DEPARTMENT OF APPLIED MECHANICS
MAJOR TEST (2nd –SEMESTER, 2006-2007)
AML150: MECHANICS OF SOLIDS AND FLUIDS

Time allowed: 2 hour
Maximum Marks: 60

1. Write short notes on the following: (3×3 = 9)
   (a) Reynolds number, Froude number and Mach number
   (b) Strain Invariants
   (c) Shear stress on a transversely loaded beam

2. The gate AB shown in Figure 1 is hinged at A and is in the form of a quarter circle of radius 1 m. The width of the gate is 0.5 m. Find the force F required to hold the gate in position. Also find out the horizontal and vertical components of the hydrostatic force acting on the gate along with their line of action. (8)

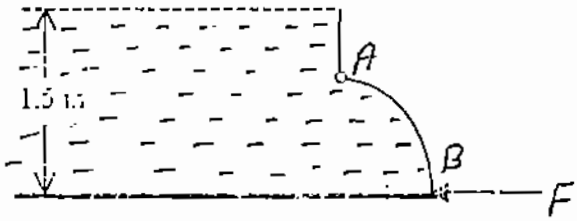

Figure 1

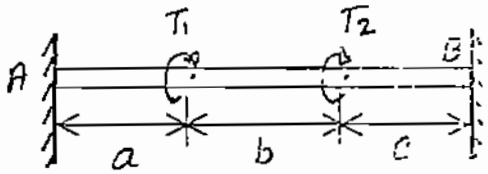

Figure 2

3. Describe various types of strain rosettes and their relative advantages. In a rectangular strain rosette, the recorded strains are $\varepsilon_0 = -110 \times 10^{-06}$, $\varepsilon_{45} = 60 \times 10^{-06}$, $\varepsilon_{90} = 110 \times 10^{-06}$. Find the principal strains and principal stresses. Poisson's ratio = 0.3, Young's modulus = 2×10^{07} N/cm^2. (10)

4. A prismatic shaft of diameter d has built-in edges and is subjected to the action of externally applied twisting moments T_1 and T_2 as shown in Figure 2. Find the support reactions, if a = 75 cm, b = 125 cm and c = 100 cm, T_1 = 12 KN-cm and T_2 = 24 KN-cm. (8)

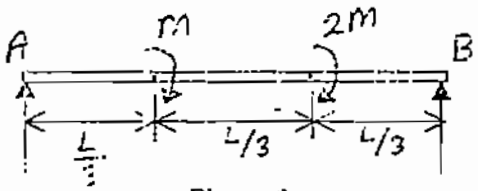

Figure 3

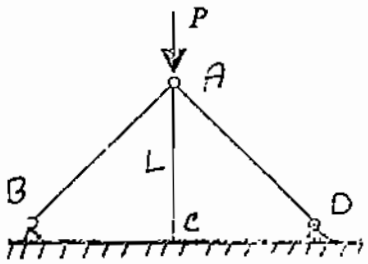

Figure 4

5. A simply supported beam AB of uniform flexural rigidity EI carries at its third-points two concentrated couples of moments M and $2M$ as shown in Figure 3. Using the moment-area method find the rotations θ_A and θ_B of the tangents at A and B respectively (8)

6. A simply supported beam AB of uniform flexural rigidity EI carries a concentrated load P at its center and a uniformly distributed load of w_0/unit length along the entire length. Using Castigliano's theorem, find the deflection at the center of the beam. (7)

7. The bars AB, AC and AD are slender steel rods of same flexural rigidity EI. They have pinned ends at A, B and D and fixed at C. Calculate the critical value of the vertical load P that can be applied at A, so that the members do not buckle (refer to Figure 4). (10)