

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2021

Programme Name: B.Tech. Mechatronics & ADE

Semester : V

Course Name : Design of Machine Elements

Time: 04 hrs

Max. Marks: 100

Course Code : MECH 3001

Nos. of page(s) : 3

Instructions: Read the questions carefully and attempt as per section. Use of Design Data handbook is allowed. Assume suitable data if required/ missing.

SECTION A (40)

Attempt all questions.

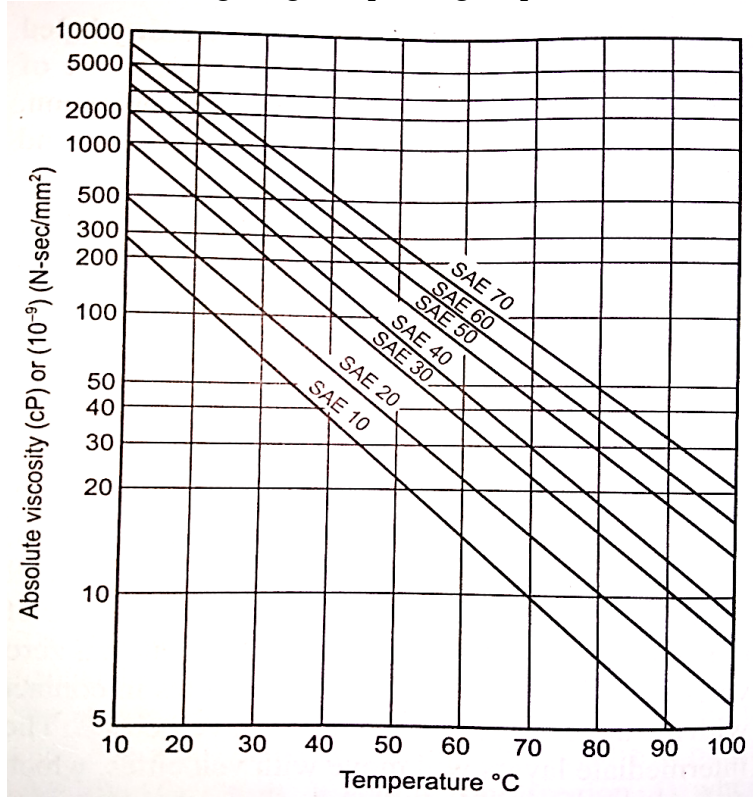
S. No.	Statement of Problem	Marks	CO
Q 1	<p>Design a longitudinal riveted joint for boiler shell the following data;</p> <p>Diameter of boiler shell = $(1800 + 100 \times A)$mm Maximum internal pressure = 2.0 N/mm^2 Strength of plate in tension = 84 MPa Crushing strength of plate = 130 MPa Shearing strength of rivet = 70 MPa Assume the relevant data from DDHB.</p> <p>Select a suitable riveted joint to be designed. Suggest the diagram for designed joint. A is last two digits of your roll no.</p> <p style="text-align: center;">OR</p> <p>A rigid coupling transmits 35 kW at 180 rpm. The service factor for the application is 1.5 (take design torque as 1.5 times the mean torque). Select the suitable material for the various parts of the coupling. Take the material for shaft as $40\text{C}8$ ($\sigma_y = 380 \text{ MPa}$), material for bolts is $30\text{C}8$ (400 MPa) and flanges are made up of cast iron $\text{FG } 150$ ($\sigma_{ut} = 150 \text{ MPa}$). Take factor of safety as 2.5 for all components. Also draw neat sketch of the coupling.</p>	20	CO3
Q 2	<p>Suggest the rolling contact bearing for the loading conditions;</p> <p>Axial force = $(8000 + 10 A) \text{ N}$ Radial force = $(6000 + 10 A) \text{ N}$ Speed = 1440 rpm Desired Life = 5 years by assuming 8 hours working in a day</p>	20	CO2/CO4

Assume the uniform and steady load .Suggest the shaft diameter.

OR

Suggest the bearing for journal diameter of 100 mm to be used for centrifugal pump application. Load applied to bearing is $(20+A)$ kN and its speed is 1000 rpm. Complete the design calculation for bearing. Mention clearly the data assumed in solution; lubricating oil, bearing characteristic numbers etc.

Use the following Viscosity diagram for selecting the lubricating oil for journal bearing design at operating temperature.



20

CO2/CO4

SECTION B (60)

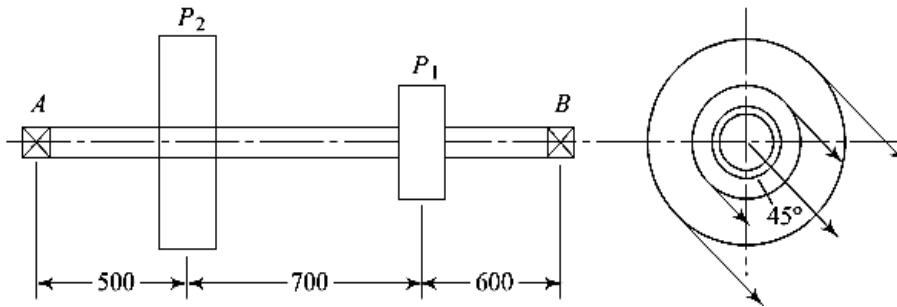
Attempt all questions.

Q 3

(i) Design a line shaft transmitting power to two machine tools. The power received by the shaft is $(30+A)$ kW at 1000 rpm. The diameter of pulley P_1 is 300 mm and its mass is 40 kg. The diameter and mass of pulley P_2 is 600 mm and 100 kg respectively. Assume the belt tension ratio of 2.5 for both pulleys, design the shaft as per ASME code.

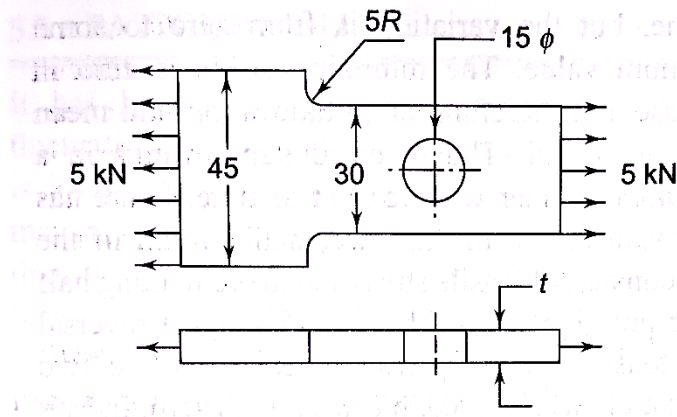
20

CO2/CO4



All the dimensions are in mm.

- (ii) A flat plate is subjected to a tensile force of 5 kN as shown in figure. The plate material is grey Cast Iron FG 250 and Factor of safety is 2.5. Determine the thickness of plate. Consider the dimensions in mm.



10

Q 4

- (i) Write the considerations to be made to select the materials to design the gears in detail & explain.
- (ii) A compressor running at 500 rpm is driven by a $(20+A)$ kW 1500 rpm motor through 20° full depth spur gears. Assume the centre distance in range of 200-300 mm. The pinion is to be made of C30 forged steel hardened and tempered. The gear is to be made of cast steel. Assuming **medium shock condition** design the gear completely for static and dynamic loading condition. Properties of materials of gear and pinion may be selected from the table as given below;

Material	Allowable static design stress	Endurance strength	BHN	Modulus of Elasticity
C30 forged steel hardened and tempered	224 MPa	300 MPa	250	210 GPa

5+25

CO1/CO4