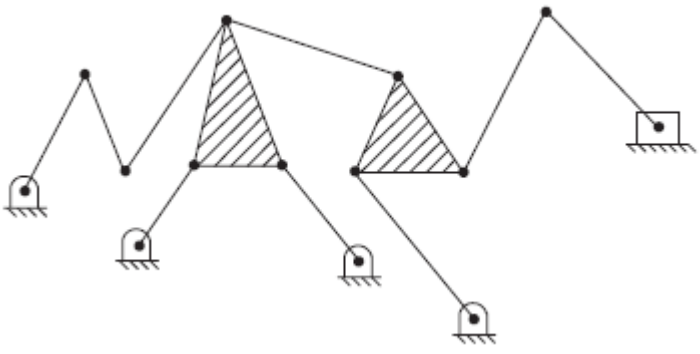
Name: **Enrolment No:**	**UPES SAP ID:**

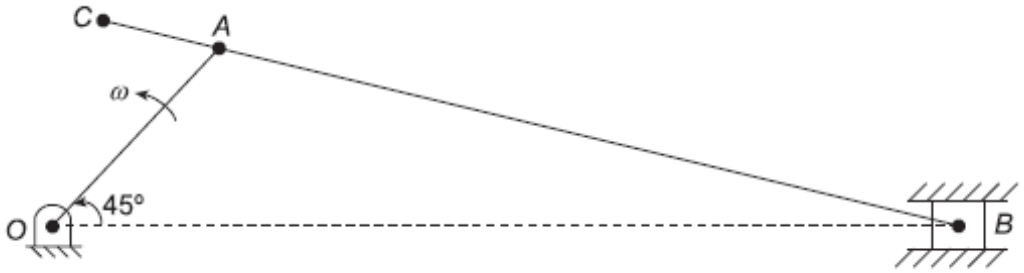
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, December, 2020

Course: Theory of Machines **Semester: V**
Program: B. Tech – Mechatronics **Time: 3 hours**
Course Code: MECH3019 **Max. Marks: 100**
No. of Pages: 03

Note: The paper consists of 3 sections A, B and C. All questions are compulsory.

Section A

Q1.	Explain the term undercutting as applicable to gears	**5**	**CO1**
Q2.	Define following terms: a. Kinematic Mechanism b. Kinematic chain	**5**	**CO1**
Q3.	Explain application of gyroscopic couple and its effect in two situation discussed below (write in brief -60 words) a. While an airplane or ship negotiating a turn there might be excessive turn that need to control by some device, called as gyroscopic stabilizer. So in this case how this stabilizer helps to stabilize the airplane or ship. b. While a two wheeler negotiating a turn, it is subjected by centrifugal and gyroscopic couple. So how rider keeping his/her motorbike under stable condition.	**5**	**CO1**
Q4.	Determine the Degrees of Freedom (DOF) of the mechanism as shown in Fig 1:  Fig 1: Mechanism	**5**	**CO2**
Q5.	Explain in brief role of cam and follower arrangement in automated machines and IC engines.	**5**	**CO1**

Q6.	Explain Coriolis acceleration component, give names of machines where it needs to be calculated.	**5**	**CO1**
	Section B		
Q7.	For the slider-crank mechanism shown in Fig. 2, 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.  Fig. 2: Crank-slider mechanism	**10**	**CO2**
Q8.	Consider the data given in Q7 and determine the accelerations of the point C and slider B.	**10**	**CO2**
Q9	A motor cycle with its rider has a mass of 300 kg. The centre of gravity of the machine and rider combined being 0.6 m above the ground with machine in vertical position. Moment of inertia of each wheel is 0.525 kg m^2 and the rolling diameter of 0.6 m. The engine rotates 6 times the speed of the road wheels and in the same sense. The engine rotating parts have a mass moment of inertia of 0.1686 kg m^2. Find (i) the angle of heel necessary if the vehicle is running at 60 km/hr round a curve of 30 m (ii) If the road and tyre friction allow for the angle of heel not to exceed 50°, what is the maximum road velocity of the motor cycle.	**10**	**CO3**
Q10.	The four masses A, B, C and D are 100 kg, 150 kg, 120 kg and 130 kg attached to a shaft and revolve in the same plane. The corresponding radii of rotations are 22.5 cm, 17.5 cm, 25 cm and 30 cm and the angles measured from A are 45°, 120° and 255°. Find the position and magnitude of the balancing mass, if the radius of rotation is 60 cm.	**10**	**CO2**
Q11.	In a compound epicyclic gear train as shown in the figure 3, has gears 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. Analyze the sense of rotation and speed of rotation of arm F and gear E. Gears A, B and C are having 18, 45 and 21 teeth respectively. All gears having same module and pitch.	**10**	**CO3**

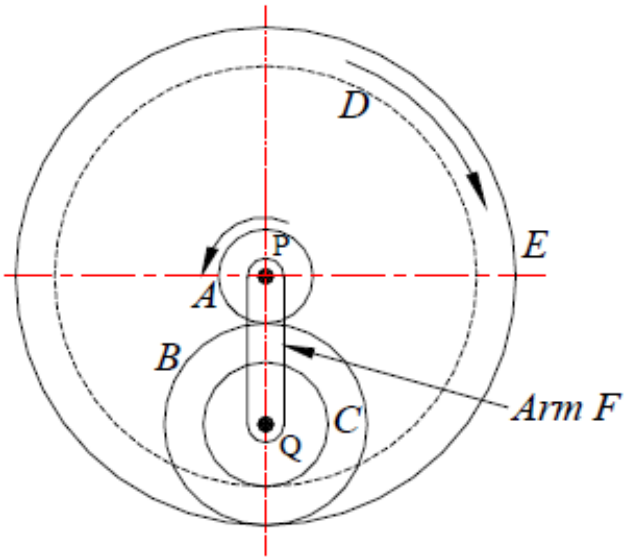


Fig 3: Epicyclic Gear Train

Section C

Q12.	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: Use the following data: 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° **OR** Draw the profile of the cam when the roller follower moves with cycloidal motion as given below: (a) Outstroke with maximum displacement of 44 mm during 180° of cam rotation. (b) Return stroke for the next 150° of cam rotation. (c) Dwell for the remaining 30° of cam rotation. The minimum radius of the cam is 20 mm and the diameter of the roller is 10 mm. The axis of the roller follower passes through the cam shaft axis.	**20**	**CO3**