31081 STEEL STRUCTURES (ELECTIVE THEORY II)

DETAILED SYLLABUS

Unit I INTRODUCTION TO PLASTIC ANALYSIS AND LIMIT STATE DESIG

Plastic Analysis: Analysis of Steel Structures– Methods– Elastic, Plastic and Dynamic Analysis and Advanced method of analysis based on IS:800-2007– Idealized Stress vs Strain curve for Structural Steel– Requirements and Assumptions of Plastic method of analysis– Formation of Plastic hinges in Flexural members– Plastic Moment of Resistance and Plastic Modulus of Sections– Shape Factors of rectangular / circular/ I / T-Sections– Collapse load– Determination of Collapse loads for Cantilever, Simply supported and Fixed beams by any (Statical or Kinematical method– Problems.

Limit State Design: Advantages of Limit State Design of Steel structures– Basis for design– Classification of Limit States– Characteristic and Design Actions– Ultimate and Design Strengths- Partial Safety Factors for Loads and Materials– Design requirements– Strength requirements: Stability, Fatigue and Plastic collapse– Serviceability requirements: Deflection limits, Vibration, Durability and Fire resistance –Geometrical properties of gross and effective cross sections– Classification of Cross Sections as per IS:800-2007– Internal, external(outstands) and tapered elements of sections– Maximum Effective Slenderness Ratio of members – Necessity of Bracings and Expansion joints in Steel Structures

Unit II DESIGN OF TENSION AND COMPRESSION MEMBERS BY L.S.M

Tension Members- Design Strength of Tension members against yielding of gross section, against rupture of critical section and due to block shear– Design requirements–Problems on determination of design strength of given members and designing tension members using rolled steel sections for given loads– Design of bolted and welded connections for tension members –Problems.

Compression Members- Effective Length and Effective Sectional Area of Compression members – Design Stress and design strength– Buckling Class of cross sections– Imperfection factor Stress reduction factor– Thickness of elements– Eccentricity of loads on columns– Single angle and double angle struts–Bolted and welded connections for struts– Design of Built up Columns– Connecting the components of built up columns by tacking bolts/ welds– Requirements of connections– Laced Columns– Single and Double laced systems– Requirements of lacing bars- Design of Lacings– Battened Columns– Requirements of battens– Design of battens– Problems

Column Bases- Slab base and Gusseted base – Code Provisions (IS:800-2007) – Minimum thickness and Effective Area of Base plate– Design of Slab base and Gusseted base for Axially loaded columns using bolts / welds.

Unit III DESIGN OF FLEXURAL MEMBERS FOR BM AND SF BY L.S.M

Laterally Supported Beams– Classification of Steel beams – Effective span– Design principles- Web Buckling and Web Crippling– Minimum thickness of Web – Sections with webs susceptible /not susceptible to buckling under shear before yielding– Design Bending Strength of sections with Low shear – Effect of holes in Tension zone– Nominal shear strength and Design shear strength of sections– Limiting deflection of beams – Design of laterally supported Simple beams for Bending moment and Shear force using single / double rolled steel sections (symmetrical cross sections only) – Problems – Un symmetrical (Bi-Axial) bending – Design of laterally supported Purlins for sloped roof trusses (for given vertical UDL with BM coefficient 0.085) – Simple problems.

Laterally Un-Supported Beams- Lateral Torsional Buckling of compression flange – Maximum permitted Slenderness Ratio of Compression flange – Design Bending Strength of laterally un supported beams – Bending stress reduction factor– Imperfection parameter–Elastic lateral buckling moment of doubly symmetric sections– End Torsional Restraints and Intermittent Bracing of Compression flange– Requirements, Types and their Effects– Design of laterally un supported beams for bending and shear using symmetrical rolled steel sections– Problems.

Unit IV DESIGN OF SECTIONS FOR COMBINED ACTIONS

Sections subjected to Bending moment and High Shear force-– Effect of high shear on flexural capacity of sections– Limiting value of shear force for full moment capacity of sections– Reduced design strength of Plastic/Compact/Semi Compact sections subjected to high shear– Design of support sections of cantilevers and continuous beams– Problems

Sections subjected to Bending moment and Axial Compression (Beam-Column)- Columns carrying eccentric loads, Columns subjected to vertical and horizontal loads (wind loads), Columns of frames, Principal rafters with purlins at non nodal points – Material failure and Buckling failure– Interaction equations – Overall buckling– Design problems(with axial compression and uni-axial BM only).

Unit IV Sections subjected to Bending moment and Axial Tension– Bottom chord members of Bridge girders–Tie members of trusses with hanging loads– Reduced effective moment– Interaction equations– Design Problems

Unit V DESIGN OF CONNECTIONS AND DETAILING

General- Types of connections– Bolted, Riveted and Welded connections– Rigid and Flexible connections– Components of connections– Basic requirements of connections- Clearance for holes– Minimum and Maximum spacing of fasteners– Minimum edge/ end distances– Requirements of Tacking fasteners.

Bolted Connection– Types of bolts– Bearing type Bolts– Nominal and Design shear strengths of bolts– Reduction factors for Long joints, Large grip lengths, Thick packing plates– Nominal and Design bearing strengths of bolts– Reduction factors for oversized and slotted holes– Nominal and Design tensile strengths (tension capacity) of bolts – Friction grip type Bolts– Advantages– Requirements as per IS 3757– Nominal and Design Slip resistance of bolts in shear– Slip factors– Nominal and Design tensile strengths of friction bolts– Simple design

Welded Connection- Types of welds– Fillet welds– Minimum and maximum sizes– Effective length of weld- Fillet welds on inclined faces–- Design strengths of shop/site welds– Butt welds– Effective throat thickness and effective length of butt weld– Strength of butt weld- Intermittent welds–-Slot or plug welds– Reduction factor for long joints– Stress in the weld due to individual forces– Design requirements of connections– Simple Design problems (Combined actions not included).

Detailing- Beam to Beam and Beam to Column connections – Seat angle and Web angle connections– Designing and detailing of simple connections for vertical forces (Moment resisting connections are not included) – Simple problems –Connection details of Truss members at Joints(neat sketches).

Reference Book:

1. M.R.Shiyekar “Limit State Design in Structural Steel”, PHI Learning Pvt Ltd, 2011 2. K.S.Sai Ram “Design of Steel Structures” Pearson-Porling Kindersley Pvt Ltd 3. Dr.Subramaniam “Steel Structures”