CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, June/July 2025
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 pair
iii) Mechanism
iv) Degree of freedom
v) Inversion **(10 Marks)**

b. Explain with a neat sketch, whitworth quick return motion mechanism. **(10 Marks)**

OR

2 a. Sketch and explain Peaucellier's straight line mechanism and prove that it can trace a straight line. **(10 Marks)**

b. Sketch and explain the following mechanisms:
i) Scotch yoke mechanism
ii) Ratchet and Pawl mechanism. **(10 Marks)**

Module-2

3 a. In a four bar mechanism ABCD, AD is fixed and crank AB rotates at 200 rpm in clockwise direction. The dimensions of various links are as follows BC = AD = 150 mm, CD = 80 mm, AB = 40 mm. Find angular velocity of link BC and CD. **(10 Marks)**

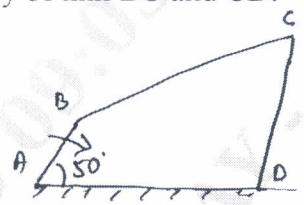

Fig.Q.3(b)

b. State and prove Kennedy's theorem. **(10 Marks)**

OR

4 a. An I.C engine mechanism in Fig.Q.4(a) in which crank AB rotates at 600 rpm. The length of crank AB is 0.5 m and connecting rod is 2 m long. When crank is turned 45° from inner dead centre IDC find:
i) Velocity of piston P
ii) Angular velocity of connecting rod BP
iii) Velocity of point D on the connecting rod which is at a distance of 0.5 m from B

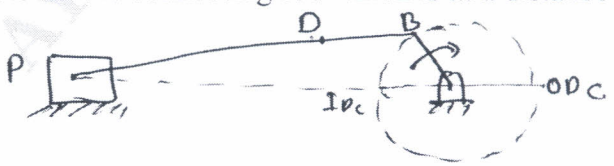

Fig.Q.4(a)

(10 Marks)

b. A four bar mechanism is shown in Fig.Q.4(b) AB = 20 cm, BC = 30 cm, CD = 32 cm and AD = 60 cm. Crank AB rotates at a uniform speed of 300 rpm in anticlockwise direction. When the crank AB has turned 60°, locate all the instantaneous centre and find the angular velocity of link BC. **(10 Marks)**

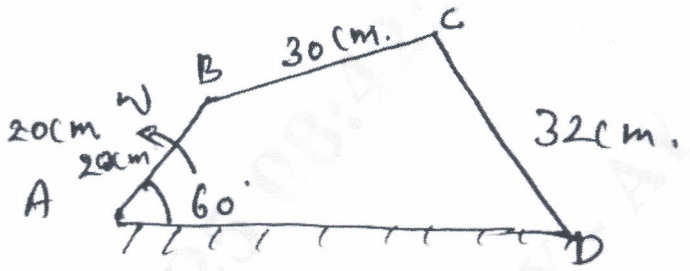

Fig.Q.4(b)

Module-3

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

OR

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

b. In a slider-crank mechanism the stroke of slider is 200 mm and obliquity ratio is 4.5. The crank rotates uniformly at 1000 rpm in clockwise direction when the crank is 30° past the O.D.C. Find :

i) Velocity and acceleration of piston

ii) Angular velocity and angular acceleration of connecting rod. **(10 Marks)**

Module-4

7 A cam rotation with uniform speed is required to give the following motion to a knife edged follower:

i) The outstroke of the follower is 40 mm for 60° of cam rotation.

ii) Dwell period for next 30° of cam rotation.

iii) The return stroke during next 60° of cam rotation.

iv) Dwell period for remaining 210° of cam rotation.

The minimum radius of cam is 50 mm. The follower moves with uniform velocity for both outstroke and return stroke. Draw a cam profile when follower passes through the axis of cam shaft. **(20 Marks)**

OR

8 Draw the profile of a cam to raise a valve with SHM through mm in $1/4^{th}$ of revolution. Keep it fully raised through $1/10^{th}$ revolution and to lower it with uniform acceleration and retardation in $1/6^{th}$ revolution. The valve remains closed during the rest of the revolution. The diameter of roller is 20 mm and minimum radius of cam to be 30 mm. The axis of the valve rod passes through the axis of cam shaft. The cam shaft rotates at 360 rpm clockwise. **(20 Marks)**

Module-5

9 a. Derive an expression for length of path of contact of two teeth from beginning to the end of engagement. **(10 Marks)**

b. In an epicyclic gear train, the internal gears A and B and compound gears C and D rotates independently about point 0. All the gears have same module and the number of teeth are $Z_C = 28$, $Z_D = 26$, $Z_E = Z_F = 18$. The gears E and F rotates on pins fixed to the arm G. Gear E meshes with gear A and C. Where as gear F meshes with B and D. Sketch the arrangement and find

i) Number of teeth on gear A and B.
ii) Speed of gear B if arm G makes 200 rpm clockwise and gear A is fixed.
iii) Speed of gear B if arm G makes 200 rpm clockwise and gear A makes 20 rpm in anticlockwise direction. **(10 Marks)**

OR

10 a. Two mating gears with module pitch of 6.5 mm have 19 and 47 teeth of 20° pressure angle and 6.5 mm addenda. Determine the number of pairs of teeth in contact and the angle turned through by the larger wheel for one pair of teeth in contact. Determine also the ratio of sliding velocity to the rolling velocity at the instant:

i) The engagement commences
ii) Engagement terminates
iii) All the pitch point. **(10 Marks)**

b. The arm of an epicyclic gear train rotates at 100 rpm in anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about het centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm, clockwise? Solve by angular method. **(10 Marks)**

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