Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Theory of Machine **Semester :IV**

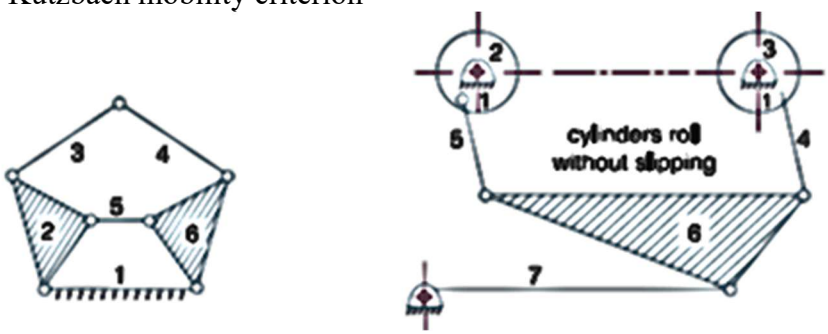
Program: B.Tech Automotive **Time : 03 hrs.**

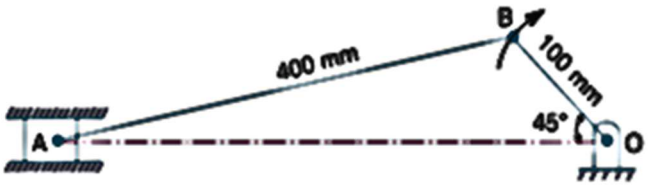
Course Code: MECH2083 **Max. Marks: 100**

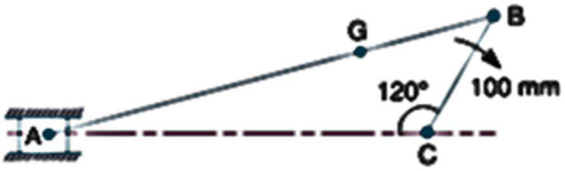
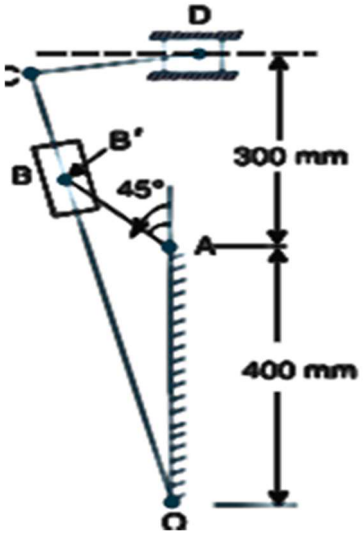
Instructions:

1. **The Question paper has three sections: Section A, B and C.**
2. **Section B and C have internal choices.**
3. **Assume the suitable data if needed**

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Determine the mobility (degrees of freedom) of the mechanism shown in Fig. using Kutzbach mobility criterion 	**4**	**CO1**
2	Identify the kinematic chains to which the following mechanisms belong 1. Steam engine mechanism 2. Beam engine 3. Whitworth quick return motion mechanism 4. Elliptical trammels	**4**	**CO2**
3	Classify the different types of Gear with potential applications.	**4**	**CO3**
4	Differentiate between various types of followers based on surface contact.	**4**	**CO2**
5	Describe with a neat sketch the working of a single plate friction clutch.	**4**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
6	Derive an expression for the magnitude and direction of coriolis component of acceleration.	**10**	**CO2**

7	Locate all the instantaneous centres of the slider crank mechanism as shown in Fig. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find Angular velocity of the connecting rod AB.  	**10**	**CO3**
8	A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000 r.p.m. Determine sliding velocities at engagement and at disengagement of pair of a teeth, and contact ratio.	**10**	**C04**
9	Calculate the power transmitted by the multiplate clutch has three pairs of contact surfaces. The outer and inner radii of the contact surfaces are 100 mm and 50 mm respectively. The maximum axial spring force is limited to 1 kN. If the coefficient of friction is 0.35 and assuming uniform wear, at 1500 r.p.m. **OR** A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 100 kW at 2400 r.p.m. and maximum torque 500 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plate is not to exceed 0.07 N/mm2. The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N /mm, determine the initial compression in the springs and dimensions of the friction plate.	**10** **10**	**C03**
SECTION-C (2Qx20M=40 Marks)			
10	A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below 1. To raise the valve through 50 mm during 120° rotation of the cam 2. To keep the valve fully raised through next 30°; 3. To lower the valve during next 60° and 4. To keep the valve closed during rest of the revolution i.e. 150° The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft, and The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the	**20**	**CO4**

	valve rod when the cam shaft rotates at 100 r.p.m. Draw the displacement, the velocity and the acceleration diagrams for one complete revolution of the cam.		
11	An engine mechanism is shown in fig The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s2. Find a. velocity of G and angular velocity of AB, and b. acceleration of G and angular acceleration of AB.  OR A mechanism of a crank and slotted lever quick return motion is shown in Fig. If the crank rotates counter clockwise at 120 r.p.m., determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Crank, AB = 150 mm ; Slotted arm, OC = 700 mm and link CD = 200 mm. 	**20**	**C03**