CBCS Scheme

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15ME42

Fourth Semester B.E. Degree Examination, June/July 2017
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.
2. In the sketches of mechanisms, clearly distinguish link & construction line.

Module-1

1 a. Define 'kinematic pair' and 'degree of freedom'. Sketch 'spherical pair' and state its degree of freedom. **(06 Marks)**

b. Name an exact straight line motion mechanism having only turning pairs. Draw a neat proportionate sketch of the same. State geometric relationships among its links. Indicate the point tracing straight line and prove that the point can trace straight line. **(10 Marks)**

OR

2 a. In a 4-bar mechanism, the lengths of driver crank, coupler and follower link are 150 mm, 250 mm and 300 mm respectively. The fixed link length is L_o. Find the range of values for L_o to make it a crank-rocker mechanism. **(06 Marks)**

b. Draw a neat proportionate sketch of 'Whitworth mechanism'. Indicate clearly the positions of driver crank corresponding to the extreme positions of shaper tool. **(06 Marks)**

c. State an application for the following:
i) Drag link mechanism ii) Oldham coupling
iii) Geneva wheel iv) Toggle mechanism **(04 Marks)**

Module-2

3 An IC engine mechanism has crank AB of 0.5m and connecting rod BC of 2m length. Crank AB rotates uniformly at 600 rpm in clockwise direction. When the crank has turned 45° from top dead centre (TDC), find the magnitude and direction of angular acceleration of connecting rod. **(16 Marks)**

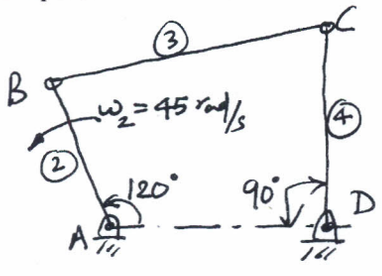
OR

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

b. A slider crank mechanism has crank of length 'r' and connecting rod 'ℓ'. Crank rotates uniformly at 'ω' rad/s in anticlockwise direction. Crank has moved θ from IDC. Assuming r, ℓ, ω and θ are known, state the procedure of 'Klein's construction' for:
i) Velocity analysis and ii) Acceleration analysis **(10 Marks)**

Module-3

5 A four bar mechanism ABCD is shown in Fig.Q5. Find the angular velocities of links 3 and 4 by complex algebra and vector algebra method, if ω_2 = 45 rad/s, counter clockwise, from first principles. **(16 Marks)**



AB = 100 mm
BC = r_3
CD = 300 mm
AD = 250 mm

Fig.Q5

OR

6 Obtain Freudenstein's equation for four bar mechanism. **(16 Marks)**

Module-4

7 a. State law of gearing and define:
i) Path of contact and
ii) Arc of contact. **(06 Marks)**

b. The number of teeth on each of the two equal spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6 mm. If the length of arc of contact is 1.75 times the circular pitch, find the addendum. **(10 Marks)**

OR

8 An epicyclic gear train has a fixed annular wheel C concentric with sun wheel A. A planet wheel B gears with A and C and can rotate freely on a pin carried by an arm D which rotates about an axis coaxial with that of A and C. If T_1 and T_2 are the numbers of teeth on A and C respectively, show that the ratio of the speeds of D to A is $\frac{T_1}{T_1 + T_2}$. **(16 Marks)**

Module-5

9 Draw the profile of a cam to raise a valve with SHM through 40 mm in $1/4^{th}$ 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 revolution. The diameter of roller is 20 mm and minimum radius of cam is 30 mm. The axis of valve rod passes through the axis of cam shaft. The cam rotates at 360 rpm, clockwise. Find maximum velocity and acceleration during raise and return of follower. **(16 Marks)**

OR

10 A symmetrical cam with convex flanks operates a flat-footed follower. The lift is 8 mm, base circle radius is 25 mm and the nose radius is 12 mm. If the total angle of cam action is 120°, find the radius of the convex flanks. Determine the maximum velocity and the maximum acceleration when the cam shaft rotates at 500 rpm. **(16 Marks)**

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