

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGG EXAM, 2025
(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) Explain the need for preferred size. Explain Renard series.
 - b) Define stress and strength. Hence explain the relation between the two. What is factor of safety?
 - c) State beam bending formula. What is working bending stress?
 - d) State the factors for selection of material for a machine component.
 - e) Explain the need for theories of failure. Explain maximum normal stress theory.
 - f) State advantages of V-belt over flat belt. When to consider the effect of centrifugal tension?
 - g) State and explain the Lamé's equation.
 - h) How to represent 1st and 3rd angle projection in drawing. Define scale of drawing.
 - i) Explain the methods of cost reduction considerations in design.
 - j) What is meant by the following?

162 P.C.D.; M75 GAS THD; M10 tapped 25 deep, SQ20 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 maximum shear stress theory of failure, $\tau = S_{sy} / FOS = (\sigma_1 - \sigma_2) / 2$ where σ_1 and σ_2 are principal stresses. Apply this theory to prove

that the cylinder wall thickness is given by: $t = \frac{D_i}{2} \left[\left(\frac{\tau}{\tau - P_i} \right)^{1/2} - 1 \right]$. Symbols have usual meaning.

3. It is required to design a rigid coupling to transmit 37.5 kW power at 180 rpm. There are four bolts and the pitch circle diameter of the bolts is 180 mm. The bolts are made of steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 2.5. Determine the diameter of the bolts.

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4. A cotter joint is to be designed to transmit 25 kN using a specific material with allowable values $\sigma_t = 70 \text{ N/mm}^2$, $\sigma_c = 140 \text{ N/mm}^2$, $\tau = 35 \text{ N/mm}^2$. Determine the different dimensions of the components of the joint.

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5. A leather belt is used to transmit 25 HP from a motor running at 1200 rpm. Diameter of driving pulley is 36 cm. The driven pulley runs at 400 rpm. The distance between the centre of two pulleys is 3.2 m. The weight of leather is $1 \times 10^{-3} \text{ kgf/cc}$. Maximum allowable stress in leather is 25 kgf/cm^2 . Friction coefficient = 0.3. Assume crossed belt drive, neglect sag and slip. Determine the width of the belt if the available thickness from catalogue is 10 mm.

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6. A double-riveted double-strap butt joint is used to connect two plates: each of 12 mm thick by means of 16 mm diameter rivets having a pitch of 48 mm. The rivets and plates are made of steel with permissible stresses in tension, shear and compression as 80, 60 and 120 N/mm^2 respectively. Determine the efficiency of the joint.

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7. The stresses induced at a critical point in a machine component made of steel 45C8 ($S_{yt} = 380 \text{ N/mm}^2$) are as follows: $\sigma_x = 100 \text{ N/mm}^2$, $\sigma_y = 40 \text{ N/mm}^2$, $\tau_{xy} = 80 \text{ N/mm}^2$. Calculate the factor of safety by (i) maximum normal stress theory (ii) maximum shear stress theory (iii) distortion energy theory.

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