Name:

Enrolment No:

UPES UNIVERSITY OF TOMORROW

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

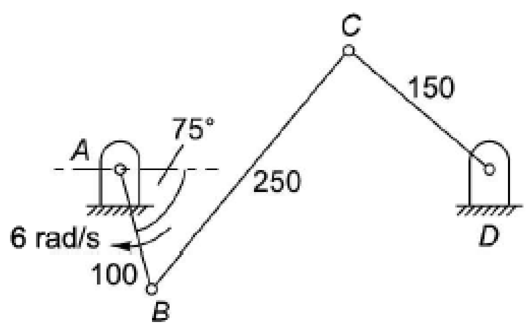
Course: Theory of Machines — **Semester: V**
Program: B.Tech – Mechanical — **Time: 03 hrs.**
Course Code: MECH 3031 — **Max. Marks: 100**

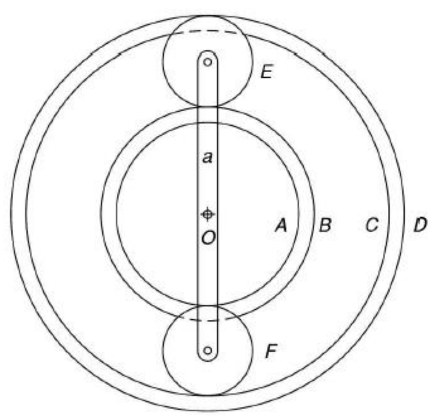
Instructions: Assume suitable data. Attempt graphical questions on A3 sheets provided.

SECTION A
(5Qx4M=20Marks)

S. No.		**Marks**	**CO**
Q 1	Define the terms circular pitch, module, addendum and dedendum as applicable to gears.	**4**	**CO1**
Q 2	Differentiate between lower and higher pairs with suitable example.	**4**	**CO1**
Q 3	Explain the reason for preferring uniform wear theory over uniform pressure theory for design of clutch.	**4**	**CO1**
Q 4	Discuss different types of followers according to shape.	**4**	**CO1**
Q 5	Explain different kinematic pairs according to nature of mechanical constraints	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20°. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, determine the (i) Contact ratio (ii) Angle of action of the pinion and the gear wheel	**10**	**CO3**
Q 7	For the four-link mechanism shown in figure below, determine the angular velocities of the links BC and CD using I-centre method. Take AD = 300 units.  	**10**	**CO2**
Q 8	A single-plate clutch transmits 25 kW at 900 rpm. The maximum pressure intensity between the plates is 85 kN/m^2. The outer diameter of the plate is 360	**10**	**CO3**

	mm. Both sides of the plate are effective, and the coefficient of friction is 0.25. Determine the (i) inner diameter of the plate (ii) axial force to engage the clutch **OR** Derive the expression for ratio of friction torques for a flat belt drive with usual notations.		
Q 9	Design a four-link mechanism to coordinate three positions of the input and the output links for the following angular displacements $\theta_{12} = 60°$ $\varphi_{12} = 30°$ $\theta_{13} = 90°$ $\varphi_{13} = 50°$	**10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	Lay out the profile of a cam so that the follower • is moved outwards through 30 mm during 180º of cam rotation with SHM • dwells for 20º of the cam rotation • returns with uniform velocity during the remaining 160º of the cam rotation The base circle diameter of the cam is 28 mm and the roller diameter is 8 mm. The axis of the follower is offset by 6 mm to the left.	**20**	**CO4**
Q 11	In the epicyclic gear train shown in figure below, the compound wheels *A* and *B* as well as internal wheels *C* and *D* rotate independently about the axis *O*. The wheels E and F rotate on the pins fixed to the arm *a*. All the wheels are of the same module. The number of teeth on the wheels are $T_A = 52$, $T_B = 56$, $T_E = T_F = 36$ Determine the speed of *C* if (i) the wheel *D* fixed and the arm *a* rotates at 200 rpm clockwise (ii) the wheel *D* rotates at 200 rpm counterclockwise and the arm *a* rotates at 20 rpm counterclockwise  **OR** A pinion of 20º involute teeth rotating at 275 rpm meshes with a gear and provides a gear ratio of 1.8. The number of teeth on the pinion is 20 and the module is 8 mm. if the interference is just avoided, determine (i) the addenda on the wheel and the pinion, (ii) the path of contact, and (iii) the maximum velocity of sliding on both sides of the pitch point.	**20**	**CO3**