Hall Ticket No: | | | | | | | | | | | **Question Paper Code :**

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES

(AUTONOMOUS)

M.E/M.Tech I-Semester Regular Examinations, November 2015

ADVANCED MECHANICS OF SOLIDS

(MACHINE DESIGN)

Date: **Time: 3 hours** **Max Marks: 60**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

Unit-1

1. A rectangular steel plate has a length of 2 m, width of 1 m, and fixed edges. The plate is subjected to a uniform pressure P=270 KPa. Assume that the design pressure for the plate is limited by the maximum stress in the plate this would be the case for fatigue loading for instance. For a working stress limit $\sigma_w = \frac{Y}{2}$ determine the required plate thickness and maximum deflection. Take E = 200 GPa , ϑ= 0.29, and Y = 280 MPa. Derive from first principles the formulae used.

OR

2. A square plate is simply supported on all edges and is loaded by gravel such that $p=p_0 \sin \frac{m\pi x}{a} \sin \frac{m\pi y}{a}$.
   a. Determine the maximum deflection and its location
   b. Determine the maximum values of the moments.
   c. Determine maximum values of the Krichhoff shear forces

Unit-2

3. Derive the general equation of twist and shear stress induced in the shafts of non-circular cross-section subjected to pure torsion.

OR

4. Explain clearly about prandtl's membrane analogy and derive the necessary equations involved.

Unit-3

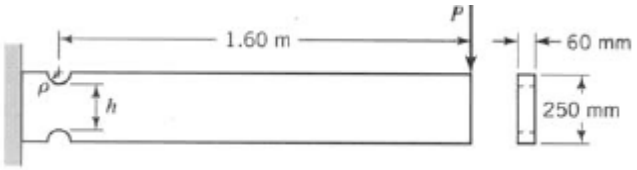
5. Consider a beam of infinite length, on an elastic foundation subjected to a uniform load w [F/L] over its entire length. By the method of superposition, determine the displacement, slope, moment, and shear of the beam.

OR

6. A steel I-beam (E = 200 GPa) has a length of L = 3.00 m,depth of 305 mm, flange width of 129 mm, and moment of inertia I_x= 95.3 x $l0^6$ mm^4. The beam rests on a hard rubber elasticfoundation whose spring constant is k_0= 0.300 N/mm^3. If the beam is subjected to a concentrated load P = 270 kN at its center, determine the maximum deflection and maximum flexural stress in the beam.

Unit-4

7. The beam as in the Figure is made of a brittle material that has an ultimate strength σ_u = 450 MPa. If the h = 125 mm and ρ= 15.0 mm, determine the magnitude of P based on a safetyfactor SF = 3.50. Assume that the material is linearly elastic upto the ultimate strength.

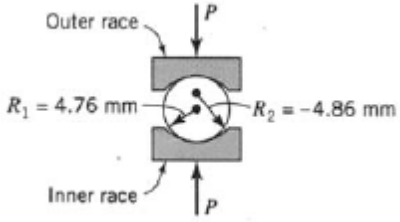


OR

8. Derive an expression for stress concentration at the tip of a elliptical hole introduced in a plate subjected to far field stress of σ.

Unit-5

9. A steel ball bearing consisting of an inner race, an outer race, and 12 balls is shown in Figure. Take E=200GPa,$\mu = 0.29$ and Y =1600MPa. A rated load of P_o= 4.2 KN is given in a manufacturer'shandbook for this bearing when operated at 3000 rpm. An empirical is used to determine the load P on the top most ball that bears the largest portion of the load $p = \frac{5p_0}{n}$ = 1.75 KN in which n is the number of balls. At the region of contact between the inner race and topmost ball, determine the maximum principalstress, maximum shear stress, and maximum octahedral shear stress, dimensions of the area of contact, maximum orthogonal shear stress, and distance from the point of contact to the point where these stresses occur.



OR

10. A steel railway car wheel may be considered a cylinder with a radius of 440 mm. The wheel rolls on a steel rail whose top surface may be considered another cylinder with a radius of330 mm. For the steel wheel and steel rail, E = 200 GPa, v =0.29, and Y = 880 MPa. If the wheel load is 110 kN,
    a. Determineσ_{max} ,, τ_{max} , $\tau_{oct\,(max)}$,$2\tau_o$
    b. What is the factor of safety against initiation of yielding based on the maximum shear-stress criterion