Name: **Enrolment No:**	

UPES Dehradun
End Semester Examination, May 2023

Course: Design of Machine Element **Semester: VI**
Program: B.Tech (Mechanical Engineering) **Time : 03 hrs.**
Course Code: MECH3001 **Max. Marks: 100**

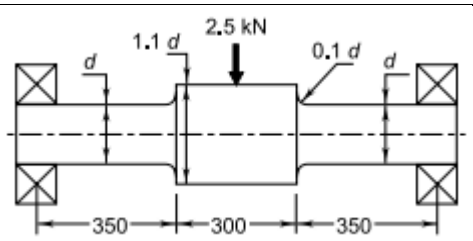
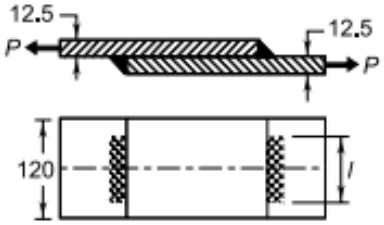
Instructions: Design Databook by K Mahadevan and K Balaveera Reddy will to be provided to students. All values need to solve design problem need to be assumed by the students.

SECTION A
(5Qx4M=20Marks)

S. No.	Statement of question	Marks	CO
Q 1	Explain maximum principal stress theory.	**4**	**CO1**
Q 2	It is required to design a square key for fixing a gear on a shaft of 30 mm diameter. The shaft is transmitting 15 kW power at 720 rpm to the gear. The key is made of steel 50C4 (Syt = 460 N/mm2) and the factor of safety is 3. For key material, the yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key.	**4**	**CO1**
Q 3	Describe the difference between rigid coupling and flexible coupling.	**4**	**CO4**
Q 4	Define clutch. Desribe the difference between single plate and multiplate clutch.	**4**	**CO1**
Q 5	A multi-disck clutch consisting of five steel plates and four bronze plates. The inner and outer diameters of the frinction disks are 75 and 150mm respectively. The coefficient of friction is 0.1 and the intensity of pressure on friction lining is limited to 0.3N/mm2. Assuming uniform wear theory, calculate the required force to engage the clutch and power transmitting capacity at 750rpm.	**4**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A non-rotating shaft supporting a load of 2.5 kN is shown in Fig. The shaft is made of brittle material, with an ultimate tensile strength of 300 N/mm^2. The factor of safety is 3. Determine the dimensions of the shaft.	**10**	**CO2**

			
Q 7	The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 r.p.m. Determine the following : Length of the bearing if the allowable bearing pressure is 1.6 N/mm2, and Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm.	**10**	**CO4**
Q8	Two steel plates, 120 mm wide and 12.5 mm thick, are joined together by means of double transverse fillet welds as shown in Fig. 8.10. The maximum tensile stress for the plates and the welding material should not exceed 110 N/mm^2. Find the required length of the weld, if the strength of weld is equal to the strength of the plates. 	**10**	**CO3**
Q9	A triple threaded worm has teeth of 6 mm module and pitch circle diameter of 50 mm. If the worm gear has 30 teeth of 14½° and the coefficient of friction of the worm gearing is 0.05, find 1. the lead angle of the worm, 2. velocity ratio, 3. centre distance, and 4. efficiency of the worm gearing. **OR** Define beam strength of the gear. Write a short note on the properties of gear materials.	**10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q10	A helical compression spring, made of circular wire, is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the defl ection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold-drawn steel wire with ultimate tensile strength of 1050 N/mm2 and modulus of rigidity of 81370 N/mm2. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate:	**20**	**CO2**

	(i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) total number of coils; (v) solid length of the spring; (vi) free length of the spring; (vii) required spring rate; and (viii) actual spring rate		
Q11	The nominal diameter of a triple threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having an outer diameter of 100 mm and inner diameter as 65 mm. The coefficient of friction at the thread surface as well as at the collar surface can be taken as 0.15. The screw is used to raise a load of 15 kN. Using the uniform wear theory for collar friction, calculate: (i) torque required to raise the load; (ii) torque required to lower the load; and (iii) the force required to raise the load, if applied at a radius of 500 mm. **OR** Define Nipping and derive the expression for nipping.	**20**	**CO3**