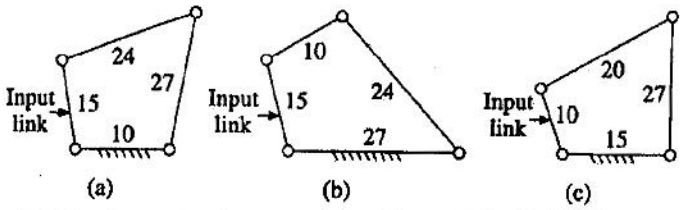
B.E. MECHANICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAM 2018

Subject: **KINEMATIC ANALYSIS AND SYNTHESIS**

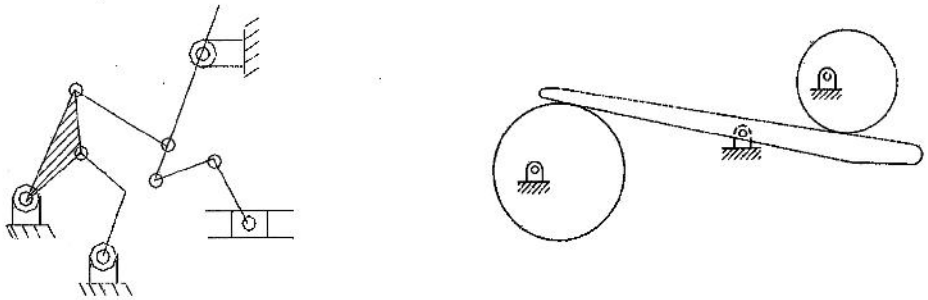
Time : Three hours **Full Marks: 100**

Different parts of the same question should be answered together.

CO1 [20]	[1] Describe the following terms in short (any four): [5x4] (i) Toggle mechanism (ii) Steering mechanism (iii) Geneva wheel (iv) Quick return mechanism (v) Straight line mechanism (vi) Elliptical trammel
CO2 [20]	[2] Answer any one from (a) and (b) in this block. (a) (i) Find out the cases shown in Fig. 6 where input link can make a complete rotation. The number indicates the link length.

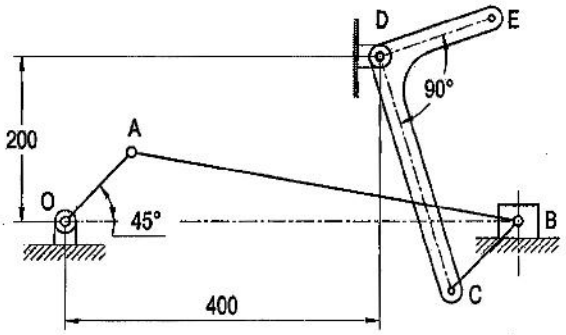


(ii) Find out the degree of freedom of the following mechanisms.

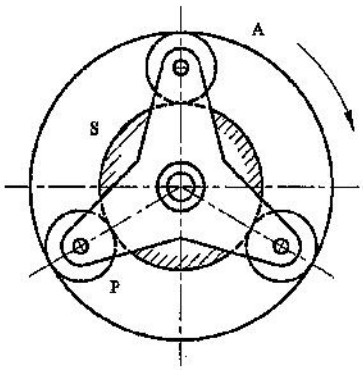


[12+8]

(b) The various dimensions of the mechanism, as shown in figure below, are OA=120mm, AB=500mm, BC=120mm, CD=300mm and DE=150mm. the crank OA rotates at 150 rpm in CCW direction. The bell crank leaver is DE. Determine the absolute velocity of point E. Use graphical method.



[20]

CO3 [30]	*Answer any* **three** from *this block:* [10+10+10] [3] (i) Derive the expression of minimum number of teeth on pinion spur gear of rack-pinion drive for avoiding interference. (ii) In the Figure below, annulus A is rotating at 300 rpm about an axis of the fixed wheel S which has 80 teeth. The three-armed spider is driven at 180 rpm. Determine the number of teeth required on the wheel A.  (iii) Assume the follower displacement y as a polynomial function of θ, that is, $y = Co + C_1\theta + C_2\theta_2 + C_3\theta_3 + \ldots\ldots + C_5\theta_5 + \ldots\ldots$ Satisfying the following boundary conditions, namely, y = 0, y'= 0 at θ = 0 and y = L, y' = 0 at θ = β. Find out the expression for velocity and acceleration of the follower motion. Number of constants should be compatible to the given boundary condition. (iv) The number of teeth on each of the two equal spur gears in mesh is 40. The teeth have 200 involute profiles and the module is 6mm. If the arc of contact is 1.75 times the circular pitch, find the addendum. (Iv) Draw the cam profile for the data given below: Motion of the follower= SHM during ascent and decent. Types of follower= Knife-edge. Base circle radius of the cam= 30mm. Maximum lift of the follower= 40mm. Angle of ascent, dwell, decent and dwell= 1500, 600, 900 and 600 respectively. Speed of the cam= 150rpm.
CO4 [20]	*Answer any* **one(1) from (a) and (b)** *in this block:* [4] (a) An automatic device requires generating a function $y = \log_{10} x$ in an interval of $10 \le x \le 20$ with 3 accuracy points. Assuming $\Delta\theta_2 = 75^0$ for input and $\Delta\theta_4 = 110^0$ for output, design a 4-bar linkage that can generate the function. For a length of 10 cm of the smallest link, draw the linkage you have designed. [20] (b) Describe three position synthesis of four bar linkage mechanism by comparing inversion method and relative pole method. Assume fixed link length and output link length are same for both cases. $\theta_1 = 25$ deg, $\theta_2 = 35$ deg, $\theta_3 = 50$ deg and $\varphi_1 = 30$ deg, $\varphi_2 = 40$ deg, $\varphi_3 = 60$ deg. [20]
CO5 [10]	*Answer any* **two(2)** *from this block:* [5+5] [5] Explain the following: (i) Composite homogeneous transformation matrix (ii) Classification of robot (iii) Euler angle (iv) Rotational matrix of body attach frame w.r.t OXYZ reference coordinate frame.