2 | 2 | 3 | 2 | 2 | 2 |
| PO7 | Communication | 2 | 2 | 2 | 2 | 2 | 2 |
| PO11 | Project Management andFinance | 2 | 2 | 2 | 2 | 2 | 2 |
| PO12 | Life Long Learning | 3 | 3 | 3 | 3 | 3 | 3 |
| **PROGRAM SPECIFIC OUTCOMES(PSO)** | | | | | | | |
| PSO1 | Knowledge of Civil Engineering discipline | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO2 | Critical analysis of Civil Engineering problems andinnovation | 3 | 3 | 3 | 3 | 3 | 3 |
| PSO3 | Conceptualization and evaluation of engineering solutions to Civil Engineering Issues | 3 | 3 | 3 | 3 | 3 | 3 |