UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Program: B. Tech.   ADE   **Semester-IV**
Course: Mechanics of Vehicle and Machines   **Course Code: MEAD 2008**
Max. Marks: 100   **Time:03 Hours**
Instructions: Attempt all sections.

	SECTION A		**(5x4 = 20 marks)**

Instructions: Answer all questions @ 4 marks

| Q 1	A. Define the Grubler's criterion for degree of freedom of plane mechanism. B. Explain the difference between higher pairs and lower pairs.	2+2	CO1
Q 2	If the motion of follower can be defined as following equation $$s = \frac{h}{2}\left(1 - cos\,\frac{\pi\theta}{\varphi}\right).$$ Where h maximum follower displacement, θ cam instantaneous rotation angle in radian. s follower instantaneous displacement, φ cam rotation angle for the maximum follower displacement. Derive the velocity term of follower and explain the type of follower motion, if cam rotates with constant angular speed ω.	4	CO4
Q 3	The number of teeth of spur gear is 30 and it rotates at 200 rpm. What will be its circular pitch and the pitch line velocity if it has a module of 2 mm.	4	CO2
Q 4	State the Kennedy's theorem.	4	CO3
Q 5	A. Define the addendum and dedendum in gear. B. Define the pressure angle in cams.	2+2	CO3

	SECTION B		**(4x10 = 40 marks)**

Instructions: Answer all questions @ 10 marks

Q 6	Explain with help of suitable sketches the inversion of slider crank chain mechanism	10	CO1
Q 7	An epicyclic gear train consists of three gears A, B, C as shown in figure. Gear A has 72 internal teeth and gear C has 32 external teeth. Gear B meshes with both A	10	CO3

and C and is carried on an arm EF which rotates about the center of A at 18 rpm, If the gear A is fixed, determine the speed of gears B and C.
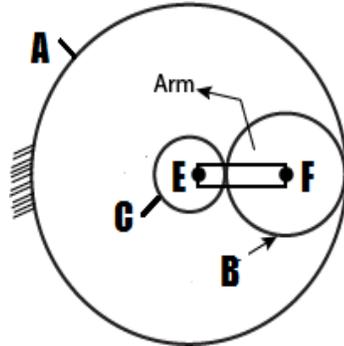
OR

A cam rotating clockwise at a uniform speed of 1000 rpm is required to give a knife edge follower the motion defined as below:

Follower to move outwards through 50 mm during $120°$ of cam rotation and further followed $60°$ dwell of cam rotation.

Follower to return to its starting position during next $90°$ of cam rotation and further followed dwell for the rest of cam rotation.

The minimum radius of cam is 50 mm and diameter of roller 10 mm. if the displacement of the follower takes place with cycloidal motion on both the outward and return strokes. Find the maximum velocity and acceleration during out and return stroke.

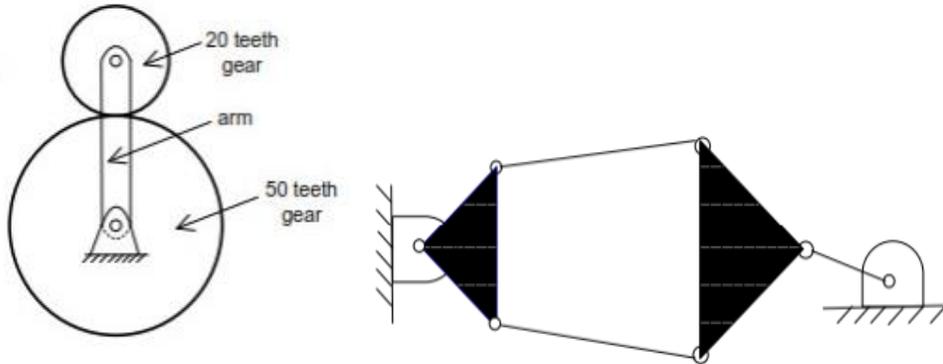|			
Q 8	Four masses m_1=200 kg, m_2= 300 kg, m_3= 240 kg and m_4= 260 kg, with their corresponding radii of rotation r_1= 0.2 m, r_2= 0.15m, r_3= 0.25 m and r_4= 0.3 m respectively are placed in system. The angle between successive masses are $45°$ (m_1 and m_2), $75°$ (m_2 and m_3) and $135°$ (m_3 and m_4). Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.	**10**	**CO3**
Q 9	A. A planar closed kinematic chain is formed with rigid links PQ = 2.0 m, QR = 3.0 m, RS = 2.5 m and SP = 2.7 m with all revolute joints. The link to be fixed to obtain a double rocker (rocker-rocker) mechanism is … B. Estimate degree of freedom of following mechanism	**2+8**	**CO2**

Labels in figure: 20 teeth gear, arm, 50 teeth gear

	SECTION C	**(2x20 = 40 marks)**	
Instructions: Answer all questions @ 20 marks			
Q 10	In a slider crank mechanism, the crank is 480 mm long and rotates at 20 rad/s in the counter clockwise direction. The length of the connecting road is 1.6 m. when the crank turns $60°$ from the inner dead center. Using graphical method **OR** analytical method **OR** instantaneous method, determine the (i) Velocity of slider (ii) Angular velocity of connecting rod (iii) Velocity of point E located at a distance 450 mm on the connecting rod extended. (iv) Also locate the I center of given mechanism with suitable scaling parameter.	20	CO2
Q 11	A. Draw the profile of a cam operating a roller follower (radius 7.5 mm) having a lift of 30 mm. The motion of cam and follower is given below. (i) The cam raises the follower with uniform acceleration for $150°$ of the rotation. Which is followed by a period of dwell for $60°$ (ii) The follower descends for the next $100°$ of the cam with uniform acceleration and again followed by dwell. B. Also Find out the maximum velocity and uniform acceleration of the follower during the ascent and descent motion. **OR** A. Drive the expression for the minimum number of teeth on a gear to avoid interference between gears.	10+10	CO4

| | | B. Two 20° involute spur gears mesh externally and give a velocity ratio of 3. The module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine the minimum number of teeth on each wheel to avoid interference and contact ration for both gear. | | |