

**Government College of Engineering, Aurangabad**

(An Autonomous Institute of Government of Maharashtra)

**M.E. (Mech. Design) Examination**

End Semester Examination Nov. 2016

**ME 501: Machine Stress Analysis**

**28 NOV 2016**

Time: Three Hours

Max. Marks: 60

*"Verify the course code and check whether you have got the correct question paper"*

**Instructions:**

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Assume suitable data if necessary.
4. Use of non-programmable calculator is allowed.

**Q.1: Attempt any two.**

**(16)**

- (i) Derive the differential equations of equilibrium in polar coordinates. Consider only a two dimensional case. Find the compatibility equations in the form of stresses.
- (ii) Explain how Boussinesq function is useful in solving wedge problem.
- (iii) What are the stresses given by the stress function:

$$\phi = (qr^2 / 2\pi) (\sin 2\theta/2 - \theta)$$

Interpret the loading described by these stresses on the semi-infinite plate from  $\theta = 0$  to  $\theta = \pi$ .

**Q.2: Attempt any two.**

**(16)**

- (i) A cantilever beam is struck at its tip by a body of weight  $W$  falling freely through a height  $h$  above the beam. Neglecting the weight of the beam, determine the total deflection at the tip.
- (ii) A thin ring is subjected to diametrically opposite loads  $P$  in its own plane. Find the increase and decrease in the diameter of the ring stating the section where it occurs.
- (iii) Derive by using Prandtl's membrane analogy the relationship between torque, angle of twist and shear stress in case of a narrow rectangular strip.

**Q.3: Attempt any two.**

**(16)**

- (i) Derive the equations for maximum shearing stress and angle of twist for an elliptical cross section torsion member.
- (ii) A steel railway car wheel may be considered to be approximately a cylinder with a radius of 440 mm. The wheel rolls on a steel rail top surface which may be considered to be approximately another cylinder with radius of 330 mm. For the steel wheel and the steel rail:  
 $E = 200 \text{ GPa}$ ,  $\mu = 0.29$ ,  $S_y = 800 \text{ MPa}$ . If the wheel load is 110 kN, determine  $\sigma_{\max}$ ,  $\sigma_{\min}$ ,  $\lambda_{(\text{oct})\max}$  and the factor of safety by maximum shear stress theory.
- (iii) Explain the assumptions on which solution for contact stresses is based.

**(P.T.O.)**

**Q.4: Write short notes on any two.**

**(12)**

- (i) Kelvin's fluid flow analogy
  - (ii) Mechanical strain gauges
  - (iii) Plane stress and plane strain
  - (iv) Warping of cross sections
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