COURSE TITLE   : STRUCTURAL DESIGN
COURSE CODE   : 4005
COURSE CATEGORY   : A
PERIODS/WEEK   : 6
PERIODS/SEMESTER   : 96
CREDITS   : 5

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Introduction to materials, Concept of RC Design, Design of Singly Reinforced beams, Concept of Limit State Design, Flexural Design of Singly Reinforced beams & Lintels, Doubly Reinforced beams & Flanged Beams. Stiffness, Shear, Torsion and bond	27
II	One-way slab & Two way slabs & Stair case , Column and Column Footing	27
III	Introduction to steel structures, Connections- Bolted and welded, Design of tension members and compression members	27
IV	Design of beams, Design of Truss	27
	TOTAL	**108**

Rationale:

Different Civil Engineering structures made of reinforced concrete & Steel are to be supervised by Civil Engineering technicians. For effective supervision & site control he must be able to draw read & interpret the R C C & Steel drawing and design details. To inculcate these abilities he must have gone through design strategies also.

Design of a structure is the subject placed at technology level. This subject requires prerequisite knowledge, skill and competences acquired from the subject concrete technology and theory of structure. Limit state method is based on statistical probability approach, which provides rational solution to the design problem. L.S.M. philosophy uses multiple safety factors format which attempts to provide adequate safety at ultimate load as well as adequate serviceability at service load by considering all possible limit states

Steel is extensively used as construction materials in the construction of Civil Engineering work such as high rise buildings, industrial buildings, transmission towers, railway bridges, overhead tank, chimney, bunkers, silos etc.

The design of steel structure involve the planning of structure for specific purpose, proportioning and selection members to carry loads in most economic manner and erection of structure at site. This can be achieved by proper functional planning and providing adequate strength to withstand direct and induced forces which may acts on the structure during its life time. The knowledge of material properties and behaviors of structural member, methods of structural analysis, determining design loads and method of design by using latest IS codes, hand books and design aids

<center>**OBJECTIVES**</center>

Upon completion of course the student should be able to:

MODULE I
I. 1.0 Understand the properties of materials of RCC as per the latest IS codes
1.1.1 Know the Grades of concrete and their strength.
1.1.2 Know the types of steel used in RCC
1.1.3 Know the Permissible stresses in concrete and steel.
1.1.4 Understand the concept of RCC design.
1.1.7 Know materials for concrete-Grading of aggregate, proportioning and mixing of concrete, bulking of sand, water cement ratio and placing and Compaction of concrete and removal of forms.
I.2.0 Understand the concept of Limit State Design
1.2.1 Define Partial Safety factors in Limit State method of Design.
1.2.2 Understand the values of Partial safety factors with reference to latest I S Codes.
1.2.3 Understand Principles of Limit State Design
1.2.4 Define characteristic load & characteristic strength.
1.2.5 Draw the stress-strain curve of Concrete and steel.
1.2.6 State the assumptions made in the Limit State method of Design
1.2.7 Analyses the Neutral Axis Depth, Limiting value of NA.
1.2.8 Design a simply supported beam and Cantilever beams for different loading
     Conditions for flexure.
1.2.9 Study and Use of SP 16
1.2.10 Design doubly Reinforced Rectangular beams under different loading conditions.
1.2.11 Design of flanged beams under different loading conditions
1.2.12 Design of lintels under different loading conditions
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1.3.0 Understand the check for stiffness as per IS code
1.3.1 Basic l/d ratio, Modification factor for Tension and compression, Deduction factor
     For flanged beams.
1.3.2 Check the deflection of singly reinforced, doubly reinforced and flanged beams.
1.3.3 Understand the shear and torsional behavior in RCC members.
1.3.4 Design of beams under different loading conditions for shear
1.3.5 Understand bond and anchorage
1.3.6 Study the calculation of development length
1.3.7 Check for curtailment of bars in beams
1.3.8 Code provisions for lap length

MODULE II
2.1.0 Study the behavior of slabs
2.1.1 Design of one way slabs simply supported, Continuous, cantilever and sunshade
2.1.2 Design of Two way slab, simply supported
2.1.3 Design of two-way slabs, restrained and different end condition
2.1.4 Design of staircases under different loading and end conditions.
2.2.0 Study the design of columns
2.2.1 Study the behavior of short and long columns
2.2.2 Slenderness limit for columns as per IS code
2.2.3 Design the short column for direct load
2.2.4 Design the column for uniaxial bending using SP16
2.2.5 Study of slender column
2.2.6 Study of Column footing
2.2.7 Design of isolated column footing
2.2.8 Introduction on combined footing

