21051 STRUCTURAL ENGINEERING

DETAILED SYLLABUS

Unit I REINFORCED CEMENT CONCRETE STRUCTURES

1.1 INTRODUCTION TO WORKING STRESS AND LIMIT STATE METHOD

Reinforced Cement Concrete- Materials used in R.C.C and their basic requirements – Purpose of providing reinforcement – Different types and grades of cement and steel – Characteristic strength and grades of concrete – Behaviour of R.C members in bending-Modular ratio and Equivalent area of R.C.Sections – Different types of loads on structures as per IS: 875-1987 - Different methods of design. Working Stress Method-Assumptions made in the W.S.M- Singly reinforced rectangular sections – Strain and stress distribution due to bending – Actual and Critical neutral axes – Under / over reinforced sections- Balanced sections – Lever arm – Moment of resistance of singly reinforced rectangular sections (No problems). Limit State Method - Concept –Advantages- Different limit states- Characteristic strength and design strength of materials – Characteristic loads and design loads - Partial safety factors for loads and material strength - Limit state of collapse in flexure – Assumptions – Stress Strain curves for concrete and steel – Stress block – Maximum strain in concrete – Limiting values of neutral axis of singly reinforced section for different grades of steel -Design stress in tension and compression steel– Moment of resistance of singly and doubly reinforced rectangular sections – Problems.

1.2 DESIGN OF RECTANGULAR BEAMS FOR FLEXURE BY L.S.M

Design requirements-Effective spans of cantilever and simply supported beams – Breadth and depth requirements of beams – Control of deflection – Minimum depth requirement for stiffness – Minimum concrete cover to reinforcement steel for durability and fire resistance – Minimum and maximum areas/ spacing for main reinforcement and side face reinforcement as per IS 456 -2000 - Development Length-Anchorage values of bends and hooks - Curtailment of reinforcements- Design bending moments –

Unit II

2.1 DESIGN OF T-BEAMS AND LINTELS FOR FLEXURE BY L.S.M Cross sections of Tee and L-beams- Effective width of flange Neutral Axis and M.R of Singly Reinforced T-Sections- Design of singly reinforced T-beams/L-beams for flexure–Problems on Cantilevers (Inverted-T) and Simply supported T- beams – Loads on Isolated Lintels over openings of masonry walls - Design B.M for isolated lintels carrying rectangular/triangular loads- Design of Lintel- Simple problems

2.2 DESIGN OF CONTINUOUS BEAMS FOR FLEXURE AND SHEAR BY L.S.M Methods of analysis of continuous beams- Effective Span- Arrangement of Loading for Critical Bending Moments- B.M coefficients specified by IS:456-200-Design of rectangular continuous beams (Singly and Doubly Reinforced) using B.M. coefficients (equal spans & u.d.l only) for sagging and hogging moments. Limit state of collapse in shear – Design shear strength of concrete – Design shear strengths of vertical / inclined stirrups and bent up bars –Principle of shear design – Critical sections for shear- S.F Coefficients specified by IS:456- 2000– Nominal shear stress –Minimum shear reinforcement- Design of vertical stirrups, inclined stirrups and bent up bars for rectangular beams using limit state method –Simple problems- Practice on use of Design Aids (not for examination).

Unit III

3.1 DESIGN OF ONE WAY SLABS AND STAIRCASES BY L.S.M Classification of Slabs – Effective spans – Loads (DL and IL) on floor/roof slabs and stairs (IS: 875-1987) – Strength and Stiffness requirements –Minimum and maximum permitted size, spacing and area of main and secondary reinforcements as per IS 456 2000-Cover requirement to reinforcements in slabs- Design of cantilever/simply supported one way slabs and sunshades by limit state method – Design of continuous slabs using B.M coefficients- Check for shear and stiffness – Curtailment of tension reinforcement –Anchoring of reinforcement– Practice in designing slabs using design aids (not for examination).

