## 31041 THEORY OF STRUCTURES

## DETAILED SYLLABUS

**Unit: I**

1.1 SLOPE AND DEFLECTION OF BEAMS Deflected shapes / Elastic curves of beams with different support conditions –Definition of Slope and Deflection- Flexural rigidity and Stiffness of beams- Mohr's Theorems – Area Moment method for slope maximum deflection of standard cases by area moment method for cantilever and simply supported beams subjected to symmetrical UDL & point loads – Numerical problems on determination of slopes and deflections at salient points of Cantilevers and Simply supported beams from first principles and by using formulae

1.2 PROPPED CANTILEVERS Statically determinate and indeterminate Structures- Stable and Unstable Structures- Examples- Degree of Indeterminacy Concept of Analysis of Indeterminate beams - Definition of Prop –Types of Props- Prop reaction from deflection consideration – Drawing SF and BM diagrams by area moment method for UDL throughout the span, central and non-central concentrated loads – Propped cantilever with overhang – Point of Contra flexure.

**Unit II**

2.1 FIXED BEAMS – AREA MOMENT METHOD Introduction to fixed beam - Advantages –Degree of indeterminacy of fixed beam- Sagging and Hogging bending moments – Determination of fixing end(support) moments(FEM) by Area Moment method – Derivation of Expressions for Standard cases – Fixed beams subjected to symmetrical and unsymmetrical concentrated loads and UDL – Drawing SF and BM diagrams for Fixed beams with supports at the same level (sinking of supports or supports at different levels are not included) – Points of Contra flexure –Problems- Determination of Slope and Deflection of fixed beams subjected to only symmetrical loads by area moment method – Problems.

2.2 CONTINUOUS BEAMS – THEOREM OF THREE MOMENTS METHOD Introduction to continuous beams – Degree of indeterminacy of continuous beams with respect to number of spans and types of supports –Simple/Partially fixed / Fixed supports of beams- General methods of analysis of Indeterminate structures – Clapeyron's theorem of three moments – Application of Clapeyron's theorem of three moments for the following cases – Two span beams with both ends simply supported or fixed – Two span beams with one end fixed and the other end simply supported – Two span beams with one end simply supported or fixed and other end overhanging –Determination of Reactions at Supports- Application of Three moment equations to Three span Continuous Beams and Propped cantilevers –Problems- Sketching of SFD and BMD for all the above cases.

**Unit III**

3.1 CONTINUOUS BEAMS – MOMENT DISTRIBUTION METHOD Introduction to Carry over factor, Stiffness factor and Distribution factor –Stiffness Ratio or Relative Stiffness- Concept of distribution of un balanced moments at joints - Sign conventions – Application of M-D method to Continuous beams of two / three spans and to Propped cantilever (Maximum of three cycles of distribution

sufficient) –Finding Support Reactions- Problems - Sketching SFD and BMD for two / three span beams.

3.2 PORTAL FRAMES – MOMENT DISTRIBUTION METHOD Definition of Frames – Types – Bays and Storey - Sketches of Single/Multi Storey Frames, Single/Multi Bay Frames- Portal Frame – Sway and Non- sway Frames- Analysis of Non sway (Symmetrical) Portal Frames for Joint moments by Moment Distribution Method and drawing BMD only– Deflected shapes of Portal frames under different loading / support conditions.

**Unit IV**

4.1 COLUMNS AND STRUTS Columns and Struts – Definition – Short and Long columns – End conditions – Equivalent length / Effective length– Slenderness ratio – Axially loaded short column - Axially loaded long column – Euler's theory of long columns – Derivation of expression for Critical load of Columns with hinged ends – Expressions for other standard cases of end conditions (separate derivations not required) – Problems – Derivation of Rankine's formula for Crippling load of Columns– Factor of Safety- Safe load on Columns- Simple problems.

4.2 COMBINED BENDING AND DIRECT STRESSES Direct and Indirect stresses – Combination of stresses – Eccentric loads on Columns – Effects of Eccentric loads / Moments on Short columns – Combined direct and bending stresses – Maximum and Minimum stresses in Sections– Problems – Conditions for no tension – Limit of eccentricity – Middle third rule – Core or Kern for square, rectangular and circular sections – Chimneys subjected to uniform wind pressure –Combined stresses in Chimneys due to Self weight and Wind load- Chimneys of Hollow square and Hollow circular cross sections only – Problem

**Unit V**

5.1 MASONRY DAMS Gravity Dams – Derivation of Expression for maximum and minimum stresses at Base – Stress distribution diagrams – Problems – Factors affecting Stability of masonry dams – Factor of safety- Problems on Stability of Dams– Minimum base width and maximum height of dam for no tension at base – Elementary profile of a dam – Minimum base width of elementary profile for no tension.

5.2 EARTH PRESSURE AND RETAINING WALLS Definition – Angle of repose /Angle of Internal friction of soil– State of equilibrium of soil – Active and Passive earth pressures – Rankine's theory of earth pressure – Assumptions – Lateral earth pressure with level back fill / level surcharge (Angular Surcharge not required)– Earth pressure due to Submerged soils – (Soil retained on vertical back of wall only) – Maximum and minimum stresses at base of Trapezoidal Gravity walls – Stress distribution diagrams – Problems – Stability of earth retaining walls – Problems to check the stability of walls- Minimum base width for no tension. REVISION & TEST

REFERENCE: 1. S. Ramamrutham, "Theory of structures" 2. B.C. Punmia, Ashok Jain & Arun Jain," Theory of structures ",Laxmi Publications, 9th Edition, April1992. 3. S.B. Junnarkar, Mechanics of structures (Vol.II) Charator Publiching,22nd Edition,1997