B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING, 2022

(3rd Year, 2nd Semester)

Machine Design and Drawing (Hons.)

Time: Three hours Full Marks: 100

Missing data, if any, may be assumed.

Answer **Question No 1** and any **Four** from the rest.

1. a) What is preferred number series? Find out the numbers of R5 basic series from 1 to 10.
   b) Explain the difference between stress and strength. What is factor of safety?
   c) What is SG 800/2? State its tensile strength and % elongation.
   d) Explain the factors to be considered for selection of material for a machine component.
   e) Explain the need for theories of failure. Explain maximum normal stress theory.
   f) Explain the relative merits and demerits of V-belt over flat belt.
   g) Explain the conditions of applicability of Lame's eqn. and Clavarino's eqn.
   h) Show the symbolic representation of 1st and 3rd angle projection.
   i) State the purpose of stuffing box and packing in an autoclave.
   j) What is meant by the following?
   M12x1.25; 162 P.C.D.; M75 GAS THD; M10 tapped 25 deep. 4 x 10

2. A thick cylinder is made of ductile material with closed ends having inner diameter D_i and subjected to internal pressure P_i. According to the distortion energy theory of failure, $\sigma = S_{yt} / FOS = \sqrt{\frac{1}{2}[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2]}$ where σ_1, σ_2 and σ_3 are principal stresses. Apply this theory to prove that the cylinder wall thickness is given by: $t = \frac{D_i}{2}[(\frac{\sigma}{\sigma - \sqrt{3}P_i})^{1/2} - 1]$. Symbols have usual meaning. 15

3. A rigid coupling is used to transmit 20 kW power at 720 rpm. There are four bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts. 15

4. Design a cotter joint to transmit 20 kN. Take material with allowable values $\sigma_t = 70$ N/mm^2, $\sigma_c = 140$ N/mm^2, $\tau = 35$ N/mm^2. 15

5. Determine the width of a 9.75 mm thick leather belt required to transmit 20 HP from a motor running at 900 rpm. Diameter of driving pulley is 30 cm. The driven pulley runs at 300 rpm. The distance between the centre of two pulleys is 3 m. The weight of leather is 1×10^{-3} kgf/cc. Maximum allowable stress in leather is 25 kgf/cm^2. COF =0.3. Assume open belt drive, neglect sag and slip. 15

6. Design a knuckle joint to transmit 150 kN. Take material with allowable values $\sigma_t = 75$ N/mm^2, $\sigma_c = 150$ N/mm^2, $\tau = 60$ N/mm^2. 15