3.2 DESIGN OF TWO WAY SLABS BY L.S.M Introduction –Effective spans – Thickness of slab for strength and stiffness requirements - Middle and Edge strips – B.M coefficients as per IS:456 – Design B.Ms for Simply supported, Restrained and Continuous slabs – Tension and Torsion reinforcement requirement– Design of two way slabs using B.M. coefficients – Curtailment of reinforcement – Check for stiffness only.

Unit IV

4.1 DESIGN OF COLUMNS BYL.S.M Limit state of collapse in compression – Assumptions - Limiting strength of short axially loaded compression members - Effective length of compression members – Slenderness limits for columns – Classification of columns -Minimum eccentricity for column loads – Longitudinal and Transverse reinforcement requirements as per I S 456-2000 – Cover requirement - Design of axially loaded short columns with lateral ties / helical reinforcement – Practice on use of Design Aids (not for examination).

4.2 DESIGN OF COLUMN FOOTINGS Basic requirements of Footings-Types of R.C footings –Minimum depth below GL- Footings with uniform thickness and varying thickness (sloped footing) – Critical sections for BM, Transverse/Punching Shears – Minimum reinforcement, Distribution of reinforcement, Development length,

Anchorage, Cover, Minimum edge thickness requirements as per IS 456-2000 – Design of Isolated footing (square and rectangular) with uniform/ varying thickness by limit state method- For Examination : Problem either on (i) Designing Size of Footing and Area of tension steel for flexure only for the given Column load and SBC of soil, or on (ii) Checking the footing for Punching shear and Transverse shear only, for the given sizes and other required details of the footing.

Unit V

5.1 DESIGN OF TENSION AND COMPRESSION MEMBERS BY L.S.M General- Characteristic Actions, Partial Safety Factors for Loads, Design Actions- Ultimate Strength, Partial Safety Factors for Materials, Design Strengths of Materials - Rolled Steel Sections - Different forms of Tension members – Gross area, Net area and Net Effective sectional area of Tension members– Maximum permitted values of Effective Slenderness Ratio –Design Strength of Tension members against Yielding of Gross section, Rupture of Critical section and Block Shear- Design Strength of given Plates/ Angles connected to gussets by bolts/welds- Design of ties using single/ double angles, T-sections and channels. Different forms of Compression members- Classification of Cross sections- Limiting Width to Thickness Ratio- Effective sectional area- End Conditions and Effective length of Compression members – Maximum permitted values of Slenderness ratio – Imperfection factor and Stress reduction factor– Design Strength of Compression members- Problems – – Design of single angle and double angle Struts – Design of steel columns using rolled steel sections (Symmetrical sections only) with or without cover plates. (Lacing and battens not included).

5.2 DESIGN OF SIMPLE BEAMS AND WELDED CONNECTIONS BY L.S.M Classification of Steel beams –Effective span- Design principles- Minimum thickness of Web-Design Strength in Bending/ Shear- Limiting deflection of beams - Lateral buckling of beams – Maximum permitted Slenderness Ratio- Plastic Moment of Resistance and Plastic Section Modulus of Sections- Shape Factor —- Design of laterally supported Simple beams using single / double rolled steel sections (symmetrical cross sections only) (Built-up beams not included). Types of welds – Size, Effective area and Effective length of Fillet welds – Requirements of welds- Stresses in Welds –Design strength of fillet/ butt welds – Lap and butt joints for plates and angles – Problems on design of welded connections for Plates and Angles (Moment resistant connections not included). REVISION AND TEST

Reference Book:1. S.R.Karve and V.L.Shah," Limit state Theory and Design of Reinforced Concrete",Pune Vidya Griha Prakashan. 2. P C Varghese," Limit state Design of Reinforced Concrete",PHI Learning Pvt. Ltd",2011. 3. Dr.S.Ramachandra,Limit State Design of Concrete Structures",Scientific publishers, 2004. 4. Mallick and Rangasamy,"Reinforced Cement Concrete" Oxford-IBH.