Name: **Enrolment No:** **Roll No.**	UPES UNIVERSITY WITH A PURPOSE

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

Course: Design of Machine Elements **Semester: VIth Sem**
Program: B.Tech. Mechanical **Time 04 hrs.**
Course Code: MECH3001 **Max. Marks: 100**

Instructions:
1. Use of Design Data Handbook is allowed during the examination.
2. Assume the suitable data and mention in solution at start.
3. Draw the necessary diagrams.

Note:

1. Read the instruction carefully before attempting.

2. This question paper has 2 Sections: **Section A and Section B**.

3. There are total 4 questions of Scan and upload type in **Section A /B .**

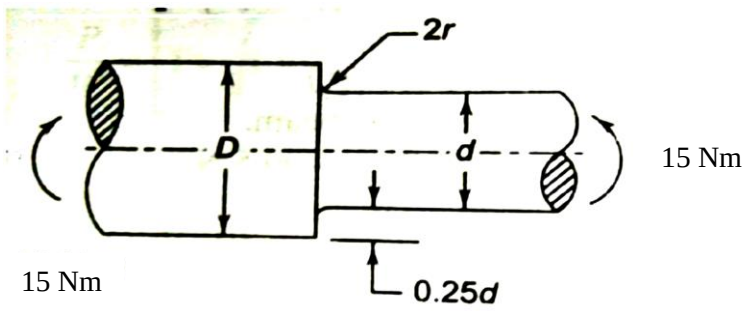
4. **Both the sections** consist of design problems related to machine components.

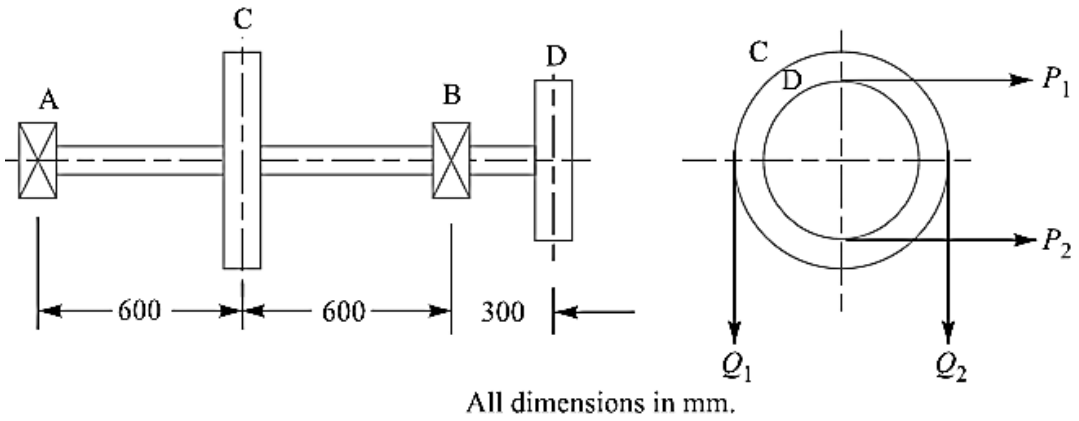
5. **A is last 2 digits of your roll no. i.e if Power is given by equation (20 +0.1 x A). If last two digits of roll no. is 10 then power to be used as (20+0.1 x 10)= 21 kW.**

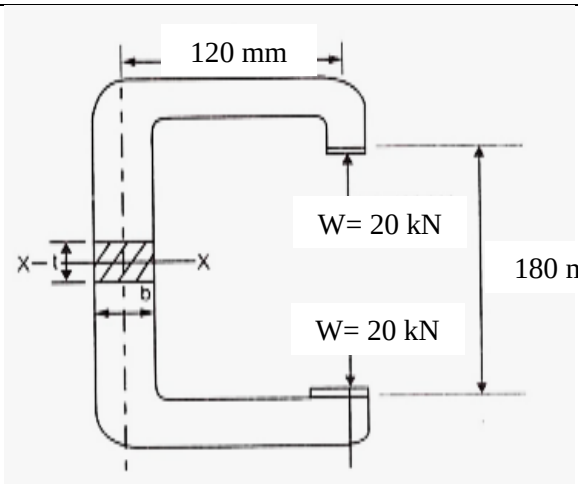
6. **Examination** will be conducted online on CODETANTRA platform.

