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17ME42

## Fourth Semester B.E. Degree Examination, Aug./Sept. 2020 Kinematics of Machinery

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

### Module-1

- 1 a. Define the following:
 

(i) Kinematic chain	(ii) Mechanism	(iii) Structure	(iv) Inversion
(v) Degree of freedom	(10 Marks)		
- b. Describe with neat figures two inversions of double slider-crank mechanism. (10 Marks)

**OR**

- 2 a. With neat sketch, explain crank and slotted lever quick return motion mechanism. (07 Marks)
- b. Draw a line diagram and explain peaucellier exact straight line mechanism. (07 Marks)
- c. The length of the fixed link of a crank and slotted lever mechanism is 250 mm and that of the crank is 100 mm. Determine (i) Angle between extreme positions of slotted lever (ii) Ratio of the time of cutting stroke to that of the return stroke. (06 Marks)

### Module-2

- 3 In the mechanism shown in Fig. Q3. The crank 2 rotates at 3000 rpm. Find the acceleration of point C in magnitude and direction. Also find the angular acceleration of link 3. OA = 50 mm, AB = 175 mm, AC = 75 mm and AB = 125 mm. (20 Marks)

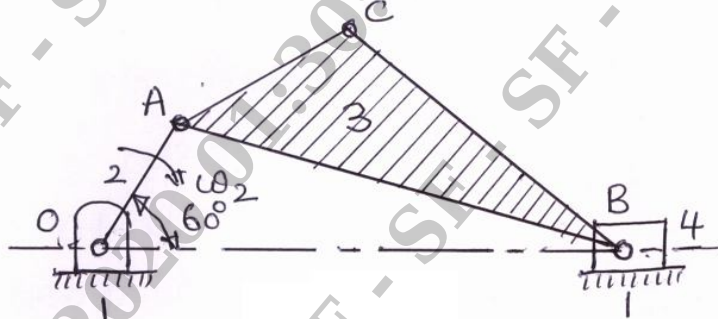


Fig. Q3

**OR**

- 4 a. State and Prove Kennedy's theorem. (06 Marks)
- b. Determine the velocity and acceleration of the piston by Klein construction to the following specification: Stroke = 300 mm, Ratio of length of connecting rod to crank radius = 4, Speed of the engine = 300 rpm, Position of crank = 45° with inner dead centre. (14 Marks)

### Module-3

- 5 The crank of an engine mechanism is 200 mm long and the ratio of connecting rod length to the crank radius is 4. Determine the acceleration of the piston when the crank has turned through an angle of 45° from the inner dead centre and rotating at a speed of 240 rpm counter clockwise direction by complex number approach. (20 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.

OR

- 6 a. Explain function generation for 4-bar mechanism. (05 Marks)  
 b. Design a 4 link mechanism, if the motion of input and output links are governed by a function  $y = x^{1.5}$  and  $x$  varies from 1 to 4. Assume  $\theta$  is vary from  $30^\circ$  to  $120^\circ$  and  $\phi$  from  $60^\circ$  to  $130^\circ$ . The length of the fixed link is 30 mm. Use Chebyshev spacing of accuracy points. (15 Marks)

Module-4

- 7 a. State and prove law of gearing. (06 Marks)  
 b. Derive an expression for path of contact. (06 Marks)  
 c. The two spur gears 19 and 47 teeth are in mesh. The module is 6.5 mm and pressure angle is  $20^\circ$ . Determine the number of pair in contact and the angle turned by the larger gear when one pair of teeth in contact. (08 Marks)

OR

- 8 a. Explain reverted gear train with neat figure. (05 Marks)  
 b. An epicyclic gear train consists of a sunwheel (S), a stationary internal gear (E) and 3 Identical planet wheels (P) carried on a star shaped planet carrier (C). The size of different toothed wheels are such that the planet carrier C rotates at  $\frac{1}{5}$  of the speed of the sun wheel. The minimum number of teeth on any wheel is 16. The drilling torque on the sunwheel is 100 N-m. Determine (i) The number of teeth on different wheels of train. (ii) Torque necessary to keep the internal gear stationary. (15 Marks)

Module-5

- 9 The following data relate to cam profile in which the roller moves with SHM during ascent and UARM during descent. Minimum radius of cam = 30 mm, Roller radius = 8 mm, Lift = 28 mm, Offset of the follower axis = 12 mm towards right, Angle of ascent =  $90^\circ$ , Angle of descent =  $60^\circ$ , Angle of dwell between ascent and descent =  $45^\circ$ , Speed of cam = 200 rpm in counter clockwise direction. Draw the profile of the cam and determine the maximum velocity and acceleration during outstroke and return stroke. (20 Marks)

OR

- 10 A suction valve of a 4-stroke petrol engine is operated by a symmetrical circular cam with a flat faced follower. The details are as follows, lift = 10 mm, least radius = 20 mm, nose radius = 2.5 mm, crank angle when suction valve opens after TDC =  $4^\circ$ , Crank angle when suction valve closes after BDC =  $50^\circ$ , Cam shaft speed = 600 rpm. Determine maximum velocity of the valve and its maximum acceleration and retardation. Also determine the minimum force exerted by the springs to overcome the inertia of moving parts weighing 250 gm. (20 Marks)

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