GUJARAT TECHNOLOGICAL UNIVERSITY

Diploma in Transportation Engineering

SEMESTER: V

Subject Name: **Design of Concrete Structures**

Sr. No.	Course Content
1.	**Introduction to is – 456:2000** 1.1. Importance of use of steel as reinforcement 1.2. Limit state design method 1.3. Limit state of collapse and serviceability 1.4. Characteristic strength of concrete and grades of concrete 1.5. Characteristic strength of steel and grades of steel 1.6. Partial safety factors for material 1.7. Types of loads, load combinations and partial safety factors for loads 1.8. Limit state of collapse – FLEXURE and its assumptions 1.9. Limit state of collapse – SHEAR and its assumptions 1.10. Limit state of collapse – COMPRESSION and its assumptions 1.11. Limit state of serviceability – DEFLECTION 1.12. Limit state of serviceability – CRACKING
2.	**General is Requirements for Design According to is - 456:2000** 2.1 Exposure conditions and minimum cover to the reinforcement, spacing of bars in a layer and different layers 2.2 Define effective depth 2.3 Effective span for different support conditions 2.4 Basic factors for control of deflection and different modification factors 2.5 Requirements of minimum and maximum flexural reinforcement in beam 2.6 Requirement of minimum flexural reinforcement, maximum diameter and maximum spacing of reinforcement in slab 2.7 Requirements of minimum shear reinforcement in beam 2.8 Short column, minimum eccentricity and requirements of longitudinal and lateral reinforcement in column 2.9 Bond stress: τ_{bd} and development length of bar
3.	**Beam and Lintel:** 3.1 Classification of rectangular beam according to reinforcement: balanced section, under reinforced section, over reinforced section, singly reinforced section and doubly reinforced section 3.2 Singly reinforced rectangular beam: (Annexure-G, IS – 456:2000) 3.2.1. Depth of neutral axis: Xu_{max}, Xu 3.2.2. Limiting percentage of steel: pt_{lim} 3.2.3. Moment of resistance factor: Q 3.2.4. Use of SP-16 tables for $\frac{Xu_{max}}{d}$, pt_{lim} and Q 3.2.5. Limiting moment of resistance: Mu_{lim} 3.2.6. Moment of resistance: Mu

	3.2.7. Design of tension reinforcement: A_{ST} for given Mu, its check against requirement of reinforcement 3.2.8. Use of SP-16 tables for A_{ST} 3.3 Doubly reinforced rectangular beam: (Annexure-G, IS – 456:2000) 3.3.1. Need of doubly reinforced section 3.3.2. Moment of resistance: Mu 3.3.3. Design of tension reinforcement: A_{ST} and compression reinforcement: A_{SC} for given Mu, its check against requirement of reinforcement 3.3.4. Use of SP-16 tables for A_{ST} and A_{SC} 3.4 Singly reinforced flanged (TEE and ELL) beam: 3.4.1 IS criteria for effective width of flange: BF 3.4.2 Limiting moment of resistance: Mu_{lim} (Annexure-G, IS – 456:2000) 3.4.3 Moment of resistance: Mu 3.5 Shear reinforcement 3.5.1. Nominal shear stress: τ_V 3.5.2. Design shear strength of concrete without shear reinforcement: τ_C 3.5.3. Maximum shear strength of concrete shear reinforcement: τ_{Cmax} 3.5.4. Correction factor: k according to depth of concrete 3.5.5. Contribution of bent-up bars in shear 3.5.6. Design of shear reinforcement with and without bent-up bars 3.6 Development length of bar at support 3.7 Lintels: Load calculations according to height of masonry above lintel, design of flexural and shear reinforcement in lintel, check for reinforcement
4.	**Slab and Staircase:** 4.1 Classification of slab panel according to span ratio: One way slab and Two way slab 4.2 Live Load on slab according to IS – 875:1987 (Part-II) 4.3 Effective span for One way simply supported slab 4.4 Design of One way simply supported slab with checks for flexure, shear, bond, deflection and cracking 4.5 Shear force and bending moment coefficient for One way continuous slab 4.6 Effective span for One way continuous slab 4.7 Design of One way continuous slab with checks for flexure, shear, bond, deflection and cracking 4.8 Provisions for Two way slab (Annexure-D, IS – 456:2000) 4.9 Design of Two way simply supported slab with torsion reinforcement with checks for flexure, shear, bond, deflection and cracking 4.10 Design of Two way simply supported slab without torsion reinforcement with checks for flexure, shear, bond, deflection and cracking 4.11 Design of waist slab for stair without stringer beam with checks for flexure, shear, bond, deflection and cracking
5.	**Axially Loaded Short Column:** 5.1 Effective length of column 5.2 Check for eccentricity 5.3 Factored/Design load capacity: Pu for different types of cross-section for given percentage of A_{SC} 5.4 Increase in factored load capacity for helically reinforced circular column 5.5 Design of longitudinal and lateral reinforcement for axially loaded short column

6.	**Isolated Column Footing:** 6.1 Bearing capacity of soil 6.2 Types of footing 6.3 Critical sections for flexure and shear 6.4 Bearing stress at junction of column and footing, provision of dowel bars 6.5 Design of rectangular pad footing with checks for flexure, One way and Two way shear, bearing, bond and cracking 6.6 Design of rectangular slopped footing with checks for flexure, One way and Two way shear, bearing, bond and cracking
7.	**Ductile Detailing of Structures Subjected to Seismic Forces in Accordance With is – 13920:** 7.1 Definition: ductility, space frame, moment resisting frame, shear wall, soft storey and weak storey, space frame 7.2 Terminology: cross tie and hoop its IS requirement 7.3 Necessity of ductility in structure 7.4 Scope of ductile detailing 7.5 Methods of improving ductility of structure 7.6 Force-displacement response of ductile and brittle materials 7.7 Ductility requirements for beam section and steel provision 7.8 Ductility requirements for column section and steel provision 7.9 Requirements for special confining reinforcement

Laboratory Experiences:

1. IS – 456:2000, IS – 875:1987, IS – 13920-1993
2. SP-16: Design Aids to IS – 456
3. SP-34: Reinforcement detailing
4. Limit state design of RC structures (Vol.-I) by H J Shah
5. Limit state design of RC structures by A K Jain
6. Limit state design of RC structures by B C Punmia
7. Limit state design of RC structures by P C Verghese
8. Limit state design of RC structures by P Dayaratnam