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# P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)
Second Semester, M. Tech - Civil Engineering (MCAD)

Semester End Examination; June - 2017 Advanced Design of Steel Structures

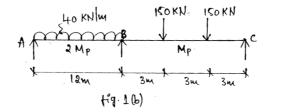
Time: 3 hrs Max. Marks: 100

Note: i) Answer FIVE full questions, selecting ONE full question from each unit.

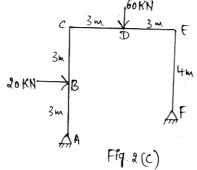
- ii) Use of IS 800, IS 801, IS 811 and steel table are permitted.
- iii) Missing data may be assumed suitably.

## UNIT - I

- 1 a. State and explain the theorems in plastic analysis. Also explain how plastic analysis is carried out by static and Kinematic methods.
  - b. Analyze the continuous beam shown in Fig. 1(b) by plastic analysis.



- 2 a. Explain the effect of axial force on the plastic moment capacity of a beam.
  - b. Explain the various mechanisms involved in the analysis of a portal frame.
  - c. Find the collapse load for the frame of uniform cross section shown Fig. 2(c) under the applied factored loads.



**UNIT-II** 

- 3 a. Explain the phenomenon of lateral torsional buckling. List the factors affecting the lateral stability of beams and explain the influence of type of cross section on the lateral stability of beam.
  - b. A simply supported beam of effective length 6 m is subjected to a bending moment of 60 kN/m (clockwise) and 40 kN/m (anticlockwise) at the two ends. The beam is made up of ISMB 450 and is laterally unsupported. Find the critical moment (M<sub>cr</sub>) for lateral torsional buckling considering the effect of moment gradient. Assume both ends to be unrestrained for torsion and warping.
- 4 a. Write a brief note on lateral torsional buckling of non-uniform beam and its design consideration.
  - b. A simply supported beam of effective span 6 m is loaded in such a way that the design bending moment and shear force are 80 kNm and 50 kN respectively. The beam is laterally unsupported with a bearing at support of 200 mm. Design the beam and apply necessary checks.

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### **UNIT - III**

5 a. Explain the influence of axial force and slenderness ratio on the failure modes of a beam –column.

b. An ISHB at 51 kg/m section has been used as column in a non-sway building frame. The column is subjected to factored moments of 27 kNm at its top and 45 kNm at its bottom about the major axis. In addition to that, a factored axial load of 500 kN is acting at its center. Check the adequacy of the section taking  $f_y = 250$  MPa. Span of the member is 4 m about both axis. Consider effective length factor K = 0.8.

6. Design a beam-column for the following data:

Effective length = 4 m

Design axial force = 2500 kN

Major axis factored bending moment =  $M_z = -350$  kNm at base

+350 kNm at top

Minor axis factored bending moment =  $M_y = 0$  at base

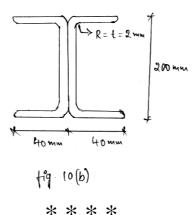
100 kNm at the top of column

### **UNIT-IV**

- 7 a. Explain the effect of web openings in a beam. Also describe the general guidelines to be followed while placing a web opening in order to minimize its adverse effects.
  - b. Explain the bending stress and shear stress calculation in a castellated beam.
- 8. An ISMB 600 beam is to be used as a castellated beam for a span of 18, subjected to a design load of 20 kN/m. The expansion ratio of 1.5 is to be used. Design the Castellated beam by determining the size and spacings of the castellations. The beam shall be checked for bending, shear and deflection.

#### **UNIT - V**

- 9 a. A column of effective length 2.3 m is to be made of light gauge steel sections. Design the column using a lipped channel section. Take  $E=205\ kN/mm^2$ ,  $f_y=240\ MPa$ .
  - b. Explain the methods of manufacturing of light gauge steel structures.
- 10 a. Write a note on the connections in tabular structures.
  - b. A cold formed section shown below in Fig. 10(b) to be used for a beam of 4 m span carrying a UDL of 25 kN/m. Check the adequacy of the section.



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