Enrolment No

UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Programme Name: B. Tech. ASE **Semester: IV**
Course Name : Design of Machine Element **Time: 03 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.***

SECTION A (30)

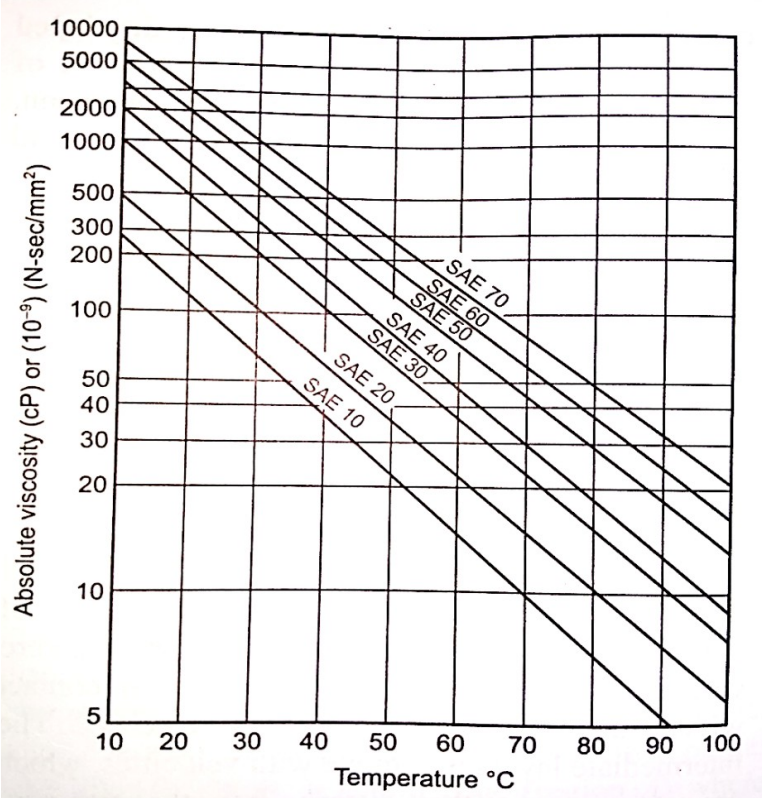
Attempt all questions.

S. No.	Statement of Problem	Marks	CO
Q 1	(i) Explain fatigue strength. Also draw the S-N (Stress Vs Speed) curve for ferrous & non- ferrous materials (ii) Explain stress concentration factor. Explain the methods employed to reduce the stress concentration in machine elements with help of suitable examples.	5 5	CO1
Q 2	(i) Shaft is generally made with either plain carbon or alloy steel. Justify the statement with any two important characteristics of selected materials. (ii) In a design problem it is necessary to replace a 2m long aluminum shaft of 100mm diameter by a tubular steel shaft of the same outside diameter transmitting the same torque and having the same angle of twist. Find the inner radius of the steel bar if G_{Al} = 28GPa and G_{St} = 84GPa.	5 5	CO1 CO1
Q 3	(i) Classify the gears on following criteria; (a) Axes of shaft (b) Speed ratio Support the answer with suitable diagrams and mention least mention one application area in (a) & (b). (ii)Explain the SKF bearing designation with an example.	5 5	CO3 CO4

SECTION B (45)

Attempt all questions. There is internal choice in Q. No.6.

Q 4	Design a longitudinal riveted joint for boiler shell the following data; Diameter of boiler shell = 1.35 m Maximum internal pressure = 2.5 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.	15	CO3

	Select a suitable riveted joint to be designed. Suggest the diagram for designed joint.		
Q 5	Design the flange coupling for following data ; Power to be transmitted = 30 kW Speed of shaft = 200 rpm Allowable stresses may be considered as mentioned below; Bolt material (shearing strength) = 100 MPa Shaft & Key material (shearing strength) = 55 MPa. The flanges are made with CI for which shear stresses are 24 N/mm^2. Also draw the sectional elevation and outside view of designed coupling.	**15**	**CO4**
Q 6	A journal bearing is proposed for a centrifugal pump application. Diameter of journal is 0.15 m and load on it is 35 kN and its speed is 900 rom. 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.***  **OR** Design the deep groove ball bearing for the following data ; Radial force = 5000 N Axial force = 6000 N Speed =1600 rpm Desired Life = 5 Yrs at 10 hrs per day Assume the uniform and steady load .Suggest the shaft dia for which designed bearing can be used.	**15** **15**	**CO2/CO4** **CO2/CO4**

SECTION-C (25)

There is internal choice in Q. No. 7

<table>
<tr>
<td>Q 7</td>
<td>A compressor running at 300 rpm is driven by a 15 kW 1200 rpm motor through 14 ½ ^{0}full depth gears. The Centre distance is 0.375 m. 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 ;
(a) Determine the module , face width and number of teeth on each gear
(b) Check the drive for wear
Properties of materials of gear and pinion may be selected from the table as given below;
<table>
<tr><th>Material</th><th>Allowable static design stress</th><th>Endurance strength</th><th>BHN</th><th>Modulus of Elasticity</th></tr>
<tr><td>C30 forged steel hardened and tempered</td><td>224 MPa</td><td>300 MPa</td><td>250</td><td>210 GPa</td></tr>
<tr><td>Cast steel</td><td>140 MPa</td><td>225 MPa</td><td>160</td><td>210 GPa</td></tr>
</table>
OR

A pair of parallel helical gear 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 is 20^0. Both gears are made of cased hardened alloy steel. Assume the suitable data and design the gear .Also check for wear by considering the dynamic loading.</td>
<td>25</td>
<td>CO2/CO4</td>
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