[Total No. of Questions - 9] [Total No. of Printed Pages - 4]

Dec.-23-0437

ME-504 (Machine Design-I) [ME, AE]

B.Tech. 5th (CBCS)

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i) Attempt five questions in all by picking up one question each from unit I to IV. Question 9 is compulsory.

(ii) Use of PSG Design Data Book is allowed.

(iii) Assume missing data if any.

UNIT - I

1. (a) What role does ergonomics and aesthetics play in the design of machine components? What are the steps associated with such considerations?

(b) What is the factor of safety, what are the considerations of selection ol factor of safety? Will the factor of safety for tearing, crushing, shearing, bending be the same? Justify your claim. (4+6=10)

2. (a) What do you understand by the term "fit", how are these classified? Discuss with suitable sketches and examples.

(b) A plate made of steel 1020 in hot rolled condition is shown in Fig. 1. It is subjected to a completely reversed axial load of 30 kN. Considering the expected reliability as 90% and the factor

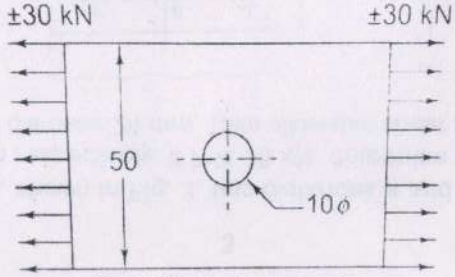

Fig. 1 (Dimensions in mm)

of safety as 2, determine the plate thickness for infinite life. Select appropriate size factor and suitable notch sensitivity factor. (4+6=10)

UNIT - II

3. (a) What is the function of key? how are these classified? With suitable sketches discuss the application of one of the keys normally used for rotating parts.

(b) Armature shaft of a 40 kW, 720 rpm electric motor, mounted on two bearings A and B, is shown in Fig. 2. The shah is made of steel A148 grade 105-85, determine the shaft diameter if, shock and fatigue factor applied to bending moment is 1.5 and shock and fatigue factor applied to twisting moment is 1.0. (4+6=10)

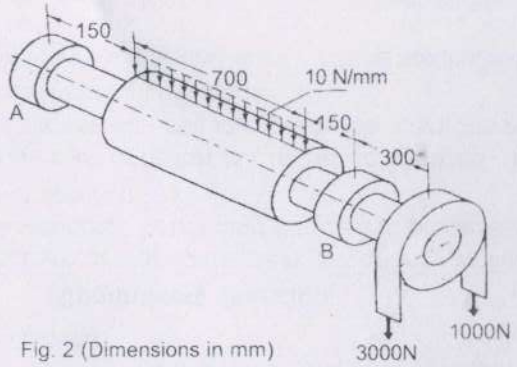

Fig. 2 (Dimensions in mm)

4. (a) Which type of shaft will you prefer amongst hollow and solid shaft, and why? Enumerate through suitable derivation.

(b) A steel solid shaft transmitting 15 kW at 200 rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is also located 600 mm to the left of the right hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft. (4+6=10)

UNIT - III

5. (a) Where are rivetted joints employed? What type of failures are normally expected in rivetted joints, how can these be avoided? Discuss with suitable sketches and examples. **[P.T.O.]**

(b) A joint, shown in Fig. 3, has distances a and b as 50 mm and 75 mm respectively. If P is 36 kN, determine eccentricity e, for rivet of diameter 24 mm. Take allowable shear stress as 60 MPa. (4+6=10)

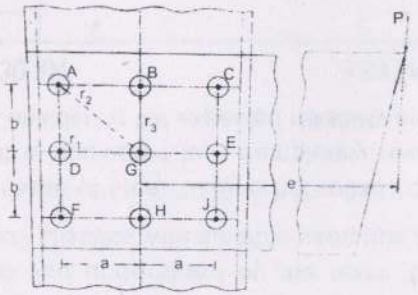

Fig. 3

6. (a) What are the advantages and disadvantages of welded joints over riveted joints? What are some applications of such joints? Can such a process be replaced by some other type of joining system?

(b) A rectangular steel plate is welded as a cantilever to a vertical column and supports, a single concentrated load P, as shown in Fig. 4. Determine the weld size if shear stress in the same is not to exceed 140 MPa. (4+6=10)

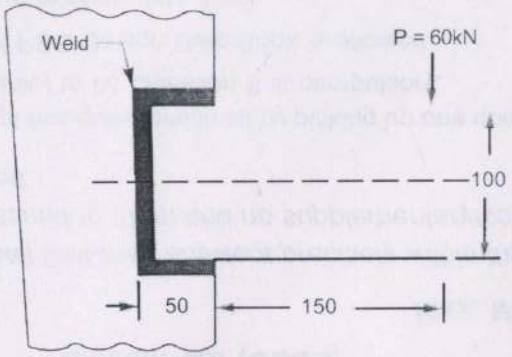

Fig. 4 (Dimensions in mm)

UNIT - IV

7. (a) What are applications of cotter joints? What are the advantages of such joints? Why any taper is required in such a joint, if yes why?

(b) Two rods, made of normalized AISI 1040, are to be connected by means of a cotter joint. The diameter of each rod is 50 mm and the cotter is made from a steel plate of 15 mm thickness Calculate the dimensions of the socket end considering the following assumptions: (i) the yield strength in compression is twice of the tensile yield strength; and (ii) the yield strength in shear is 50% of the tensile yield strength. The factor of safety is 6. (4+6=10)

8. (a) What type of stresses are developed in pipes? Which type of stresses might lead to the failure of a piping joint?

(b) A cast iron pipe of internal diameter 200 mm and thickness 50mm carries water under a pressure of 5 N/mm^2. Calculate the tangential and radial stresses at radius (r) = 100 mm; 110 mm: 120 mm; 130 mm; 140 mm and 150 mm. Sketch the stress distribution curves. (4+6=10)

Compulsory Question

9. (a) Which mechanical properties are of importance while selecting a material subjected to bending? In design process, what role the factor of safety plays?

(b) When Goodman criterion is to be considered in design process? Discuss with suitable examples. Can this be applied for all type of loading conditions?

(c) What is the function of flexible shaft? Where are these commonly used?

(d) What for the keys are used in mechanical components? Are there any disadvantages of keyed joint, if yes discuss?

(e) What is caulking? What is its objective? Discuss with suitable sketches and examples.

(f) What are permanent and detachable fastenings? Discuss with suitable sketches.

(g) What criterion is suitable for design of a mechanical component subjected to cyclic load? How might the failure happen in such a case?

(h) What type of failure theory is most suitable for ductile materials and why? Can some other theory also be applied?

(i) What are the three basic modes of failure of mechanical components? Which type of failure is more prominent and why?

(j) Which type of pipe joint is most suitable for carrying steam at high pressure and why? (10×2=20)