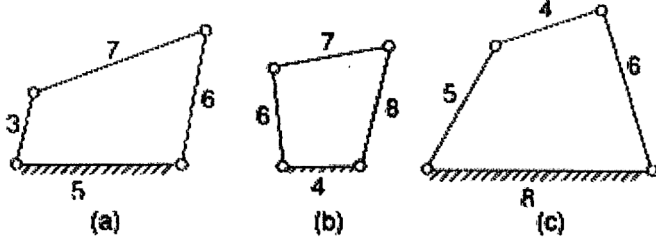# B.E. MECHANICAL ENGINEERING SECOND YEAR SECOND SEMESTER – 2023
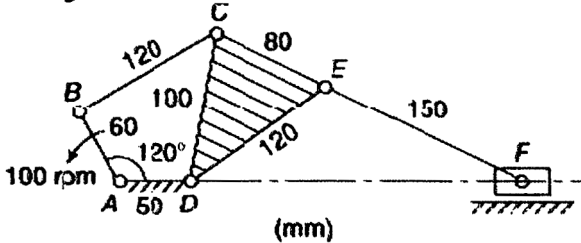
KINEMATIC ANALYSIS AND SYNTHESIS
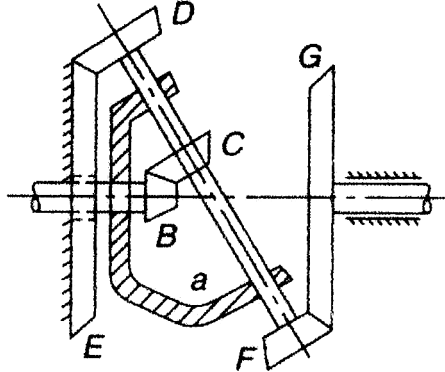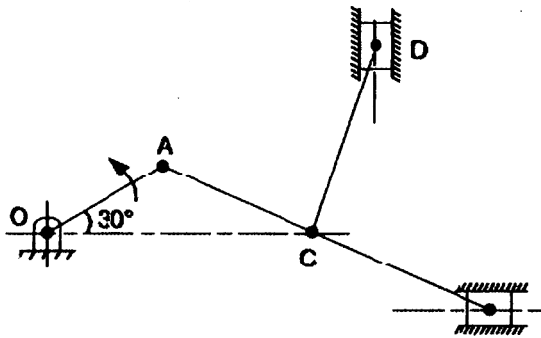
Time : 3hrs   Full Marks : 100

Answer Question No. 1 and any 4 from the rest

1.		**Answer any 6 from following**	36
	(i)	How are the Whitworth quick-return mechanism and crank and slotted-lever mechanism different from each other?	6
	(ii)	Discuss various types of constrained motion. What is redundant degree of freedom of a mechanism?	4+2
	(iii)	Figure shows some 4–bar link mechanisms in which the figures indicate the dimensions in standard units of length. Indicate the type of each mechanism, shown in the figures.	6
	(iv)	Explain the occurance of Coriolis acceleration with proper sketch? How do you determine its magnitude and direction?	6
	(v)	Explain with sketch the function of differential gear box used in an automobile?	6
	(vi)	How can we esure that a Tchebicheff mechanism traces an approximate straight line?	6
	(vii)	Explain steering mechanism with sketch.	6
	(viii)	What is pressure line and pressure angle of a gear? State and drive the law of gearing.	6
	(ix)	The displacement diagram of a cam is $y = 10\,L\,(\beta/\theta)^3 - 15\,L\,(\beta/\theta)^4 + 6\,L\,(\beta/\theta)^5$. Find out the displacement, velocity and acceleration at $\theta = 0$ and $\theta = \beta$.	6
		Answer any 4 from following	
2.		Determine the velocities of the points C, E and F and the angular velocities of the lnks BC, CDE and EF shown in this figure Q2.	16

Figure Q2

| 3. | | Determine a suitable train of wheels to satisfy the requirements of a clock, the minute hand of which is fixed to a spindle and the hour hand to a sleeve rotating freely on the same spindle. The pitch is the same for all the wheels and each wheel has at least 11 teeth. The total number of teeth should be as small as possible. | 16 |

4.	(a)	What are centripetal and tangential components of acceleration? When do they occur? How are they determined?	6
	(b)	Figure Q4 below shows a train of bevel gear. The wheel E is fixed whereas the wheels B and G are keyed to the driving and driven shafts respectively. The wheels C, D and F are keyed to the inclined shaft which is supported on the arm a. The arm is free to rotate about the common axis of the driving and driven shafts. The number of teeth on the wheels B, C, D, E, F and G are 15, 45, 45, 135, 40 and 100, respectively. Find the ratio of the driving and driven shaft speeds. **Figure Q4**	10
5.		Design a 4-bar link mechanism to coordinate three positions of the input and the output lnks given by $\theta_1 = 25°$ $\varphi_1 = 30°$ $\theta_2 = 35°$ $\varphi_2 = 40°$ $\theta_3 = 50°$ $\varphi_3 = 60°$ Compare with relative pole method and Inversion method.	16
6.		A tanget cam with straight working faces is tangential to a base circle of 80 mm diameter. Itoperates a roller follower of 32 mm diamter. The lie of srtoke of the follower passes through the axis of the cam. The nose circle radious of the cam is 10 mm and the angle between the ta of the tangential face of the cam is $90°$. If the speed of the cam is 315 rpm, detrmine the acceleration of the follower when (a) during the lft, the roller just leaves the straight flank, and (b) the roller is at the outer end of its lift, i.e., at the top of the nose.	16
7.		The dimensions of the various links of a mechanism as shown in Figure below, are: OA = 80 mm ; AC = CB = CD = 120 mm If the crank OA rotates at 150 r.p.m. in the anticlockwise direction, find, for the given configuration: (a) velocity and acceleration of B and D ; (b) rubbing velocity on the pin at C, if its diameter is 20 mm ; and (c) angular acceleration of the links AB and CD. 	16