Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **M.Tech**

P1MEBC04

1st Semester Regular/Back Examination 2019-20

ADVANCED MECHANICS OF SOLID

BRANCH : CAD / CAM ENGG, DESIGN AND DYNAMICS, HEAT POWER & THERMAL ENGG, HEAT POWER ENGG, MACHINE DESIGN, MECH. ENGG (THERMAL & FLUID ENGG), MECH. ENGG., MECH. SYSTEM DESIGN, MECH. SYSTEMS DESIGN & DYNAMICS, PRODUCTION ENGG, PRODUCTION ENGG AND OPERATIONAL MGT, SYSTEM DESIGN, THERMAL & FLUID ENGG, THERMAL ENGG, THERMAL POWER ENGG

Max Marks : 100

Time : 3 Hours

Q.CODE : HRB736

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) What do you mean by stress invariants and why they are called so.
b) What is the difference between a plane stress problem and plane strain problem.
c) What do you mean by Beam Column?
d) What is the Principle of Virtual Work ?
e) Define Shear Centre and why it is important ?
f) State and explain Hamilton's Principle.
g) What is the difference between plates and beams
h) Write the Winkler-Bach formula with explanation of the terms used
i) State the Principle of Minimum Total Potential Energy.
j) Explain the notation for Bending Moments and Twisting Moments in Plate Theory.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) What is stress cubic equation. Write the corresponding equation and explain the significance.
b) Write the Differential Equations of equilibrium in 3-dimensional elasticity explaining the terms used and significance.
c) Using Hamilton's Principle, develop the Equation of motion of a vibrating system consisting of a mass m and a spring of stiffness k.
d) Write about the method of locating the neutral axis in bending of curved beams with large initial curvature.
e) State and develop the Maxwell's theorem of reciprocal relations
f) How is the Distribution of radial stress and circumferential stress in a thick cylinder under external pressure only (write the formula and draw the plot).
g) Briefly differentiate between St.Venant's approach and Prandtl's approach to Torsion problems.
h) Briefly differentiate between the Kirchhof concept and Mindlin concept of Plate theory.
i) Develop the General Equations of a Beam-Column under the action of transverse distributed load of intensity q (x) and an axial compressive load P.
j) The cylinder of a hydraulic ram is 6 cm internal diameter. Find the thickness required to withstand an internal pressure of 40 N/mm^2, if the maximum tensile stress is limited to 60 N/mm^2 and the maximum shear stress is limited to 50 N/mm^2.

k) A curved beam of square section, 3-cm sides and mean radius of curvature 4.5 cm is initially unstressed. If a bending moment of 300 Nm is applied to the beam tending to straighten it, find the stress at the inner and outer faces.

l) A thin uniform steel disc of 25 cm diameter with a central hole of 5 cm dia. runs at 10000 rpm. Calculate the maximum principal stress and maximum shear stress in the disc. The Poisson's ratio is 0.3 and density is 7700 kg/m^3.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 The state of stress at a point is given by the following : **(16)**

σ_x = 110 MPa, σ_y = -86 MPa, σ_z = 55 MPa, τ_{xy} = 60 MPa, τ_{yz} = 0, τ_{zx} = 0. Determine the principal stresses, the direction cosines of the principal stresses and the maximum shear stress.

Q4 A steel railway track is supported on timber sleepers which exert an equivalent load of 2800 N/m length of rail per mm deflection from its unloaded position. For each rail, the moment of inertia of cross section is 12,000,000 mm^4, section modulus is 160,000 mm^3 and Young's modulus is 205,000 N/mm^2. If a point load of 100 kN acts on each rail, find the length of rail over which the sleepers are depressed and the maximum bending stress on the rail. **(16)**

Q5 A simply supported I-beam of 2-m span carries a central load of 4 kN (Fig.1). The load acts through the centroid, the line of action is inclined at 30^0 to the vertical direction. Determine the maximum stress. The thickness of flanges and web is 10 mm. **(16)**

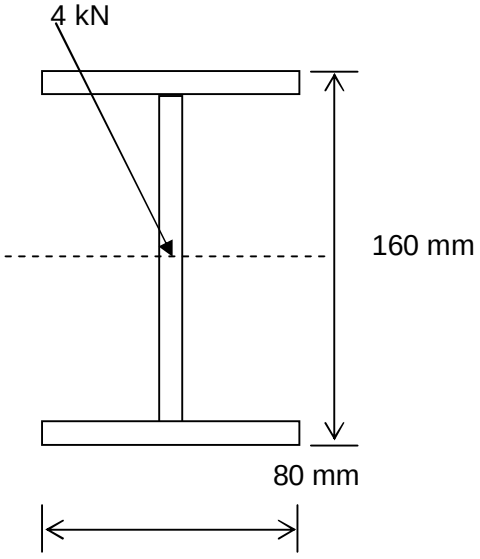

Figure 1

Q6 Derive expression for locating the shear centre of a beam of symmetric channel section (or C-section) whose two symmetric flanges are horizontal and the web is vertical. The load is vertical parallel to the web. The width of the flange is b, depth of the web is h and the thickness of the flange and web is t. **(16)**