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**Fourth Semester B.E. Degree Examination, June/July 2013**  
**Kinematics of Machines**

Time: 3 hrs.

Max. Marks:100

**Note:1. Answer FIVE full questions, selecting at least TWO questions from each part.**  
**2. Graphical solutions may be obtained either on Graph sheets or in Answer book itself.**

**PART – A**

- 1 a. Define with suitable examples, i) Kinematic link ii) Higher pair iii) Lower pair iv) Degree of freedom. (08 Marks)
- b. Explain with the help of neat sketches the following mechanisms : i) Parallel Crank mechanism ii) Gnome Engine mechanism iii) Elliptical Trammel. (12 Marks)
- 2 a. With the help of neat sketch, explain the working principle of Crank and Slotted lever mechanism. (10 Marks)
- b. Derive the condition for the correct steering mechanism, for a four wheeled vehicle. (10 Marks)
- 3 The lengths of the links of a four bar chain are AB = 150 mm, BC = 450 mm, CD = 300 mm and AD = 525 mm. The link AD is fixed and the link AB turns with uniform angular velocity. When angle BAD is 90° and B and C are on opposite sides of AD, find the position of the point E on BC which at that instant is accelerated along BC. (20 Marks)
- 4 a. State and prove Kennedy's theorem of instantaneous centre. (06 Marks)
- b. Determine the velocity and acceleration of the piston by Klien's construction for a steam engine of following specifications. Stroke of piston = 600 mm, Ratio of length of connecting rod to crank length 5, Speed of engine 450 rpm clockwise. Position of crank - 45° with inner dead center. (14 Marks)

**PART – B**

- 5 Four bar mechanism ABCD is made up of four links pin jointed at the ends. AD is fixed link of 600 mm. Links AB, BC and CD are 300 mm, 360 mm and 360 mm respectively. At certain instant the link AB makes an angle of 60° with link AD. If the link AB rotates at an angular velocity of 10 rad/sec and an angular acceleration of 30 rad/sec<sup>2</sup>, both clockwise. Determine the angular velocity and angular acceleration of link BC and CD by complex number approach. (20 Marks)
- 6 a. Derive an expression for the minimum number of teeth on the gear wheel meshing with the pinion of involute profile to avoid interference. (08 Marks)
- b. Two mating gears have 30 and 50 involute teeth of module 12 mm and 20° pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum height, for each gear wheel, length of path of contact, arc of contact and contact ratio. (12 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 7 Compound epicyclic gear is shown in Fig. Q7. The gears A, D and E are free to rotate on the axis P. The compound gear B and C rotate together on the axis Q at the arm F. All the gears have equal pitch. The number of external teeth on the gears A, B and C are 18, 45 and 21 respectively. The gears D and E are annular gears. The gear A rotates at 100 rpm in anticlockwise direction and the gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm and the gear E. (20 Marks)

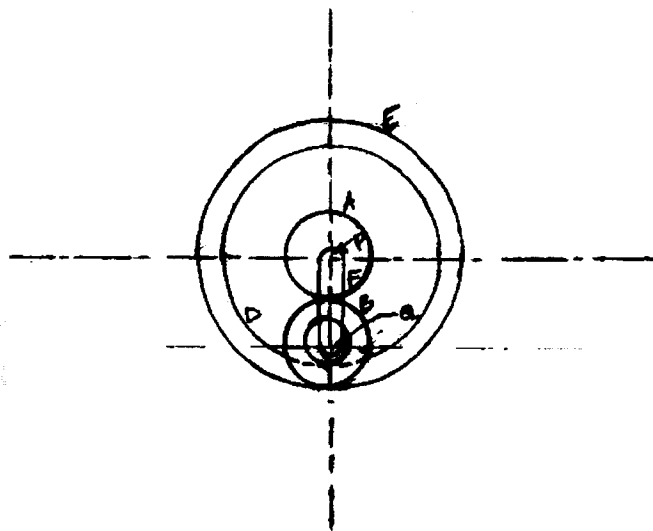


Fig. Q7

- 8 From the following data: Draw the profile of a cam in which the follower moves with simple harmonic motion during ascent while it moves with uniform acceleration and retardation motion during descent. Least radius of cam = 50 mm, Angle of ascent  $50^\circ$ , Dwell between ascent and descent =  $40^\circ$ , Angle of descent =  $60^\circ$ . Lift of follower 40 mm. Diameter of roller follower 30 mm. Distance between line of action of follower and axis of cam is 20 mm is offset. If the cam rotates at 360 rpm clockwise also find the maximum velocity and acceleration of the follower during ascent and descent. (20 Marks)

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