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17ME42

## Fourth Semester B.E. Degree Examination, Feb./Mar. 2022 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 terms:  
 i) Link    ii) Kinematic pair    iii) Kinematic chain    iv) Machine    v) Structure  
 vi) Constrained motion    vii) Mechanism    viii) Inversion    ix) Degree of freedom  
 x) Grashof's law. (10 Marks)
- b. With neat sketch, explain crank and slotted lever quick return motion mechanism. (10 Marks)

OR

- 2 a. Draw a neat sketch of Peaucellier straight line motion mechanism. Explain with a proof how the tracing point describes a straight line path. (10 Marks)
- b. Explain with neat sketches:  
 i) Ratchet mechanism  
 ii) Geneva wheel (10 Marks)

### Module-2

- 3 a. A four bar chain ABCD has a fixed link  $AD = 1\text{m}$ . The driving crank  $AB = 0.3\text{m}$ . The follower link  $CD = 0.6\text{m}$  and the connecting link  $BC = 1.2\text{m}$ . The crank AB rotates at a speed of 300rpm clockwise with an angular acceleration of  $200\text{ rad/sec}^2$  in anti-clockwise direction. When the angle made by the crank with the fixed link is  $135^\circ$  in anti-clockwise direction. Determine:  
 i) Angular velocity of link BC and CD  
 ii) Acceleration of B and C. (12 Marks)
- b. Explain and derive an expression for Coriolis component of acceleration. (08 Marks)

OR

- 4 a. Sketch and explain Klein's construction for single slider-crank mechanism. (10 Marks)
- b. In a pin jointed 4-bar mechanism as shown in Fig.Q.4(b),  $AB = 150\text{mm}$ ,  $BC = CD = 180\text{mm}$  and  $AD = 300\text{mm}$ . The angle of  $BAD = 60^\circ$ . The crank AB rotates uniformly at 100rpm. Locate all the instantaneous center and find the angular velocity of the link BC. (10 Marks)

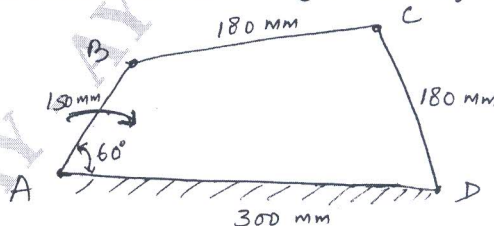


Fig.Q.4(b)

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.

**Module-3**

- 5 For an inclined slider crank mechanism of crank length of 50mm, crank angle of  $30^\circ$  and connecting rod length 150mm, determine the velocity and acceleration of the slider using complex algebra method. Take the constant speed of the crank as 2100 rpm in clockwise direction. (20 Marks)

OR

- 6 a. Derive an expression for the Freudensteins equation of four bar mechanism. (12 Marks)  
b. Explain the function generation, path generation and motion generation. (08 Marks)

**Module-4**

- 7 a. State and prove law of gearing. (06 Marks)  
b. Derive an expression for path of contact. (06 Marks)  
c. A pair of spur gears has 16 teeth and 18 teeth, a module 12.5mm, an addendum 12.5mm and a pressure angle  $14.5^\circ$ . Prove that the gears have interference. Determine the minimum number of teeth and the velocity ratio to avoid interference. (08 Marks)

OR

- 8 a. Explain epicyclic gear train with neat figure. (08 Marks)  
b. An epicyclic gear train consists of a sun wheel (S), a stationary internal gear (E) and the three identical planet wheel (P) carried on a star shaped planet carrier (C). The sizes of different toothed wheels are such that the planet carrier C rotates at  $1/5$  of the speed of the sun wheel. The minimum number of teeth on any wheel is 100N-m. Determine:  
i) Number of teeth on different wheels of train.  
ii) Torque necessary to keep the internal gear stationary. (12 Marks)

**Module-5**

- 9 Draw the profile of a cam operating a roller follower with the following data:  
Minimum radius of the cam = 25mm; lift = 30mm; roller diameter = 15mm. The cam lifts the follower for  $120^\circ$  with SHM followed by a dwell period of  $30^\circ$ . Then the follower lowers down during  $150^\circ$  of the cam rotation with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150rpm. Calculate the maximum velocity and acceleration of the follower during descent period. (20 Marks)

OR

- 10 a. Derive an expression for displacement, velocity and acceleration when the flat face of the follower contact with the straight flank of the tangent cam. (08 Marks)  
b. A symmetrical circular arc cam operating a flat faced follower has the following particulars.  
Least radius of the cam = 30mm, lift = 20mm, angle of lift =  $75^\circ$ , nose radius = 5mm, speed = 600rpm. Find:  
i) The principal dimensions of cam.  
ii) The acceleration of the follower at the beginning of lift, at the end of contact with the circular flank, at the beginning of contact with nose and at the apex of nose. (12 Marks)

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