7. Write the answer over A4 sheet and mention clearly the page number at the top. After the completion of the Section A and B , scan and upload online through CODETANTRA platform.

Section – A (Attempt all the questions)

S. No.	Statement of question	Marks	CO
	SECTION A		
Q 1	(a) A round shaft made of a brittle material and subjected to a bending moment of 15 N-m is shown in figure. The stress concentration factor at the fillet (fillet radius is indicated as **2r** means it is 2 mm) is 1.5 and the ultimate strength of the shaft material is 200 N/mm^2. Determine the diameter d, the magnitude of stress at the fillet and Factor of safety.  	**5**	**CO2**

	(b)A horizontal shaft AD supported in bearings at A and B and carrying pulleys at C and D is to transmit ($20+\frac{A}{10}$) kW at 600 r.p.m. from drive pulley D to off-take pulley C, as shown in Fig. Calculate the diameter of shaft. The data given is : $P_1 = 3\ P_2$ (both horizontal), $Q_1 = 2\ Q_2$ (both vertical), radius of pulley C = 200 mm, radius of pulley D = 150 mm. Design the shaft by using the ASME. Assume the suitable data from Design data handbook.  All dimensions in mm.	**15**	**CO2**
Q 2	Design a riveted Joint in which the pitch of the rivets in the outer row is twice that in the inner rows. Diameter of boiler shell is **(1600+ 10 x A)** mm and is subjected to internal pressure of 2.0 N/mm ^{2}. Consider the working stresses as σ_t = 90 MPa in tension, σ_c = 135 MPa in compression, and τ = 60 MPa in shear for the joint. **OR** Determine the dimension of flange coupling that connect a motor and a pump shaft. The power to be transmitted a (**20 +0.1 x A**) kW at a shaft speed of 1000 rpm. Select suitable materials for the components of the couplings and list the dimensions with help of suitable diagram.	**20**	**CO3**
	Section B		
Q 3	(a) Design ‘‘C’’ clamp frame for a total clamping force of 20 kN. The cross-section of the frame is rectangular and width to thickness ratio is 2. The distance between the load line and natural axis of rectangular cross section is 120 mm and the gap between two faces is 180 mm. The frame is made of cast steel for which maximum permissible tensile stress is 100 N/mm^2	**5**	**CO1**



(b) Design a pair of spur gear for following data to transmit $(12+\frac{A}{10})$ kW of power available at pinion for speed reduction ratio of **3: 1**; Speed of pinion may be considered as 900 rpm.

25 **CO4**

Detail	***Pinion***	***Gear***
Material	Semi Steel	Cast Iron
Design Stress	84 MPa	56 Mpa
BHN	200	160
Speed	900	300
Tooth Profile	20^0	20^0
σ_{en}	170 MPa	84 MPa
Modulus of Elasticity	210 GPa	100 GPa
BHN	200	160
Centre distance	Assume in range of 200 to 300 mm.	

Check the gear for dynamic loading and make the conclusions after calculation of BHN .

Q 4

(a) Select a suitable ball bearing (Deep groove ball bearing) for the spindle of a drilling machine rotating at 1200 rpm. The radial load of (**3000+10 x A**)N and a thrust load of (**2000+10 x A**)N is available at bearing. The machine is to work for 8 hours/day for a service life of 6 years. Suggest the diameter of spindle for which bearing can be used.

15 **CO2/CO4**

(b) Design a journal bearing for following data used for **steam turbine** application ;
Load W= (**15+0.1 x A**) kN
Journal speed =1440 rpm
Assume following :

Journal diameter or l/d ratio to maintain the pressure as recommended for the application **(here steam turbine),** other relevant data (Lubricating oil and operating temperature) and design completely the journal bearing by maintaining the hydrodynamic lubrication conditions. Make the conclusions if any.

15 **CO2/CO4**

Fig : Viscosity Vs Temperature Diagram for Lubricating Oils (Journal Bearing)
Q.No.4 (b)