Ex/Met/ES/B/ME/TS/221/2022

B.E. METALLURGICAL AND MATERIAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2022

MACHINE DESIGN AND DRAWING

Time: **Three hours** Full Marks: **100**

Missing data, if any, are to be reasonably chosen. Give sketches wherever applicable.

Answer **Question No 1 and Question No 2** and any **Six (06)** from the rest

1. Justify the following:
   a) Generally, factor of safety for brittle material is higher than ductile material. b) Standardization in design may reduce the cost of the product. c) In riveting operation, rivet hole diameter is larger than rivet shank diameter. d) Clearances are provided in cotter joints. e) Generally, effect of stress concentration in ductile material under static loading may be neglected. f) Resilience property is the essential property of a spring. g) Generally, the cross section of the pulley arm is elliptical and the major axis of the arm is placed in the plane of rotation. h) Material for pulley and coupling is generally Cast Iron. i) Radial stress in thin cylinder is generally neglected. j) The slack side is preferably kept on top in horizontal flat belt drives. ***10x02=20***
2. Design and draw (two views, one view should be in section) the socket and spigot type cotter joint subjected to an axial load of 120 kN. All components are made up of plain carbon steel. The allowable stresses are 150 MPa in tension, 87 MPa in shear and 240 MPa in crushing. ***20***
3. A bracket is fixed to the wall by means of 4 identical bolts and loaded by a vertical load as shown in the Fig. 3. Material of bolts is C30 carbon steel (σ_y=340 N/mm^2) and factor of safety is 3. Determine the nominal diameter of the bolts. ***10***
4. A solid circular steel shaft, 15 mm in diameter, is subjected to torsional shear stress which varies from 0 to 35 MPa and at the same time, is subjected to an axial stress that varies from 30 N/mm^2 to 80 N/mm^2. The frequencies of variations of these stresses are equal to the shaft speed. Calculate the factor of safety considering the following: σ_{ut}= 540 MPa, σ_{yt}= 400 MPa and σ_e= 200 MPa. ***10***
5. An element is loaded by stresses σ_x= 119 MPa, σ_y= 7 MPa, and τ_{xy}= 42 MPa. Material is cast iron with σ_{ut}= 200 MPa and σ_{uc}= 730 MPa. Calculate factor of safety using Rankine's theory of failure. ***10***
6. Prove the relationship given by $\frac{T_1-mv^2}{T_2-mv^2} = e^{\mu\theta}$, where symbols bear their usual meanings. ***10***
7. Deduce the expressions for different stresses in a thick walled cylindrical pressure vessel subjected to an internal pressure. ***10***
8. A rotating shaft is transmitting a power of 63 kW at 550 rpm and at the same time is subjected to a bending moment of 100 N-m. The shaft material is plain carbon steel having σ_{yt}= 340 MPa and σ_{ut}= 520 MPa. The shaft has a keyway. Calculate the shaft diameter using ASME code. ***10***
9. Calculate the belt width and thickness of a flat belt drive based on the following data: i) rated power is 22.5 kW at 490 rpm at driven end, ii) driving pulley diameter and rpm are 300 mm and 980 respectively, iii) There is no belt slip, iv) pulley center distance is 2000 mm, v) belt material is rubber having allowable σ_t=3.5 N/mm^2 and density is 1.14 gm/cc. vi) Coefficient of friction between the belt and the pulley is 0.3 vii) belt joint efficiency is 0.90. viii) Standard belt thickness and belt widths are given below. ***10***

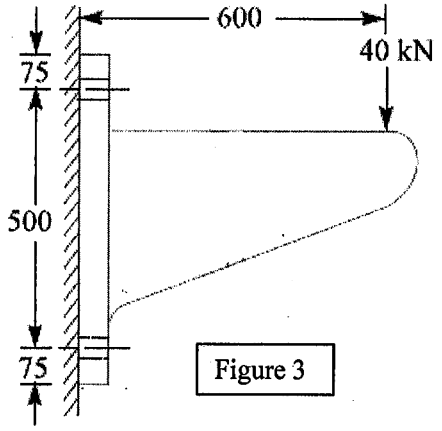

Figure 3

Std. belt thickness	Std. belt widths (mm)
6 mm	50, 63, 71, 80, 90, 100, 112, 125, 140
8 mm	90, 100, 112, 125, 140, 160, 180, 200, 224
10 mm	125, 140, 160, 180, 200, 224, 250, 280, 315, 355, 400
12 mm	250,280,315,355,400,450,500,560,600