Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: ME318

Course Name: MACHINE DESIGN (PE)

Max. Marks: 100 Duration: 3 Hours

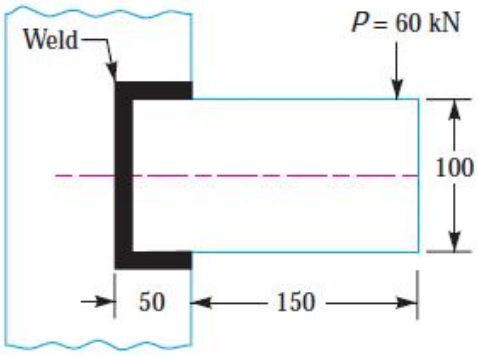
PART A

Answer any twofull questions, each carries 15 marks. Marks

1 a) Calculate the tolerances, fundamental deviations and limits of sizes for the shaft designated as 40 H8 / f7. (8)

b) A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameterof the shaft using two different theories of failure, and assuming a factor of safety of 2. Take E = 210GPa and poison's ratio = 0.25. (7)

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

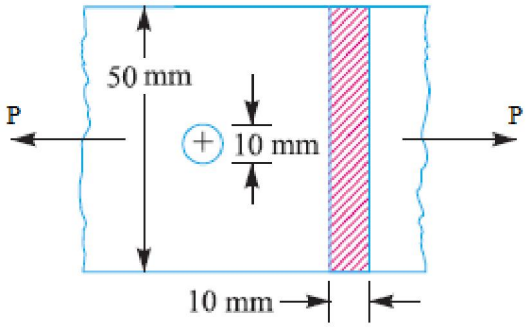


(10)

b) The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm^2. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa. (5)

3 a) What are the steps in machine design process? (5)

b) What maximum axial force can be applied on a plate of width 50 mm and thickness 10 mm width with a central hole of 10 mm diameter without exceeding its yield point stress of 62.5 MPa across its width? (5)



c) A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of the weld so that the maximum stress does not exceed 56 MPa. Consider the joint first under static loading and then under fatigue loading. (5)

PART B

Answer any twofull questions, each carries 15 marks.

4 a) Design a helical tension spring for a spring loaded safety valve so as to meet the following requirements.

Diameter of the valve seat = 65 mm
Operating pressure (when the valve begins to lift) = 0.7 N/mm^2
Maximum pressure (when the valve blows off freely) =0.75 N/mm^2
Lift of the valve during change of pressure = 3.5 mm
Permissible shear stress = 550 MPa

(10)

Take G = 0.84 X 10^{5}MPa and C = 6

b) Briefly discuss the construction of a leaf spring? (5)

5 a) Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used :

Shear stress for shaft, bolt and key material = 40 MPa
Crushing stress for bolt and key = 80 MPa
Shear stress for cast iron = 8 MPa

(7)

b) A steel spindle transmits 4 kW at 800 r.p.m. The angular deflection should not exceed 0.25° per metre of the spindle. If the modulus of rigidity for the material of the spindle is 84GPa, find the diameter of the spindle and the shear stress induced in the spindle (6)

c) What is the effect of keyway cut into the shaft? (2)

6 a) A mild steel shaft transmits 20 kW at 200 r.p.m. It carries a central load of 900 N and is simply supported between the bearings 2.5 metres apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads? (7)

b) A closely coiled helical spring is made of 10 mm diameter steel wire, the coil consisting of 10 complete turns with a mean diameter of 120 mm. The spring carries an axial pull of200 N. Determine the shear stress induced in the spring (8)

neglecting the effect of stress concentration. Determine also the deflection in the spring, its stiffness and strain energy stored by it if the modulus of rigidity of the material is 80 kN/mm^2.

PART C

Answer any two full questions, each carries 20marks.

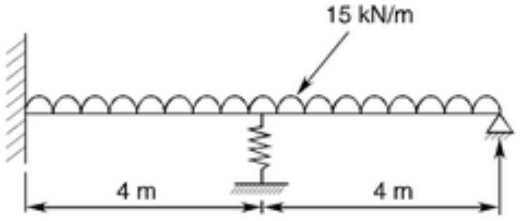
7 a) Discuss the basic assumptions used in the theory of hydrodynamic lubrication. (5)

b) Enumerate the important physical characteristics of a good bearing material. (5)

c) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. (10)

8 a) Explain the basic steps in FEM. (7)

b) Determine the displacement and rotation at various nodal points of a beam as shown in the following figure. The spring stiffness 24EI/l^3 and EI = 400 KN.m^2



(10)

c) What is the importance of boundary conditions in a finite element problem? (3)

9 a) Discuss the procedure followed in designing a journal bearing. (7)

b) List the disadvantages ofrolling contact bearings over sliding contact bearings. (5)

c) The load on the journal bearing is 150 kN due to turbine shaft of 300 mmdiameter running at 1800 r.p.m. Determine the following :
1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2, and
2. Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02kg/m-s and the bearing clearance is 0.25 mm. (8)

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