Name: **Enrolment No:**	

UPES

End Semester Examination, May 2023

Course: Theory of Machines **Semester: IV**

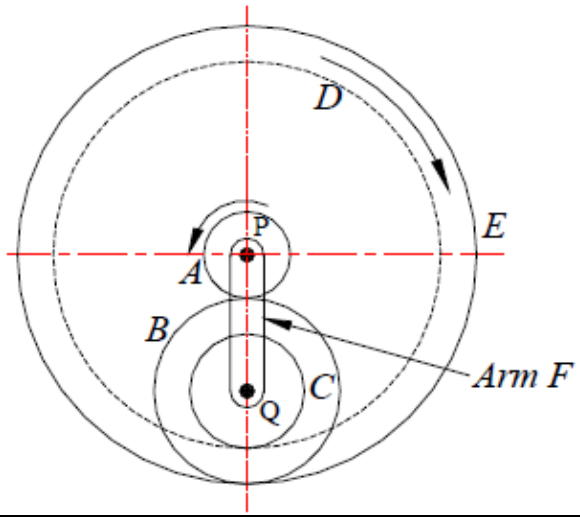
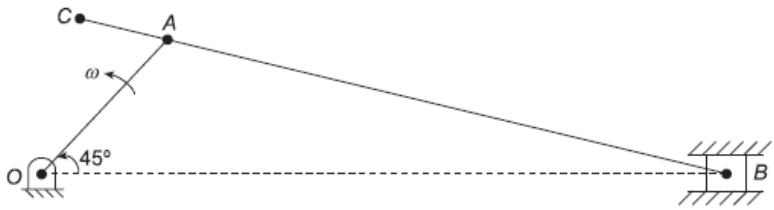
Program: B.Tech – Mechatronics **Time: 03 hrs.**

Course Code: MECH 2013 **Max. Marks: 100**

Instructions: Assume suitable data. Attempt graphical questions on A3 sheets provided. Q 9 and Q 11 have internal choices.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain the term undercutting as applicable to gears.	**4**	**CO1**
Q 2	Differentiate between Whitworth quick return mechanism and Crank and Slotted lever mechanism.	**4**	**CO1**
Q 3	Explain in brief the application of cam and follower arrangement in any three machines.	**4**	**CO1**
Q 4	Discuss different follower according to shape.	**4**	**CO1**
Q 5	Explain Coriolis acceleration component with examples of mechanisms where it is applicable.	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	The addendum on each wheel of two mating gears is to be such that the line of contact on each side of the pitch point is half the maximum possible length. The number of teeth on the two gears is 24 and 48. The teeth are of 20^{o} pressure angle involute with a module of 12 mm. Determine the addendum for the pinion and the gear. Also, determine the arc of contact and contact ratio.	**10**	**CO3**
Q 7	Each wheel of a four-wheeled rear engine automobile has a moment of inertia of 2.2 kg.m^2 and an effective diameter of 600 mm. The rotating parts of the engine have a moment of inertia of 1.25 kg.m^2. The gear ratio of the engine to the back wheel is 3.2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The mass of the vehicle is 2050 kg and the centre of the mass is 520 mm above the road level. The track width of the vehicle is 1.6 m. Determine the limiting speed of the vehicle around a curve with 120 m radius so that all the four wheels maintain contact with the road surface.	**10**	**CO3**
Q 8	In a compound epicyclic gear train as shown in the figure, gear A and an annular gears D & E are free to rotate on the axis P, B and C is a compound gear rotate about axis Q. Gear A rotates at 90 rpm CCW and gear D rotates at 450 rpm CW. Determine the speed and direction of rotation of arm F and gear E. Gears A, B	**10**	**CO4**

	and C are having 18, 45 and 21 teeth respectively. All gears have same module and pitch.  		
Q 9	For the slider-crank mechanism shown in figure below, determine the velocity of the point C on the link AB when the crank OA rotates at 180 rpm counterclockwise. OA = 500 mm, AB = 1500 mm and AC = 250 mm.  **OR** 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	Use the following data and draw the profile of a cam in which a radial knife edge follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion: Least radius of cam = 60 mm Lift of follower = 45 mm Angle of ascent = 60° Angle of dwell between ascent and descent = 40° Angle of descent = 75° If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent.	**20**	**CO4**
Q 11	A rotor has the following properties: Mass | Magnitude | Radius | Angle | Axial Distance from 1st mass 1 | 9 kg | 100 mm | 0° |	**20**	**CO3**

2	7 kg	120 mm	60º	160 mm
3	8 kg	140 mm	135º	320 mm
4	6 kg	120 mm	270º	560 mm

If the shaft is balanced by two counter-masses located at 100 mm radii and revolving in planes midway of planes 1 and 2, and midway of 3 and 4, determine the magnitude of the masses and their respective angular positions. Justify your answer by graphical method.

OR

Differentiate between static and dynamic balancing of rotating masses.

Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90º and 210º respectively with that of mass B in the counterclockwise direction. The rotating masses have the following properties-

$m_b = 15$ kg $\quad r_a = 360$ mm

$m_c = 25$ kg $\quad r_b = 480$ mm

$m_d = 20$ kg $\quad r_c = 240$ mm

$r_d = 300$ mm

Planes B and C are 250 mm apart. Determine the mass A and its angular position with that of mass B. Also find the positions of all the planes relative to plane of mass A.

5+15 **CO3**