Hall Ticket No | | | | | | | | | | |

Question Paper Code: BCC206

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Regular) - January, 2018

Regulation: IARE–R16

ADVANCED MECHANICS OF SOLIDS
(CAD/CAM)

Time: 3 Hours **Max Marks: 70**

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

UNIT – I

1. (a) Determine the position of shear centre for unequal I - section as shown in Figure 1 **[7M]**

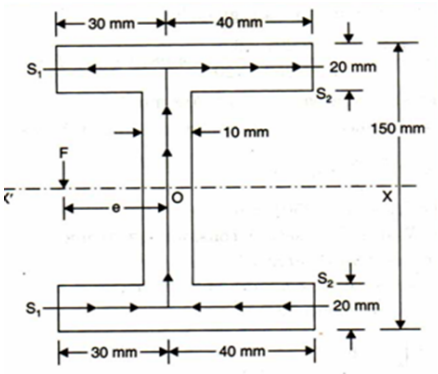

Figure 1

(b) Explain the method for finding bending stress in unsymmetrical bending. **[7M]**

2. (a) A channel section has flanges 12 cm X 2 cm and web 16 cm X 1cm. Determine the shear centre of the channel. **[7M]**

(b) Determine the position of shear centre for the C-section as shown in Figure 2. **[7M]**

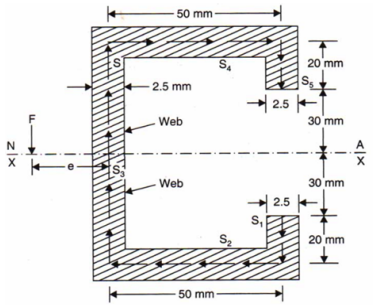

Figure 2

UNIT – II

3. (a) Derive an equation for the value of h^2 for a trapezoidal section **[7M]**

   (b) Determine : **[7M]**

   i. Location of neutral axis

   ii. Maximum and minimum stress.

   iii. Ratio of maximum and minimum stress, when a curved beam of rectangular cross- section of width 20 mm and of depth 40 mm is subjected to pure bending moment of +600 Nm. The beam is curved in a plane parallel to depth. The mean radius of curvature is 50 mm.

4. (a) Derive an equation for the value of h^2 for a circular section. **[7M]**

   (b) A closed ring of mean radius of curvature 90 mm is subjected to a pull of 3 kN. The line of action of the load passes through the centre of the ring. Calculate the maximum tensile and compressive stresses in the material of the ring is circular in cross-section with diameter equal to 15 mm. **[7M]**

UNIT – III

5. (a) A rectangular steel shaft is transmitting power at 300 rpm lifting a load of 40 kN at a speed of 10 m/min. If the maximum permissible shear stress in the shaft is 45 MN/m^2 and efficiency of the crane gearing is 60 percent, Determine: **[7M]**

   i. Size of the shaft

   ii. Angle of the twist per metre length. Take C = 78.4 MN/m^2, breadth to depth ratio = 1.5

   (b) A shaft of hollow square section is of uniform wall thickness of 4 mm and centre line of the wall forms a square of 200 mm side. It is to be replaced by a solid circular shaft of the same material and having the same torsional stiffness. If the stress concentration factor K at the inner corners of the hollow square section is 1.7 and the twisting moment applied is 800 Nm. Find : **[7M]**

   i. Diameter of the solid shaft

   ii. Maximum shear stresses in both the shafts.

6. (a) A steel disc of uniform thickness having diameter 900 mm is rotating about its axis at 3000 rpm. Determine the radial and circumferential stresses at the centre and outer radius. The density of the material of the disc is 7800 kg/m^3 and poisson's ratio is 0.30 **[7M]**

   (b) A disc of uniform thickness having inner and outer diameters 100 mm and 400 mm respectively is rotating at 5000 rpm about its axis. The density of the material of the disc is 7800 kg/m^3 and poisson's ratio is 0.28. Determine the stress variations along the radius of the disc. **[7M]**

UNIT – IV

7. (a) Explain briefly about the strain – displacement relations for plates with a neat sketch. **[7M]**

   (b) A square plate is simply supported on all edges as shown in Figure 3 and is loaded by gravel such that $P(x, y) = P_0 Sin\frac{\pi x}{a}\ Sin\frac{\pi y}{a}, a = b$ **[7M]**

   i. Determine the maximum deflection and its location

   ii. Determine the maximum values of the Moments M_{xx} , M_{yy}

   iii. Determine the maximum values of the Kirchhoff shear forces V_x,V_y.

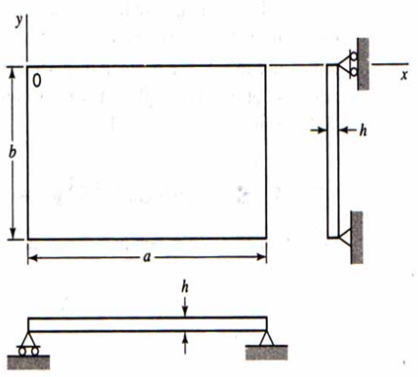

Figure 3

8. (a) A rail road uses steel rails (E = 200 GPa) with a depth of 184 mm. The distance from the top of the rail to its centroid is 99.1 mm, and the moment of inertia of the rails is 36.9 X $10^6 mm^4$ .The rail is supported by ties, ballast and a road bed that together are assumed to act as an elastic foundation with spring constant K = 14 N/mm^2.Determine the maximum deflection ,maximum bending moment and maximum flexural stress in the rail for a single wheel load of 170 kN. **[7M]**

   (b) A steel I -beam (E = 200 GPa) has a depth of 102 mm, width of 68 mm, moment of inertia of I_X = 2.53X $10^6 mm^4$, and of length 4 m. It is attached to a rubber foundation for which K_0 = 0.350 N/mm^3. A concentrated load P=30.0 kN is applied at one end of the beam. Determine the maximum deflection, maximum flexural stress in the beam and the location of each. **[7M]**

UNIT – V

9. (a) Explain the deflection of bodies in point contact with a neat sketch. **[7M]**

   (b) Explain the stresses for two bodies in line contact with loads normal and tangent to contact area. **[7M]**

10. (a) Explain the determination of contact stresses with a neat sketch. **[7M]**

    (b) Two steel cylinders each 80 mm in diameter and 150 mm long mounted on parallel shafts and loaded by a force F = 80 KN. The two cylinders (E = 200 GPa and γ = 0.29) are rotated at slightly different speeds so that the cylinder surfaces slide across each other. If the coefficient of sliding friction is $\mu = 1/3$, determine the maximum compressive principal stress σ_c, the maximum shear stress τ_{max} and the maximum octahedral shear stress. **[7M]**