Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2024

Course: Machine Design for Aerospace **Semester: VI**

Program: B. Tech Aerospace **Time : 03 hrs.**

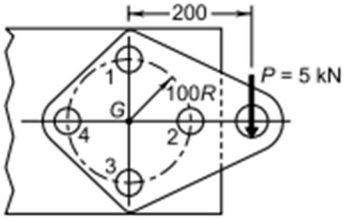
Course Code: ASEG 3029 **Max. Marks: 100**

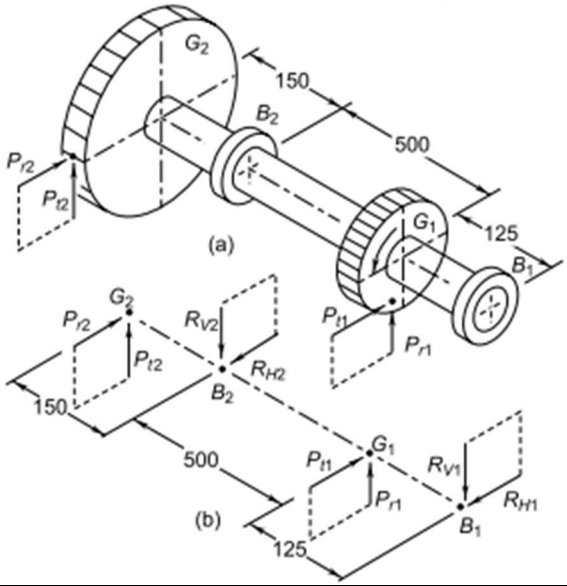
Instructions: Assume suitable data if needed.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
1	Analyze how different types of loads (torsional, axial, bending) affect key selection.	**04**	**CO1**
2	Classify the sliding contact bearing with a suitable example.	**04**	**C01**
3	Discuss the assumption of Lewis's equation valid for gear design.	**04**	**C01**
4	Compare the advantages and disadvantages of using a ball bearing versus a roller bearing	**04**	**C02**
5	Draw a stress time plot for the following fatigue stress with a. Completely reverse fatigue stress. b. Repeated fatigue stress.	**04**	**C01**

SECTION B
(4Qx10M= 40 Marks)

6	Differentiate hydrostatic and hydrodynamic Lubrication.	**10**	**CO1**
7	An aircraft Fan cowling assembly used riveted joint, consisting of four identical rivets, is subjected to an eccentric force of 5 kN as shown in Fig. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm^2. 	**10**	**C03**
8	A ball bearing is operating on a work cycle consisting of three parts a radial load of 3000 N at 1440 rpm for one quarter cycle, a radial load of 5000 N at 720 rpm for one-half cycle, and radial load of 2500 N at 1440 rpm for the remaining cycle. The expected life of the bearing is 10,000 h. Calculate the dynamic load-carrying capacity of the bearing.	**10**	**C04**

	OR A single-row deep groove ball bearing is used to support the lay shaft of a four-speed aircraft propeller gear box. It is subjected to the following loads in respective speed ratios <table><tr><th>Gear</th><th>Axial load (N)</th><th>Radial load (N)</th><th>% time engaged</th></tr><tr><td>First gear</td><td>3250</td><td>4000</td><td>1%</td></tr><tr><td>Second gear</td><td>500</td><td>2750</td><td>3%</td></tr><tr><td>Third gear</td><td>50</td><td>2750</td><td>21%</td></tr><tr><td>Fourth gear</td><td>Nil</td><td>Nil</td><td>75%</td></tr></table>The lay shaft is fixed to the engine shaft and rotates at 1750 rpm. The static and dynamic load-carrying capacities of the bearing are 11600 and 17600 N respectively. The bearing is expected to be in use for 4000 hours of operation. Find out the reliability with which life could be expected.		
9	A hot rolled steel shaft is subjected to a torsional load that varies from 300 kN-mm(clockwise) to 100 kN-mm (anticlockwise). As an applied bending moment at at critical section varies from 400 kN-mm to (–200kN-mm). the shaft is of uniform diameter and no keyway is present at the critical section. Determine the required shaft diameter by taking the factor of safety is 1.5. assume Sut = 560 Mpa, Syt= 420 Mpa, design stress is 280 Mpa, modification factor is 0.62 size correction factor 0.85 & load factor for bending is 1 & load factor for torsion = 0.58.	**10**	**C02**
	SECTION-C **(2Qx20M=40 Marks)**		
10	A shaft transmitting 50 kW at 125 rpm from the gear G1 to the gear G2 and mounted on two single-row deep groove ball bearings B1 and B2 is shown in Fig . The gear tooth forces are Pt_1 = 15915 N, Pr_1 = 5793 N, Pt_2 = 9549 N, Pr_2= 3476 N. The diameter of the shaft at bearings B1 and B2 is 75 mm. The load factor is 1.4 and the expected life for 90% of the bearings is 10000 h. Select suitable ball bearings. 	**20**	**CO4**

		10 mm (i) No. 61800 (C = 1480 N) (ii) No. 6000 (C = 4620 N) (iii) No. 6200 (C = 5070 N) (iv) No. 6300 (C = 8060 N) *20 mm* (i) No. 61804 (C = 2700 N) (ii) No. 16404 (C = 7020 N) (iii) No. 6004 (C = 9360 N) (iv) No. 6204 (C = 12700 N) (v) No. 6304 (C = 15900 N) (vi) No. 6404 (C = 30700 N)		
11	Design an Aircraft engine gearbox having a pair of straight teeth spur gear having 20^0 full depth involute teeth to transmit 20 kW. The pinion runs at 300 RPM and the speed ratio is 3:1. The following data are given no of teeth on pinion is 15. The service factor is 1 the velocity factor Cv = $\frac{3+v}{3}$ tooth form factor (y = 0.154 - $\frac{0.912}{Z}$) face width 14M allowable elastic stress for pinion and gear material are 120 Mpa and 100 Mpa check the Gear for wear and surface endurance limit 600 Mpa and modulus of elasticity for pinion & Gear 200 GPa and 100 Gpa Respectively. **OR** A Helicopter propeller blade is drive with A pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 rpm and supplying 2.5 kW power to a gear. The speed reduction is 4 : 1. The normal pressure angle and helix angle are 20° and 23° respectively. Both gears are made of hardened steel (Sut = 750 N/mm2). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of Grade 4 (i) In the initial stages of gear design, assume that the velocity factor accounts for the dynamic load and that the face width is ten times the normal module. Assuming the pitch line velocity to be 10 m/s, estimate the normal module. (ii) Select the first preference value of the normal module and calculate the main dimensions of the gears. (iii) Determine the dynamic load using Buckingham's equation and find out the effective load for the above dimensions. What is the correct factor of safety for bending? (iv) Specify surface hardness for the gears, assuming a factor of safety of 2 for wear consideration	**20**	**C04**