MODULE III
3.1.0 Understand Steel structures.
3.1.1 Know advantages and disadvantages of steel structures over RCC structures.
3.1.2 Know properties of structural steel.
3.1.3 Know method of analysis & design philosophy.
3.1.5 Explain method of connections of steel members.
3.1.6 Check strength of members using Bolted and welded connection.
3.2.7 Know the design of tension members using IS Code and steel table
3.2.8 Know the design of compression members in steel structures using IS Code and steel table

MODULE IV
4.1.0 Know the design steel beams using IS Code and steel tables
4.1.1 Design of simply supported – laterally supported beams
4.2.1 Know the different types & component of the truss.
4.2.2 Know the design of truss members
4.2.3 List the loads acting on a truss.
4.2.4. Know the design of angle purlin.
4.2.5 List the different parts of a plate girder and know the function of each part..

COURSE CONTENTS

The subject of RCC and steel are to be taught in SI Units and according to the latest IS Codes (eg: IS 456-2000, and SP 16 , IS 800-2007, , IS 875, IS 801- 1975 and Steel Tables)- permitted inside Examination Hall.

MODULE –I
Properties of materials of RCC as per the latest IS codes- materials for concrete-Grading of aggregate, proportioning and mixing of concrete, bulking of sand, water cement ratio and placing and Compaction of concrete and removal of forms-Grades of concrete and their strength- types of steel used in RCC- the Permissible stresses in concrete and steel.- The concept of Limit State Design, Partial Safety factors in Limit State method of Design, values of Partial safety factors with reference to latest I S Codes, Principles of Limit State Design, Characteristic load & characteristic strength, stress-strain curve of Concrete and steel, assumptions made in the Limit State method of Design, Neutral Axis Depth, Limiting value of NA, Design a simply supported beam and Cantilever beams for different loading conditions for flexure, Design doubly Reinforced Rectangular beams under different loading conditions. Design of lintels under different loading conditions. Design of flanged beams under different loading conditions (Use S P16).

Check for stiffness as per IS code, Basic l/d ratio, Modification factor, reduction factor for flanged beams, Check the deflection of singly reinforced, doubly reinforced and flanged beams, the shear and torsional behavior in RCC members, Nominal shear stress, maximum shear stress in concrete, permissible shear stress in concrete, Design beams under different loading
Conditions for shear, bond and anchorage, calculation of development length, Check for curtailment of bars in beams, Code provisions for lap length

MODULE -II
Study the behavior of slabs, Design of one way slabs simply supported, Continuous, cantilever and sunshade, Design of Two way slab, simply supported, restrained and different end condition (Design of two way slab by using S P 16 only), Design of staircases under different loading and end conditions.
Theory on design of columns, behavior of short and long columns, Slenderness limit for columns as per IS code, Design the short column for direct load,. Design the column for uniaxial bending

using SP16, Study of slender columns, Theory of Column footing, Design of isolated column footing (SP 16).Introduction on combined footing.

MODULE – III
Design of Steel Structures-Introduction to steel Design- Use of IS: 800, steel tables –Strength of bolted and Welded connections-Design of members using bolted and welded connection.
Design of Tension members-General- Net sectional Area of Tension
members- Effective sectional area of angles / T-sections connected by one leg / flange (welded Connections only)-   Design of ties using Single/Double angles, T-Sections and channels
Design of Compression members-General-effective length – slenderness ratio reference to IS Code – Design compressive stress and strength – Discontinuous single/double angle struts – continuous angle struts Design of columns using rolled steel sections with/without cover plates – Lacing and battens – requirements – Description only – (Design of Lacing or battens not necessary)

MODULE –IV
Design of Steel beams- Plastic moment carrying capacity of section –Classification of cross- section Bending strength, Shearing strength and deflection limit of laterally supported beam. (Symmetrical Cross sections only)
Fundamentals of Plate Girder- parts and function
Design of Roof truss-Elements of roof truss-Loads acting with reference to IS Code-Design of elements of Roof truss. Design of angle purlins-.

REFERENCES:
1. Design of Steel Structures – S S Bhavikatti – I K International Publishers.
2. Design of RCC Structures Vol-I and II by H J Sha- Charotar Publishers and distributors
3. Limit State Design of Reinforced Concrete - P C Varghese - Prentice Hall of India Ltd.
4. Design of RCC Structures - Ramamrutham- Dhanpat Rai & Sons
5. Design of RCC Structures - B Standard Publishers C Punmia -
6. Design of RCC structures – A.K.Goel & IC Syal – S.Chand & Co.
7. Steel structures - N Subramanian – Oxford Press
8. Limit State Design of RC structures, S Unnikrishna pillai and Devadas menon –Tata Mc Graw Hill