CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Kinematics of Machines

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) Link (ii) Kinematic chain (iii) Degree of freedom (iv) Inversion **(06 Marks)**

b. Explain Grubler's criterion for plane mechanism. **(06 Marks)**

c. What are quick return motion mechanisms? When are they used? Sketch and explain the functioning of Whitworth mechanism. **(08 Marks)**

OR

2 a. Derive an expression for necessary condition of correct steering and explain Ackerman steering gear with neat sketch. **(10 Marks)**

b. Sketch and explain following mechanisms:
(i) Drug link mechanism (ii) Geneva wheel. **(10 Marks)**

Module-2

3 a. State and prove Kennedy's theorem. **(06 Marks)**

b. In a reciprocating engine the length of crank is 250mm and length of connecting rod is 1000mm. The crank rotates at an uniform speed of 300 rpm in clockwise direction and the crank is inclined at 30° with inner dead centre. The centre of gravity of connecting rod is 400mm from the crank end. By Klein's construction determine
(i) Velocity and acceleration of piston.
(ii) Angular velocity and acceleration of connecting rod.
(iii) Velocity and acceleration at the centre of gravity of connecting rod. **(14 Marks)**

OR

4 In a four bar mechanism ABCD, AD is fixed link of 120 mm long. The crank AB is 30mm and rotates at 100 rpm clockwise while CD = 60mm oscillates about D. BC and AD are of same length. Find the angular velocity of link CD when angle BAD = 60° by (i) relative velocity method (ii) Instantaneous centre method. **(20 Marks)**

Module-3

5 Using complex algebra derive expressions for velocity and acceleration of the piston angular acceleration of connecting rod of a slider crank mechanism. **(20 Marks)**

OR

6 a. Derive Freudenstein's equation for slider crank mechanism. **(10 Marks)**

b. Design a four link mechanism to coordinate three positions of the input and the output as follows:

$\theta_1 = 20°$ $\phi_1 = 35°$
$\theta_2 = 35°$ $\phi_2 = 45°$
$\theta_3 = 50°$ $\phi_3 = 60°$ **(10 Marks)**

Module-4

7 A cam rotates at a uniform speed of 300 rpm clockwise and gives an oscillating follower 75mm long, an angular displacement of 30° in each stroke. The follower if fitted with a roller of 20mm diameter which makes contact with the cam. The outward and inward displacements of the follower each occupying 120° cam rotation and there is no dwell in the lifted position. The follower moves throughout with SHM. The axis of fulcrum is 80mm from the axis of cam and least distance of roller axis from cam axis is 40mm. **(20 Marks)**

OR

8 A vertical spindle supplied with a plane horizontal face at its lower end is actuated by a cam keyed to a uniformly rotating shaft. The spindle is raised through a distance of 30mm in one forth remains at rest in one fourth, is lowered in one third and remains at rest for the remainder of a complete revolution. Draw the profile assuming the least radius of cam profile as 25mm and that the spindle moves with uniform acceleration and retardation on both ascent and descent, however during descent deceleration period is half the acceleration period. The axis of the spindle passes through cam axis. The cam rotates in anticlockwise direction. **(20 Marks)**

Module-5

9 a. Derive an expression for minimum number of teeth necessary for gear to avoid interference. **(10 Marks)**

b. The standard full depth 14½° gear have module of 5mm. The pinion has 15 teeth and the gear has 60 teeth. Addendum = 1 module.
(i) Show that the gear will interfere with pinion
(ii) Should the pressure angle be increased to eliminate the interference? **(10 Marks)**

OR

10 a. Explain the term train valve and velocity ratio used in gear train. **(04 Marks)**

b. In an epicyclic gear train the internal wheels A, B and the compound wheel C and D rotate independently about the axis 'O'. The wheels E and F rotate on a pin fixed to the arm G. E gears with A and C, and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18; C = 28, D = 26.
(i) Sketch the arrangement
(ii) Find the number of teeth on A and B
(iii) If the arm G makes 150 rpm CW and A is fixed find the speed of B.
(iv) If the arm G makes 150 rpm CW and wheel A makes 15 rpm CCW find the speed of B. **(16 Marks)**

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