UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Programme Name: B. Tech ASE **Semester : V**
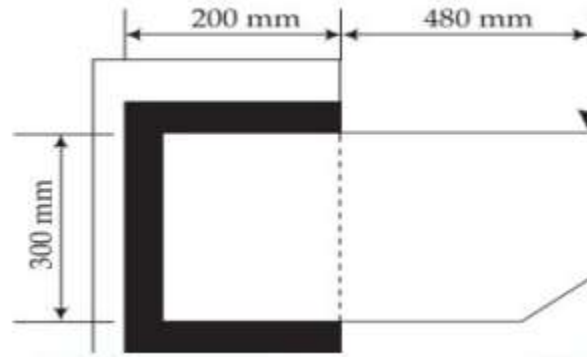**Course Name : Design of Machine Elements** **Time : 3 hr**
Course Code : MECH-3024 **Max. Marks: 100**
Nos. of page(s) : 03

Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point, answers are expected.

Q. No.	Section A (5Q x 4M = 20 Marks)	Marks	CO
1	List out the various phases of design process.	4	C01
2	Describe the common materials used in mechanical engineering design. How can the properties of steel be improved?	4	C01
3	Classify the different types of loads that can act on machine components.	4	C02
4	Explain the different cause of gear tooth failures.	4	C01
5	A 50 mm diameter solid shaft is to be welded to a flat plate and is required to carry a torque of 1500 Nm. If fillet joint is used foe welding what will be the minimum size of the weld when working shear stress is 56 MPa.	4	C03
	Section B (4Q x 10M = 40 Marks)		
6	Determine the dimeter of bar using safety factor 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load of a bar of circular cross section subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with and ultimate tensile strength of 900 Mpa and an endurance limit of 700 Mpa. Use Goodman straight line as basis for design.	10	C02
7	Determine the size of the weld for a bracket loaded as shown in the figure. The allowable stress in the weld as 60 MPa	10	C03

200 mm | 480 mm

300 mm

8	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.
	
	OR
	
	A) Which one of the three listed below will you choose to take heavy axial load on the bearing.
	   1) Self-aligning ball bearing
	   2) Deep grove ball bearing
	   3) Thrust Bearing
	   Give reason for your selection [06]
	B) Differentiate between thick film and thin film lubrication [04]
		10	C03

9	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.	10	C03
	Section C (2Q x 20M = 40 Marks)		
10	The following data is given for a full hydrodynamic bearing used for electric motor Radial load = 1400 N journal speed = 1500 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. Determine (i) length of the bearing; (ii) radial clearance (iii) minimum oil film thickness	20	C04

	(iv) heat dissipated by the bearings (v) Somerfield number (vi) Frictional force		
11	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** A 100 mm steel drive shaft transmitting 150 kW at 300 rpm has to be connectec to a machine having same diameter shaft with cast iron unprotected flange coupling. The permissible shear stress for the shaft, bolt and key are 50 MPa. The Bearing stress for bolt and key are 50 MPa and shear stress for CI in 8 MPa. The basic dimensions of the coupling may be assumed as per standard. Design the coupling and verify all the major dimensions for strength.	**20**	**C04**