Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2020

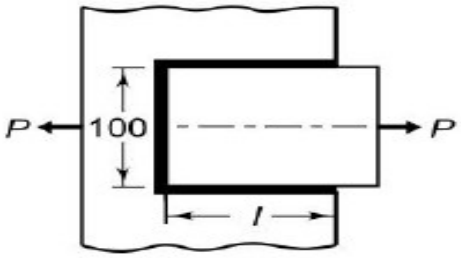
Course: Design of Machine Element **Semester : V**
Program: B. Tech ASE **Time : 03 hrs.**
Course Code: MECH 3024 **Max. Marks : 100**

SECTION A

1. **Each Question will carry 5 Marks**
2. **Instruction: Write short and to the point as per question**

S. No.		CO
Q 1	Discuss the potential application of antifriction ball bearing and hydrodynamic journal bearing.	C03
Q 2	I. A key connecting a flange coupling to a shaft is likely to fail in **[02 Marks]** **a)** Shear b) Tension c) Torsion d) Bending II. Square key of side "d/4" each and length l is used to transmit torque "T" from the shaft of diameter "d" to the hub of a pulley. Assuming the length of the key to be equal to the thickness of the pulley, the average shear stress developed in the key is given by **[03 Marks]** (a) $\frac{4T}{ld}$ (b) $\frac{16T}{ld^2}$ (c) $\frac{8T}{ld^2}$ (d) $\frac{16T}{\pi d^3}$	C01
Q 3	I. Which of the following stresses are associated with the design of pins in bushed pin-type flexible coupling? **[02 Marks]** 1. Bearing stress 2. Bending stress 3. Axial tensile stress 4. Transverse shear stress Select the correct answer using the codes given below (a) 1, 3 and 4 (b) 2, 3 and 4 (c) 1, 2 and 3 (d) 1, 2 and 4 **II.** The permissible stress in a filled weld is 100 N/mm2. The fillet weld has equal leg lengths of 15 mm each. The allowable shearing load on weldment per cm length of the weld is **[03 Marks]** (a) 22.5 KN (b) 15.0 KN (c) 10.6 KN (d) 7.5 KN.	C02
Q 4	I. In the assembly of pulley, key and shaft **[02 Marks]** a) Pulley is made weakest b) Key is made the weakest c) Key is made strongest d) All the three made equal strength	C01

	II. Which one of the following drives is used for a constant velocity ratio, positive drive with large centre distance between the driver and driven shafts? **[02Marks]** (a) Gear drive (b) Flat belt drive (c) Chain drive (d) V-belt drive III. Spur Gear will be used for heavy load application [True/False] **[01 Marks]**	
Q5	I. In a fillet welded joint, the weakest area of the weld is **[02 Marks]** (a) Toe (b) root (c) throat (d) face II. A single parallel fillet weld of total length L and weld size h subjected to a tensile load P, will have what design stress**?** **[03 Marks]** (a) Tensile and equal to $\frac{P}{0.707Lh}$ (b) Tensile and equal to $\frac{P}{Lh}$ (c) Shear and equal to $\frac{P}{0.707Lh}$ (d) Shear and equal to $\frac{P}{Lh}$	**C03**
Q6	Calculate Somerfield number of full journal bearing having clearance to radius ratio of 1/100, using a lubricant with $\mu=28\times10^{-3}$ Pa s supports the shaft journal running at $N = 2400$ RPM. and bearing pressure is 1.4 MPa.	**C04**
	SECTION B 1. **Each Question will carry 10 Marks** 2. **Instruction: Assume necessary data if needed**	
Q 1	Draw the stress time plot of the variation of stress over time in the following cases and identify types of fatigue stress. 1. Axial stress = 50 MPa and Bending stress 70 MPa. 2. Axial stress = 70 MPa and Bending stress 50 MPa. **OR** Differentiate Between Hydrodynamic and hydrostatic Journal Bearing with neat sketches	**C02**
Q2	Calculate the diameter of the shaft a shaft supported at the ends in ball bearings carries a straight tooth spur gear and its mid span and is to transmit 7.5 Kw at 300 RPM. The pitch circle diameter of the gear is 150 mm. the distance between the center line of bearings and gear are 100 mm each. If the shaft is made of steel and allowable shear stress is 45 MPa, determine the diameter of the shaft. Pressure angle may be taken as 20^{O}.	**C02**
Q3	A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds, as shown in Fig. The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld material and the plates are 70 and 50 N/mm2 respectively. Find the length of each parallel fillet weld. Assume the tensile force acting on the plates as static.	**C03**

		
Q4	Calculate the diameter of bolt and hub dimeter for a flange coupling is used to transmit 20 kW power at 720 rpm. There are four bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 (Syt = 380 N/mm2) and the factor of safety is 3.	**C03**
Q5	Design a single-row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The values of X and Y factors are 0.56 and 1.5 respectively. The shaft rotates at 1200 rpm. The diameter of the shaft is 75 mm and Bearing No. 6315 (C =112 000 N) is selected for this application. i) Estimate the life of this bearing, with 90% reliability. (ii) Estimate the reliability for 20 000 h life.	**CO4**
SECTION C 1. **Each Question will carry 20 Marks** 2. **Instruction: Assume necessary data if needed**		
Q 1	Design a pair of straight teeth spur gear and check the safe operating condition in static, dynamic and wear strength for 4 wheeler motor vehicle having resultant force acting due to passenger and all component load would be 5 KN. Average speed of the vehicle noted as 40 KMPH. Refer the following data for design of gear. 20^0 Full depth involute teeth having 20 number of teeth on pinion which rotates at 250 RPM having gear box ratio 4:1(pinion runs 4 times faster than gear). Service factor consider as 1.25 and face width 13 times of module, Allowable elastic stress for pinion and gear 150 MPa and 180 MPa. Modulus of elasticity for gear and pinion would be 200 and 150 GPa respectively. Surface endurance limit consider as 750 MPa. **OR** The following data is given for a full hydrodynamic bearing used for electric motor Radial load = 1200 N journal speed = 1440 rpm journal diameter = 50 mm static load on the bearing = 350 N viscosity of lubricant = 28 x 10 -3 Pa- sec Heat dissipating coefficient = 40 W/ m2 oC Assuming the operating temperature as 65°C.and atmospheric temperature as 28^0 C. The values of surface roughness (cla) of the journal and the bearing are 2 and 1 micron respectively. The minimum oil fi lm thickness should be five times the sum of surface roughness of the journal and the bearings.	**CO4**

	Determine (i) length of the bearing; (ii) radial clearance (iii) minimum oil film thickness (iv) heat dissipated by the bearings (v) Somerfield number (vi) Frictional force	