**Printed pages: 02** **Sub Code: EME302**

**Paper Id:** | 4 | 0 | 2 | 7 | **Roll No.** | | | | | | | | | | |

**B.Tech.**
**(SEM III) THEORY EXAMINATION 2017-18**
**STRENGTH OF MATERIALS**

***Time: 3 Hours*** ***Total Marks: 100***

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

**1. Attempt *all* questions in brief.** **2 x10 = 20**

**a** State and explain rectangular section middle third rule for column.

**b** State and explain the Castiglione's theorem.

**c** Derive the expression for extension in the vertically suspended bar due to self weight.

**d** Under what condition unsymmetrical bending occurs in a beam. Also state the position of neutral axis.

**e** Derive the expression of the value of constant ($h^2$) in curved beam for rectangular cross section area beam.

**f** Write a short note on compound thick cylinder?

**g**Derive the equation of equilibrium in z-direction by considering the equilibrium of an infinitesimal rectangular element of size dx dy dz in the Cartesian co-ordinate system.

**h** Find the free end deflection in cantilever beam with uniformly distributed load with Macaulay's method

**i** What are the stresses induced in thick and thin cylinder filled with fluids under pressure.

**j** State and explain any two theories of failure



**SECTION B**

**2. Attempt any *three* of the following:** **10 x 3 = 30**

**a** .A crane hook having trapezoidal horizontal cross-section is 50mm wide inside and 30mm outside. The crane hook carries a vertical load of 20 KN whose line of action is 50 mm from the inside edge of the section. The centre of curvature is 60mm from the inside edge. Determine bending stress of tensile nature.

**b.** An open coiled helical spring made out of 20mm, diameter steel rod has 10 complete turn at a mean diameter of 150mm, the angle of helix being 15˚.an axial load of 400N is applied. Compute (i) maximum intensities of direct stress and shear stress induced in the section of wire and (ii) deflection under load. Take $G=0.84x10^5$ N/mm$^2$ and $E=2x10^5$ N/mm$^2$.

**c.** In a cylindrical shell of 0.6m diameter and 0.9m long is subjected to an internal pressure 1.2 N/mm$^2$.Thickness of the cylinder wall is 15 mm. Determine longitudinal stresses, circumferential stress and maximum shear stresses induced and change in diameter, length and volume. Take E=200 GPa and $\mu$=0.3.

**d.** A hollow CI column whose outside diameter is 200mm has a thickness of 20mm .it is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine Gordon formula using

factor of safety of 4.Calculate the slenderness ratio of Euler's and Rankine's critical load. Take $\sigma_c$=550 N/mm$^2$ a=1/1600 in Rankine's formula and E=9.4x10$^4$ N/mm$^2$.

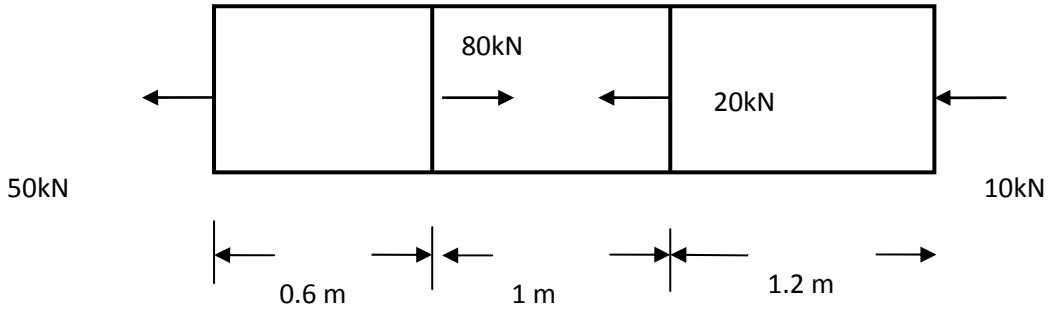
**e.** If the principal moment of inertia of section is $I_{uu}$ and $I_{vv}$ and X and Y are inclined to an angle Θ to U-V axis, and then prove that

$$I_{xx}+I_{yy}=I_{uu}+I_{vv}$$

## SECTION C

### 3. Attempt any *one/two* part of the following:10 x 1

**a.** A brass bar having a cross sectional area of 1000 mm$^2$ is subjected to axial forces as shown in fig. Find the total change in length of the bar. Take Es=105GN/m$^2$.




