K. N. I. T., SULTANPUR

(Paper code and roll No. to be filled in your answer book)

Paper code: [redacted] Roll No. | | | | | | | | | | |

B. Tech.
Third Semester Examination, 2014-15
Strength of Material

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

Note: Attempt all questions. Assume missing data, if required.

1. Attempt any four parts of the following: (5x4=20)

(a) A short metallic column of 500 mm^2 cross-sectional area carries an axial compressive load of 100 kN. For a plane inclined at 60^0 with the direction of load, calculate:
(i) Normal Stress (ii) Tangential stress (iii) Resultant Stress.

(b) The stresses on two mutually perpendicular planes are 400 MN/m^2 tensile and 300 MN/m^2 tensile at a point in a bracket. The shear stress across these planes is 200 MN/m^2. Determine the magnitude and directions of principal stresses and maximum shear stress.

(c) What is 'Maximum principle stress theory' Discuss its significance and limitations.

(d) State and explain Distortion energy theory.

(e) What is generalized Hook's law? Explain its usefulness and importance.

(f) Describe briefly Octahedral stress theory.

2. Attempt any two of the following questions: [10x2=20]

(a) Two beams have the same length, the same allowable stress and the same bending moment. The cross-sections of the beams are a square and a circle. Determine the ratio of weights of the circular and section beams.

(b) A fixed beam of 6 m span is loaded of 150 kN at a distance of 2 m from each support. Draw the bending moment and shear force diagrams. Find also the maximum deflection. Take E = $2x10^4$ kN/m^2 and I=$8x10^4$ mm^2.

(c) A solid shaft of 250 mm diameter has same cross-sectional are as hollow shaft of same material with inside diameter of 200 mm.

Find the ratio of power transmitted by the two shafts for the same angular velocity.

3. **Attempt any two parts of the following:** **(10x2=20)**

(a) Derive expressions for deflection in closed coiled helical springs with circular and square cross sections under axial load.

(b) A laminated steel spring 1 m long is to support central load of 5.8 kN. If the maximum deflection of spring is not to exceed 45 mm and maximum stress should not exceed 300 MN/m^2, calculate the thickness of leaves and their number if each plate is to be 80 mm wide. Take $E = 200\ GN/m^2$.

(c) What do mean by 'columns' and 'struts'? Discuss Euler's theory regarding columns.

4. **Attempt any two parts of the following:** **(10x2=20)**

(a) Derive expressions for circumferential stress, longitudinal stress, and longitudinal stress in thin cylinder shell subjected to internal pressure. Find out also the expressions for maximum shear stress and volumetric strain.

(b) State Lame' theory regarding the variations in the radial and circumferential stresses across the thickness of thick cylinder. Derive also the expressions, giving assumptions taken.

(c) A compound cylinder, formed by shrinking one tube to another is subjected to an internal pressure of 90 MN/m^2. Before the fluid is admitted, the internal and external diameters of the compound cylinder are 180 mm and 300 mm respectively and diameter at the junction is 240 mm. If after shrinking on, the radial pressure at the common surface is 12 MN/m^2, determine the final stresses developed in compound cylinder.

5. **Attempt any two parts of the following:** **(10x2=20)**

(a) A steel ring has a rectangular cross section 75 mm in the radial direction and 45 mm perpendicular to radial direction. If the mean radius of the ring is 150 mm and maximum tensile stress is limited to 180 MN/m^2, evaluate the tensile load the ring can carry.

(b) Derive an expression to determine the distance of neutral axis from centroid for curved bar of square section.

(c) Find the maximum bending stress in the beam shown in Fig. 1.

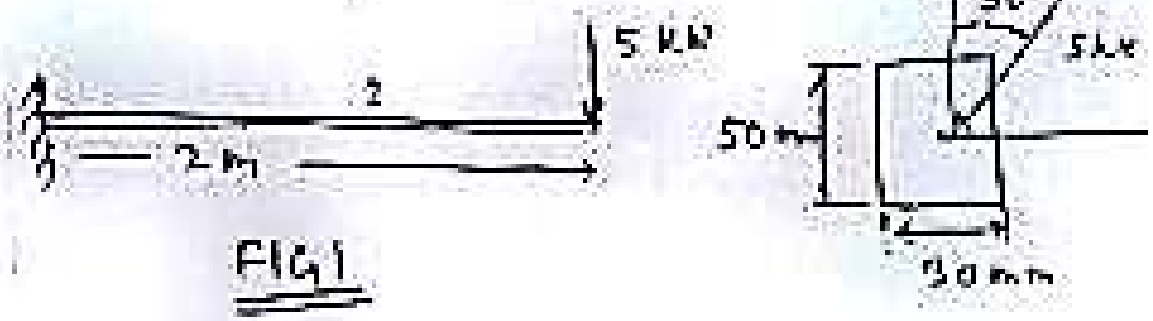

FIG 1