Name:

**Enrolment No:** 



## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

**End Semester Examination, December 2022** 

Course: Design of Machine Elements

Program: B. Tech ASE/ ASE

Course Code: Mech 3024P

Semester: V

Time : 03 hrs.

Max. Marks: 100

**Instructions: Machine Design Databook is Permitted.** 

	SECTION A (5Qx4M=20Marks)		
S.no.	(CQATIT-2017III III)	Marks	CO
Q. 1	What are the factors to be considered for selection of material for a design component?	4	CO1
Q. 2	What are allowable stresses? How will you estimate out allowable stress for ductile parts using factor of safety?	4	CO2
Q. 3	Fig. shows a machine member of 60 mm diameter, 300 mm long and supported at on end, subjected to a tensile load of 30 kN. Find the tensile and shear stresses induced in the member.	4	CO2
Q. 4	List the properties required for shaft materials.	4	CO3
Q. 5	Explain stress-strain diagram of mild steel. State the properties that can be derived using the obtained stress-strain diagram.	4	CO1
	SECTION B	1	1
	(4Qx10M=40 Marks)		
Q.6	Determine the diameter of the solid shaft required to transmit 50 KW at 1000 rpm. The allowable shear stresses may be taken as 90 MPa. Replace this solid shaft with a hollow shaft assuming the diameter ratio as 0.6, made of same material and FOS. As a result of replacement, determine:	10	CO4

	<ul><li>(i) percentage reduction in weight assuming same length for both shafts.</li><li>(ii) the ratio of torsional stiffness of the hollow shaft to that of the solid shaft.</li></ul>				
Q.7	Derive expressions for equivalent bending moment and equivalent torsional moment for a solid shaft subjected to combined bending and torsion. Assume any theory of failure.	10	CO3		
Q.8	Select a rectangular parallel key to transmit 9 kW at 300 rpm. The yield stress for the steel used is 310 MPa. Take the factor of safety to be 2.5.	10	CO3		
Q.9	An element is acted upon by the following stresses. $\sigma_x = 120 \text{ MPa}, \ \sigma_y = 90 \text{ MPa}, \ \tau_{xy} = 30 \text{ MPa}.$ (i) Compute the stresses on a plane inclined at $20^\circ$ . (ii) Find principal stresses and their location. (iii) Find maximum shear stresses and its location.	10	CO2		
SECTION-C					
Q.10	(2Qx20M=40 Marks)  (a) A non-rotating shaft supporting a load of 2.5 kN is shown in figure. The shaft is made up of brittle material, with an ultimate tensile strength of 300 N/mm <sup>2</sup> . The factor of safety is 3. Determine the dimensions of the shaft.	10	CO2		
	1.1 d 2.5 kN 0.1 d d 350 350				
	(b) Derive the expressions for torque requirement for lifting and lowering the load using screw jack. Explain with conditions the self-locking and overhauling of screws.	10	CO3		

Q	Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shaft and keys are made up of plain carbon steel 30C8 ( $S_{yt} = S_{yc} = 400 \text{ N/mm}^2$ ). The sleeve is made up of grey cast iron FG 200 ( $Sut = 200 \text{ N/mm}^2$ ). The factor of safety for the shafts and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength.	20	CO3
	OR		
	(a) Name the various types of ball and roller bearings. Why are ball and roller bearings called "antifriction" bearings? Explain the procedure of selection of bearing from manufacturers catalogue.	10	CO4
	(b) An SAE 1045 steel rod is subjected to a tensile load that varies from 60 to 120 kN. The materials have ultimate stress of 586 MPa, yield stress of 309.9 MPa and endurance stress of 290 MPa. Find the diameter of the rod taking factor of safety as 2.	10	CO2