

**Unit-I**

**Chapter 1 : Design Philosophies and Analysis**  
1-1 to 1-50

**Syllabus :** Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes of failure, moment of resistance of singly and doubly reinforced rectangular section, singly reinforced flanged section.

1.1	Introduction.....	1-1
1.2	Structure .....	1-1
1.2.1	Design of Structures.....	1-1
1.3	Reinforced Concrete structures.....	1-1
1.4	History of Structural Design (Design Philosophies) .....	1-3
1.4.1	Working Stress Method .....	1-3
1.4.1.1	Principle of Design in WSM.....	1-3
1.4.1.2	Assumptions in W.S.M.....	1-6
1.4.1.3	Drawbacks of Working Stress Method .....	1-6
1.4.2	Ultimate Load Method.....	1-6
1.4.3	Limit State Method .....	1-7
1.5	Introduction to Limit State Method of Design.....	1-7
1.5.1	Limit State Method of Design.....	1-7
1.5.2	Partial Safety Factors.....	1-9
1.5.3	Assumptions of Limit State Method.....	1-13
1.6	Singly Reinforced Section L.S.M.....	1-13
1.7	Ultimate Moment of Resistance of Singly Reinforced Sections.....	1-14
1.8	Balanced Section.....	1-15
1.9	Under Reinforced and Over Reinforced Section.....	1-16

1.9.1	Comparison of Under Reinforced Section with Over Reinforced Section.....	1-17
1.10	Types 1 : Determination of Moment of Resistance of Section .....	1-17
1.11	Type 2 : Design Type Problems.....	1-21
1.12	Doubly Reinforced Section LSM.....	1-24
1.12.1	Examples on Doubly Reinforced sections .....	1-26
1.13	Design of Doubly Reinforced section Type Problems .....	1-30
1.14	Flanged Sections .....	1-33
1.15	Design of Flanged Section.....	1-43

**Unit-II**

**Chapter 2 : Design of Slab** 2-1 to 2-72

**Syllabus :** Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients, design of two way slab: simply supported, continuous and restrained.

2.1	Design of Slabs.....	2-1
2.2	Design of One-way Simply Supported Slab.....	2-2
2.3	Design of Cantilever Slab .....	2-15
2.4	Design of One Way Continuous Slab by IS Coefficient Method.....	2-29
2.5	Two Way Slabs .....	2-33
2.6	Restrained Two Way Slabs.....	2-41

**Unit-III**

**Chapter 3 : Design of Staircase and Beam** 3-1 to 3-78

**Syllabus :** Design of staircase: dog legged and open well, design of simply supported, cantilever beams for flexure (singly reinforced, doubly reinforced and flanged), shear, bond and torsion.

3.1	Introduction to Staircase .....	3-1
3.2	Design of Dog-legged Staircase .....	3-1
3.3	Design of Open Well Staircase .....	3-26

3.4	Introduction.....	3-31
3.4.1	Beams Parallel to Shorter Side of Slab ( $L_x$ ).....	3-31
3.4.2	Beams Parallel to Longer Side of Slab ( $L_y$ ).....	3-32
3.4.3	Cover for Beam Reinforcements.....	3-33
3.4.4	Minimum and Maximum Beam Reinforcements.....	3-33
3.4.5	Steps in Design of Beam.....	3-33
3.5	Shear.....	3-38
3.5.1	Relation Between Bending Stress and Shear Stress.....	3-38
3.6	Shear Resisting Capacity of Reinforced Concrete Section.....	3-39
3.6.1	Nominal Shear Stress.....	3-39
3.6.2	Maximum Shear Stress.....	3-40
3.6.3	Design Shear Strength of Concrete.....	3-40
3.6.4	Minimum Net Shear Stress.....	3-40
3.6.5	Reinforcements Used to Resist Shear.....	3-40
3.6.5.1	Stirrups.....	3-41
3.7	Bent-up Bars.....	3-41
3.7.1	Nominal Shear Reinforcement.....	3-41
3.7.2	Design Shear Reinforcement.....	3-41
3.7.3	Zoning of Shear Reinforcement.....	3-42
3.7.4	Spacing of Stirrups.....	3-42
3.7.5	Critical Section for Shear.....	3-42
3.8	Bond and Development Length.....	3-53
3.8.1	Concept of Bond.....	3-54
3.8.2	Flexural Bond and Anchorage Bond.....	3-54
3.8.3	Development Length ( $L_d$ ).....	3-54
3.8.4	Design Bond Stress.....	3-55
3.8.5	Effects on Bond Strength Due to Curtailment.....	3-55
3.8.6	Check for Development Length.....	3-56
3.9	Torsion in Beams.....	3-66

**Unit-IV**

**Chapter 4 : Design of Beams 4-1 to 4-52**

**Syllabus :** Design of rectangular and flanged cross section continuous beam by using IS code coefficients and moment redistribution method.

4.1	Continuous Beams.....	4-1
4.1.1	Design of Continuous RCC Beam.....	4-1
4.1.2	IS Coefficient Method of Design of Continuous Beams.....	4-1
4.1.3	Steps in Design of Continuous Beam by IS Code Method.....	4-2
4.2	Continuous Beams (Redistribution).....	4-22
4.2.1	Design of Continuous Beam by Redistribution Method.....	4-22
4.2.2	Method of Redistribution.....	4-22

**Unit-V**

**Chapter 5 : Design of Column 5-1 to 5-41**

**Syllabus :** Assumptions, minimum eccentricity, design of short column for axial load, design of short column subjected to combined axial load and uni-axial/biaxial bending using interaction curves.

5.1	Axially Loaded Short Columns.....	5-1
5.1.1	Important Things Regarding Column as Per IS 456.....	5-1
5.1.2	Unsupported Length and Effective Length of Column.....	5-2
5.1.3	Design of Axially Loaded Short Column.....	5-2
5.1.4	Minimum Eccentricity.....	5-2
5.1.5	Design Steps of Axially Loaded Short Columns.....	5-3
5.2	Columns Subjected to Uniaxial and Biaxial Bending.....	5-12
5.2.1	Design of Short Columns for Uniaxial and Biaxial Bending using Interaction Diagrams.....	5-12
5.2.1.1	Design Procedure for Uniaxial Bending.....	5-12
5.2.1.2	Column subjected to biaxial bending.....	5-23

**Unit-VI**

**Chapter 6 : Design of Footings 6-1 to 6-79**

**Syllabus :** Design of isolated column footing for axial load and uni-axial bending, design of combined footing for two columns: slab type/ slab and beam type rectangular.

6.1	Design of Isolated Footing.....	6-1
6.1.1	Steps in Design of Isolated Footing .....	6-1
6.2	Combined Footing.....	6-39

6.2.1	Introduction.....	6-39
6.2.2	Design of Rectangular Slab Type Footing.....	6-41
6.2.3	Solved Examples .....	6-43
6.2.4	Design of Trapezoidal Slab Footing.....	6-64
6.2.5	Design of Beam and Slab Footing.....	6-65
6.2.6	Solved Examples .....	6-66
6.2.7	Slab Beam Combined Footing.....	6-75

