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Code No. : 16145 N/O

**VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD**

Accredited by NAAC with A++ Grade

**B.E. (Civil Engg.) VI-Semester Main & Backlog Examinations, May/June-2023**

**Design of Steel Structures**

Time: 3 hours

Max. Marks: 60

Note: 1) Answer all questions from Part-A and any FIVE from Part-B

2) Use of IS:800-2007 and steel tables is permitted

3) Assume any missing data suitably

**Part-A (10 × 2 = 20 Marks)**

| Q. No.                           | Stem of the question   | M | L | CO | PO |
|----------------------------------|--|---|---|----|----|
| 1.                               | What is the criteria for evaluating the design strength of a butt weld using shop welding?   | 2 | 1 | 1  | 1  |
| 2.                               | Determine the design shear strength of a M20 bolt of grade 4.6 to be provided in lap joint. Assume shear plane passing through the threaded portion of the bolts.  | 2 | 2 | 1  | 2  |
| 3.                               | Write down modes of failure of a tension member.   | 2 | 1 | 2  | 2  |
| 4.                               | A tension member consists of single angle ISA 125 X 75 X 10 mm connected to 12mm gusset plate with bolted connection. Calculate design strength for yielding of gross cross section. Take $f_u$ of member = 410MPa and $f_y = 250$ MPa.  | 2 | 2 | 2  | 3  |
| 5.                               | Briefly describe how the distance between the two channel sections placed back to back is found in a compression member design.  | 2 | 2 | 3  | 3  |
| 6.                               | Determine the value of effective slenderness ratio of a compression member column of length 5m and pinned at both the ends. The value of least radius of gyration of the section is 44.2mm.  | 2 | 1 | 3  | 3  |
| 7.                               | Define the plastic moment of resistance of a beam section.   | 2 | 1 | 4  | 3  |
| 8.                               | Determine the plastic section modulus of a circular section of beam of radius R.   | 2 | 2 | 4  | 3  |
| 9.                               | Define the pitch of a truss.   | 2 | 1 | 5  | 2  |
| 10.                              | Determine the approximate self weight of a roof truss of span 15m.   | 2 | 1 | 5  | 2  |
| <b>Part-B (5 × 8 = 40 Marks)</b> |  |   |   |    |    |
| 11. a)                           | Explain the concept of limit state design philosophy applicable to steel design as per IS:800-2007.  | 4 | 1 | 1  | 1  |
| b)                               | Design a double cover butt joint to connect two plates of 6mm thick with bolts of 20mm diameter of grade 4.6 for carrying a factored load of 180 KN. Provide suitable thickness to cover plate. Take $f_u$ of plate = 410Mpa and $f_y = 250$ MPa. Use IS:800-2007.   | 4 | 2 | 1  | 2  |
| 12. a)                           | Describe block shear failure in tension member design with relevant formulas as per codal provisions.  | 4 | 3 | 2  | 3  |
| b)                               | Determine the tensile strength governed by net section rupture for a single unequal angle 100 X 75 X 6 mm connected to a 10mm thick gusset plate at the ends with six 16mm diameter bolts in a line along the load applied. The gusset is connected to the 100mm leg of the angle. Take pitch = 40 mm and gauge = 60 mm. Adopt $f_y = 250$ MPa and $f_u$ of plate = 410MPa. Draw one neat sketch. Use IS:800-2007. | 4 | 3 | 2  | 3  |

|        |   |   |   |   |   |
|--------|---|---|---|---|---|
| 13. a) | Explain the effect of slenderness ratio value on the design compressive strength of a column.   | 4 | 2 | 3 | 3 |
| b)     | Determine the design compressive strength about both axes of a column section made of ISHB200@392.4N/m and length 6m long. Use grade of steel Fe410 and $f_y=250\text{MPa}$ . The column is fixed at both ends. Use IS:800-2007   | 4 | 3 | 3 | 3 |
| 14. a) | Draw a moment-rotation graph for a ductile section of beam and explain the properties of different cross section classification as per IS:800-2007.   | 4 | 3 | 4 | 3 |
| b)     | A rectangular steel section of width $b$ and depth $h$ has been stressed up to yield point $f_y$ up to a depth of $h/4$ from both the top and bottom face of the beam. Determine the value of the moment acting on the section.   | 4 | 3 | 4 | 3 |
| 15. a) | Explain the different types of loading conditions adopted in the design of a roof truss.  | 4 | 2 | 5 | 1 |
| b)     | The slope of a roof truss is $30^\circ$ (access is not provided except maintenance). Determine the amount of imposed or live load to be taken on the roof truss in $\text{N/m}^2$ .   | 4 | 2 | 5 | 2 |
| 16. a) | A 200mm wide plate is to be jointed to another 300mm wide plate section with both longitudinal and end fillet welds. The plates are 8mm thick and connected with minimum size of weld as per IS specification. Grade of steel adopted is Fe410, $f_y=250\text{Mpa}$ and shop welding is used. Determine the design strength of the joint if the overlap of the plates is 150mm. Draw a neat sketch. Use IS:800-2007                 | 4 | 3 | 1 | 2 |
| b)     | Determine the block shear strength of the tension member ISA 80 X 50 X 8mm connected to a gusset plate with two numbers of 16mm diameter bolts of grade 4.6. The 80mm side of the angle is connected to the gusset plate. Also take guage distance=45mm, end distance along the line of action=50mm. Adopt steel of grade Fe410 and $f_y = 250\text{MPa}$ . Use IS:800-2007   | 4 | 4 | 2 | 3 |
| 17.    | Answer any <i>two</i> of the following:   |   |   |   |   |
| a)     | Determine the spacing between two channel sections placed back to back by selecting a suitable channel section for a built up column 9m long to carry a factored axial compressive load of 1100 KN. The column is restrained in position but not in direction at both the ends. Assume the column is battened. Use steel of grade Fe410 and $f_y=250\text{MPa}$ . Use IS:800-2007   | 4 | 3 | 3 | 3 |
| b)     | An ISMB beam section with thickness of web equal to 7.5mm and depth equal to 400mm is laterally restrained and subjected to transverse loading. The web is free from buckling. Determine the design shear capacity of the beam. Adopt $f_y = 250\text{MPa}$ and $f_u=410\text{MPa}$ . If the factored shear force acting on the section is 200 KN then determine whether it is a low shear case or high shear case. Use IS:800-2007 | 4 | 4 | 4 | 3 |
| c)     | Develop the criteria for economizing spacing of roof trusses.   | 4 | 2 | 5 | 1 |

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

|      |                               |       |
|------|-------------------------------|-------|
| i)   | Blooms Taxonomy Level - 1     | 20%   |
| ii)  | Blooms Taxonomy Level - 2     | 32.5% |
| iii) | Blooms Taxonomy Level - 3 & 4 | 47.5% |

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