B.E. METALLURGICAL AND MATERIAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2024

MACHINE DESIGN AND DRAWING

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

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

Answer any **Four (04)** questions

1. a) Design and draw a cotter joint subjected to a tensile load of 120 kN. All components are made up of plain carbon steel. The allowable stresses are 160 MPa in tension, 240 MPa in crushing. Assume the allowable shear stress using von-Mises theory. b) In the design, which component is made the weakest member and why? How is it achieved?

20+05

2. a) Considering a 3D stress state, deduce the general expression of equivalent stress using distortion energy theory. b) Estimate the yield strength in shear from yield strength in tension using the theory. c) A shaft is subjected to a bending moment of 100 N-m and at the same time, subjected to a torsional moment of 180 N-m. The material is plain carbon steel (σ_{yt}= 340 MPa, σ_{ut}= 580 MPa). Calculate the shaft diameter using a suitable failure theory (with justification) and appropriate factor of safety (with justification).   *10+03+12*

Fig. 3a

3.a) A bracket is supported by means of 9 (nine) rivets of same size, as shown in Fig. 3a. Determine the diameter of the rivet if the maximum permissible shear stress is 40 MPa. b) What do you understand by the efficiency of riveted joints? c) Why diamond riveting is done? d) Explain the method of determining the size of the bolt when the bracket carries an eccentric load perpendicular to the axis of the bolt.   *12+03+03+07*
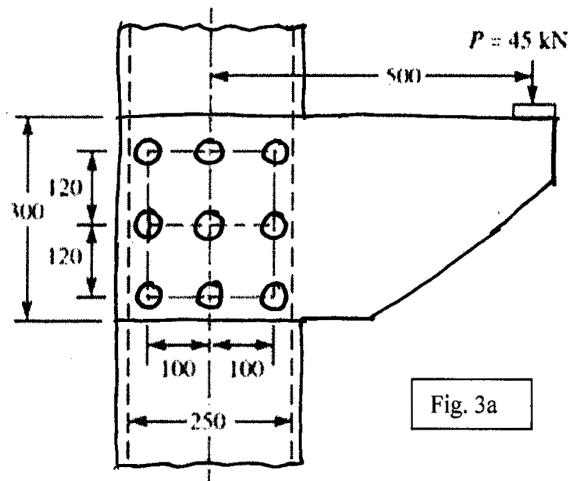
4. a) What do you understand by the terms alignment and misalignments of shafts? b) Two shafts are perfectly aligned and it is required to transmit a power of 63 kW at 750 rpm from driving shaft to the driven shaft. Suggest a suitable machine elements which may be used to couple the shafts. Also, design and draw the machine element. Choose suitable materials for the machine elements. c) In this machine element, which component is made the weakest and why?   *03+20+02*

5. a) A solid circular shaft is subjected to torsional moment that varies from 200 N-m to 400 N-m and at the same time, is subjected to bending moment that varies from 100 N-m to 200 N-m. The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of plain carbon steel (σ_y =400 N/mm² & σ_{ut} = 540 N/mm²) and the corrected endurance limit of the shaft is 230 N/mm². Determine the shaft diameter considering a factor of safety of 1.5. b) Deduce the expression for belt length considering crossed belt drive. c) Show that for thin cylinder subjected to internal pressure, the tendency to burst lengthwise is twice as great as transverse section. d) Justify the statement- Pulley arm cross-section is tapered elliptical and major diameter is placed in the plane of rotation.   *12+04+05+04*