Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S,FE) Examination December 2025 (2019 Scheme)

Course Code: RAT302

Course Name: DESIGN OF MACHINE ELEMENTS

Max. Marks : 100 **Duration : 3 Hours**

Use of approved data book is permitted
Any missing data may be suitably assumed

PART A

Answer all questions, each carries 3 marks. Marks

1	What are standards in design? Explain with two examples	(3)
2	Give any three factors that can be considered to avoid fatigue failure	(3)
3	Write short notes on gasketed joints and power screws	(3)
4	Give any three advantages and disadvantages of welded joints	(3)
5	Define compressed length, solid length and free length in relation with springs	(3)
6	Explain any three types of shafts with examples each	(3)
7	List out any three differences between involute and cycloidal tooth profiles	(3)
8	Give any three advantages and disadvantages of V-belt over flat belt	(3)
9	Explain hydrodynamic lubrication and boundary lubrication in bearings	(3)
10	Differentiate between rolling bearings and sliding bearings	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	A rectangular bar 200 mm long is subjected to an impact load of 2 KN that falls from a height of 20 mm. Determine the dimensions of the bar if the allowable stress is 125 MPa. Assume the thickness as twice the width. Take E = 200 GPa.	(4)
	b)	A transmission shaft carries a pulley midway between two bearings. The bending moment at the pulley varies from 200 Nm to 600 Nm, as the torsional moment of the shaft varies from 70 N-m to 200 N-m. The frequencies of variation of bending and torsional moments are equal to the shaft speed. The shaft is made of steel Fe	(10)

400 (σ_u = 540 MPa, σ_{yt} = 400 MPa). The corrected endurance strength of the shaft is 200 MPa. Determine the diameter of the shaft using a factor of safety of 2.

OR

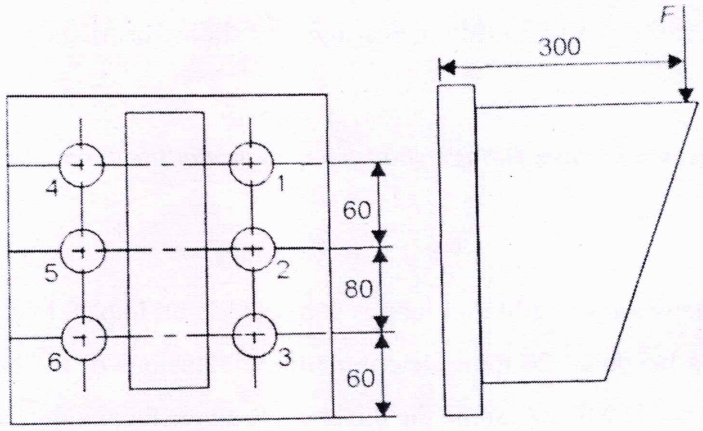
12 a) A steel rod 1.5 m long resists an impact load of 2 KN dropped through a distance of 50 mm along its axis. Limiting the maximum stress in the rod to 150 MPa, determine the diameter of the rod required and the impact factor. (4)

b) A cast iron shaft with an ultimate tensile strength of 180 MPa is subjected to a torsional load which is completely reversal. The load is to be applied at indefinite number of cycles. The shaft is 50 mm diameter and is joined with 75 mm diameter shaft with a fillet radius of 12.5 mm. Using factor of safety of 2, what is the maximum torque that can be applied to the shaft? Take surface factor = 0.75, size factor = 0.85 and load factor = 1. (10)

Module II

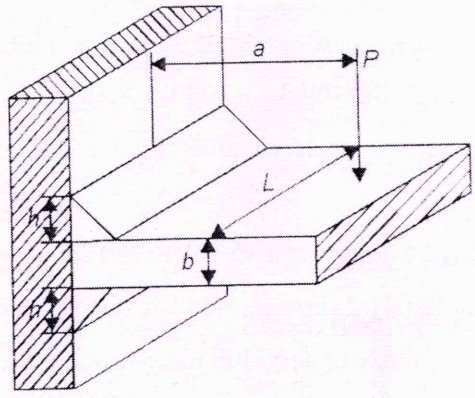
13 a) A bolt carries a tensile load of 8 kN and tightening load is 3 kN. It is made of steel having allowable tensile stress of 120 MPa. Find its size. A soft copper gasket is used. (4)

b) For the eccentrically loaded bracket with M20 bolts shown in figure, calculate the maximum load that can be applied if the allowable tensile stress in the bolt is limited to 90 MPa. (10)

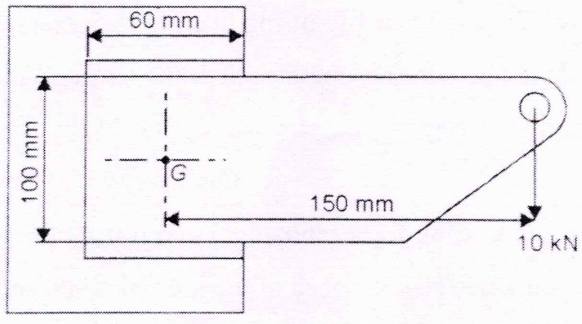


OR

14 a) A Tee joint with transverse fillet welds subjected to eccentric load is shown in figure. Find the bending stress, shear stress and the resultant stresses using the following data: P = 100 kN, a = 100 mm, h = 10 mm, b = 25 mm, L = 500 mm. (4)



b) A bracket shown in figure carries a load of 10 KN. Find the size of the weld if the allowable shear stress is not to exceed 80 MPa. (10)



Module III

15 Design a valve spring for a petrol engine under the following conditions: (14)
Spring length (valve is open) = 40 mm, Spring length (valve is closed) = 50 mm
Spring load (valve is open) = 40N, Spring load (valve is closed) = 25 N
Maximum inside diameter of spring = 25 mm
Shear stress = 40 MPa, modulus of rigidity = 84GPa

OR

16 A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and μ = 0.24. Determine the suitable diameter for a solid shaft allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of the shaft. Assume that the torque on one pulley is equal to that on the other pulley. (14)

Module IV

17 Design a pair of spur gears to transmit 40 kW at 4000 rpm of pinion to the gear 800 rpm. Select Chromium-Nickel steel for both gears. The total number of teeth on pinion and gear is 120 and service factor is 1.5. Take $\alpha = 20°$ full depth involute. (14)

OR

18 Select a V-belt drive to connect a 15 kW, 2880 rpm motor to a centrifugal pump, running at approximately 2400 rpm, for a service of 18 hours per day. The centre distance should be approximately 400 mm. Assume the pitch diameter of driving pulley as 125 mm. (14)

Module V

19 Select a single row deep groove ball bearing for a radial load of 5 kN and an axial load of 1 kN. The expected life of the bearing is 5 years at the rate of 350 days/ year, 8 hrs/day. The bearing operates at 1000 rpm and the diameter of the shaft mounted on this bearing is 75 mm. (14)

OR

20 Design a journal bearing for a centrifugal pump from the following data: Load on the journal = 10 kN, speed of the journal = 900 rpm, ambient temperature = 15°C. (14)

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