Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov/Dec– 2017**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **Code :** | **14CE2002** | **Duration :** | **3hrs** |
| **Sub. Name :** | **MECHANICS OF SOLIDS** | **Max. marks :** | **100** |

(Mech & Aero only)

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. |  | A bar LMNP fixed at L and P is subjected to axial forces as shown in figure. Determine the forces in each portion of the bar and displacement of points M and N. Take E=200 GN/m2. | CO1 | 20 |
| **(OR)** | | | | |
| 2. |  | A steel rod of 10mm diameter passes centrally though a copper tube of external diameter 40 mm and internal diameter of 30 mm and length 2m. The tube is closed at the ends by 20 mm thick steel plates. The plates and the tube are held tightly by tightening of nuts from the ends of the steel rod and length of the tube is reduced by 0.0004m. If the assembly is heated uniformly to a temperature of 600C, find the stresses in the steel rod and copper tube.  Take young’s modulus for steel and copper are 210 GPa and 100 GPa respectively. Coefficient of expansion of steel and copper are 12 x 10-6 /0C, 17.5 x 10-6 /0C. | CO1 | 20 |
| 3. |  | Draw the shear force and bending moment diagrams for the beam shown in fig. Also determine the maximum bending moment  F  E  A  B  D  C  1 m  2 m  2 kN/m  1 m  1 m  1 m  1 kN  4 kN | CO2 | 20 |
| **(OR)** | | | | |
| 4. |  | For the beam shown in fig. calculate the value of U.D.L. *w* so that ending moment at C is 50 kNm. Draw the S.F and B.M diagrams for this beam and locate the point of contraflexure.  B  D  A  C  2 m  4 m  4 m  *w* kN/m  20 kN | CO2 | 20 |
| 5. |  | A simply supported beam at ends having cross-section as I-section has a top flange of 100 mm x 30 mm, web of 30 mm x 120 mm and bottom flange of 120 mm x 50 mm is loaded with a U.D.L over its entire 8 m span. Determine the U.D.L if maximum permissible bending stress in tension is limited to 30 MN/m2 and in compression to 45 MN/m2. What are the actual maximum bending stresses setup in the section? | CO2 | 20 |
| **(OR)** | | | | |
| 6. | a. | A hollow shaft is 1 m long and has external diameter of 50 mm. it has 20 mm internal diameter for a part of length and 30 mm internal diameter for the rest of the length. If the maximum shear stress is not to exceed 80 MN/m2, determine the maximum power transmitted by it at a speed of 300 r.p.m. if the twists produced in the two internal diameter portions of the shaft are equal, find the lengths of the two internal diameter portions. | CO2 | 15 |
|  | b. | Explain the following terms  i. Solid length ii. Free length iii. Spring index | CO2 | 5 |
| 7. |  | The principle stresses at a point in a body are 100 MN/m2 (tensile) and 60 MN/m2 (compressive). Determine the normal stress and the shear stress on a plane inclined at 50˚ to the axis of the major principal stress. Also determine the maximum intensity of shear stress in the material at that point. | CO3 | 20 |
| **(OR)** | | | | |
| 8. |  | The bolt is under an axial thrust of 9.6 kN together with a transverse force of 4.8 kN. Determine the diameter according to Maximum principal stress theory, maximum shear stress theory, maximum strain theory and maximum strain energy theory. Take Factor of safety = 3, yield strength for the material of the bolt = 270 N/mm2, and Poisson’s ratio = 0.3. | CO3 | 20 |
|  | | **Compulsory** |  |  |
| 9. | a. | A 1.5 m long CI column has a circular cross-section of 50 mm diameter. One end of the column is fixed and the other end is free. Taking factor of safety as 3, calculate the safe load, using   1. Rankine – Gordon formula 2. Euler’s formula   Take Rankine Constant, a = 1/1600, Young’s modulus = 120 GN/m2 and yield stress =560 MN/m2 | CO3 | 5 |
|  | b. | A hollow cylindrical CI column is 4 m long with both ends fixed. Determine the minimum diameter of the column, if it has to carry a safe load of 250 kN with a factor of safety of 5. The internal diameter is 0.8 times the external diameter.  Take Rankine Constant, a = 1/1600 and yield stress =550 N/mm2 | CO3 | 15 |

ALL THE BEST