B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING, 2019
(2nd Year, 1st Semester)

MECHANICS OF SOLID

Time: Three hours Full Marks: 100

Answer any *five* questions

1. a) For a vector with direction cosines l, m, n prove that $l^2 + m^2 + n^2 = 1$. (10)

   b) Two vectors are given as A = (6i + 10j + 16k) N and B = (2i - 3j) N. C is also a vector in the xy plane at an inclination of 30^0 to the positive x-axis and directed away from the origin. The magnitude of C is 50 N. Find the sum of the vectors A, B and C. (10)

2. a) Refer to **Fig. Q2(a).** Calculate the magnitude of the projection of the force F = 100 kN on the diagonal AB of the upper face of the rectangular parallelepiped. (10)

   b) The turnbuckle (**Fig. Q2(b)**) is tightened until the tension in cable *AB* is 1.2 kN. Calculate the magnitude of the moment about point *O* of the force acting on point *A*. Then determine the magnitude of the moment about the *x*-axis. (10)

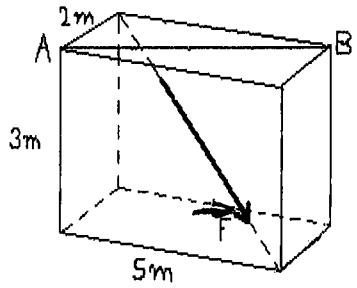

Fig. Q2(a))

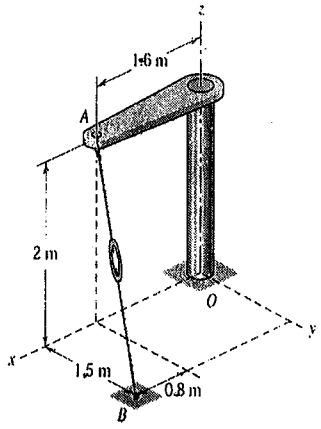

Fig. Q2(b)

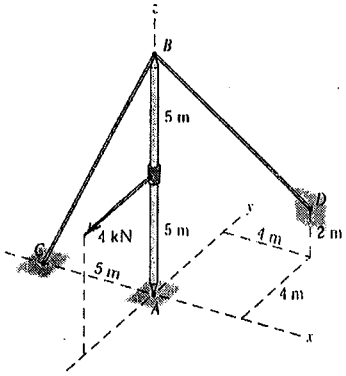

Fig. Q3

3. The vertical mast (**Fig. Q3**) supports 4 kN force and is constrained by the two fixed cables *BC* and *BD* and by a ball-and-socket connection at *A*. Calculate the tension in cable *BD*. (20) **contd..**

[Turn over

4. a) A mild steel tensile test specimen, having a circular cross-section of diameter 1.5 cm shows an elongation reading of 0.01 cm over a gauge length of 10.0 cm. Calculate the tensile stress in the material, assuming that Young's Modulus of Elasticity, $E = 0.8 \times 10^6$ kgf/cm^2. (10)

   b) Derive the equation defining the deflection curve of a uniformly loaded cantilever beam. Also determine the expression for the maximum deflection of the beam. (10)

5. a) For torsion of a circular shaft with usual notations show that

$$T/J = (G\theta)/L \qquad (10)$$

   b) A steel shaft 10 mm in diameter turns at 12,000 rpm. What is the maximum power that such a shaft may develop if the assigned working stress in shear is 400 kgf/cm^2. (10)

6. a) For pure bending of a simply supported beam with usual notations show that

$$\sigma / y = M / I \qquad (05)$$

   b) A simply supported beam of length 3.6 m is to carry a uniformly distributed load of intensity, w = 1,600 kgf/m. The cross-section is to be rectangular with depth h and width b = h/2. If the allowable bending stress in tension or compression is 84 kgf/cm^2, what is the required depth h for the cross-section? Also draw shear force and bending moment diagrams of the beam. (15)