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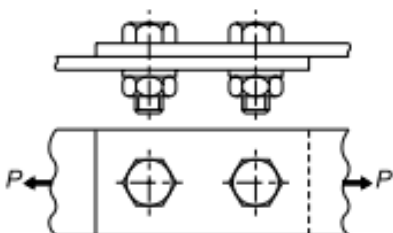
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Design of Machine Elements
Program: B.Tech (Mechatronics)
Course Code: MECH3024

Semester: V
Time : 03 hrs.
Max. Marks: 100

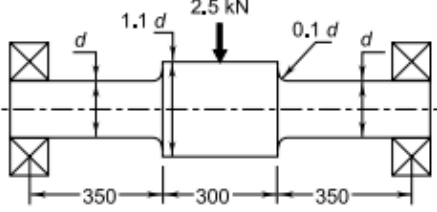
Instructions: Design Databook by K Mahadevan and K Balaveera Reddy will to be provided to students. All values need to solve design problem need to be assumed by the students.

SECTION A
(5Qx4M=20Marks)

S. No.	Statement of question	Marks	CO
Q 1	Describe various types of plain carbon steels with their applications.	4	CO1
Q 2	Explain the following steels compositions: 55C4, 25Cr4Mo2, X15Cr25Ni12, 25C12S14	4	CO1
Q 3	Define various types of fits with neat diagram.	4	CO1
Q 4	Describe the size of the bolts if two plates are fastened by means of two bolts as shown in Fig. The bolts are made of plain carbon steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 5. $P = 5 \text{ kN}$ 	4	CO3
Q 5	Explain the difference between rigid and flexible coupling.	4	CO4

SECTION B
(4Qx10M= 40 Marks)

Q 6	Design the dimension of a non-rotating shaft supporting a load of 2.5 kN is shown in Fig. 5.14. The shaft is made of brittle material, with an ultimate tensile strength of 300 N/mm ² . The factor of safety is 3.	10	CO2
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Q7	Describe stress concentration. Explain various methods to reduce the stress concentration with neat diagram.	10	CO2
Q8	Explain how the efficiency of a self-locking square threaded power screw is less than 1/2 or 50%.	10	CO3
Q9	<p>Design the length of the key if A shaft, 40 mm in diameter, is transmitting 35 kW power at 300 rpm by means of Kennedy keys of 10x10 mm cross-section. The keys are made of steel 45C8 ($S_{yt} = S_{yc} = 380 \text{ N/mm}^2$) and the factor of safety is 3.</p> <p style="text-align: center;">OR</p> <p>Explain the power wasted in friction if A 150 mm diameter shaft supporting a load of 10 kN has a speed of 1500 r.p.m. The shaft runs in a bearing whose length is 1.5 times the shaft diameter. If the diametral clearance of the bearing is 0.15 mm and the absolute viscosity of the oil at the operating temperature is 0.011 kg/m-s.</p>	10	CO4
SECTION-C (2Qx20M=40 Marks)			
Q10	Design a screw jack for a load carrying capacity of 100 kN and 0.5m lift.	20	CO3
Q11	<p>Describe the difference between full journal and partial journal bearings with neat diagram. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm². The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find : 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J / kg / °C.</p> <p style="text-align: center;">OR</p> <p>Design a spur gear if a pair of straight teeth spur gears is to transmit 20 kW when the pinion rotates at 300 r.p.m. The velocity ratio is 1 : 3. The allowable static stresses for the pinion and gear materials are 120 MPa and 100 MPa respectively. The pinion has 15 teeth and its face width is 14 times the module. Determine : 1. module; 2. face width; and 3. pitch circle diameters of both the pinion and the gear from the standpoint of strength only, taking into consideration the effect of the dynamic loading. Take $C_v = 3/(3+v)$, where v is expressed in m / s.</p>	20	CO4