**b.** At a point in an elastic material under strain, there are normal stresses of 50N/mm$^2$(tensile)and 30N/mm$^2$ (tensile) respectively at right angle to each other with a shearing stress of 25N /mm$^2$.Find the principal stress and maximum shear stress using Mohr's circle diagram.



### 4. Attempt any *one/two* part of the following: 10 x 1

**a.** Draw the Mohr's stress circle for direct stressof 65 MN/mm$^2$(tensile and 35MN/mm$^2$(compressive) and estimate the magnitude of normal stress tangential stress and resultant stress on plane making an angle of 20˚ with the plane of major stress.

**b.** A thick cylinder of 160mm internal diameter 240 mm external diameter is subjected to an external pressure 12MPa.Determine the maximum internal pressure that can be applied if the maximum allowable normal stress is 36MPa.Plot the variation of radial stress and hoop stress.

### 5. Attempt any *one/two* part of the following: 10 x 1

**a.** A piece of steel plate is subjected to perpendicular stresses of 50N/mm$^2$ and 30N/mm$^2$,both tensile .Calculate the normal tangential stresses and the magnitude and the direction of the resultant stress on the interface whose normal makes an angle of 30˚ with the axis of the second stress.

**b.** A rigid bar is supported by three rods in the same vertical plane and equidistant. The outer rods are of brass and of the length 600mm and diameter 30mm. The central rod is of steel of 900mm length and of 37.5mm diameter. Calculate the force in the bar due to an applied force 100kN, Take $E_s=2E_b$

### 6. Attempt any *one/two* part of the following: 10 x 1

**a.** prove that maximum normal stress in a steel plate subjected to normal stress of $\sigma_x$ and$\sigma_y$ on its two sides together with a tangential stress $\tau_{xy}$ is $\sigma_{max} = \frac{\sigma_x+\sigma_y}{2} + \sqrt{\left(\frac{\sigma_x+\sigma_y}{2}\right)^2 + \tau^2{}_{xy}}$

**b.** A simply supported beam of span 1.5m carries a concentrated load of 8kN at an angle of 20˚ from vertical as shown in figure. Load passes through the centroid of the section. Determine the maximum bending stress in the beam.

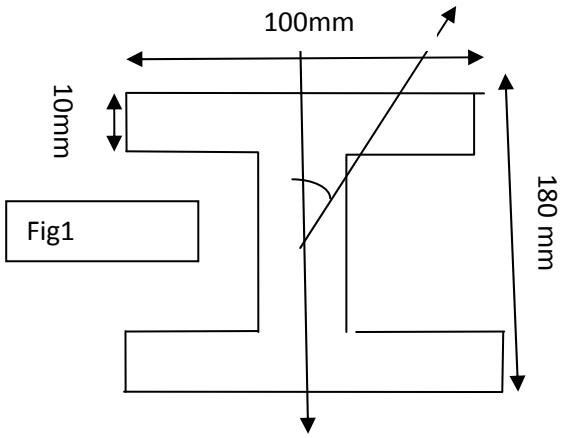



Fig1

**7. Attempt any *one* part of the following: 10 x 1**

**a.** Derive the expression for maximum stress axial deflection axial rotation and the strain energy stored in any one of spring.

**b.** An element of material in plane strain undergoes the following strains:

$\varepsilon_x=340x10^{-6}, \varepsilon_y=110x10^{-6}, \gamma_{xy}=180x10^{-6}$

Determine (i) strain of a line inclined at an angle of 30˚ from X-axis (ii) principal strains ans (iii) Maximum shear strain.