Kinematics of Machines VTU CBCS Question Paper Set 2018

CBCS Scheme

USN | | | | | | | | | | 15ME42

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain:
i) kinematic pair,
ii) Types of links,
iii) Grashof's criterion. **(06 Marks)**

b. Explain with neat sketches:
i) Ratchet and pawl mechanism
ii) Toggle mechanism. **(10 Marks)**

OR

2 a. What is quick return motion? Explain with neat sketch crank and slotted lever mechanism. **(08 Marks)**

b. Draw a neat sketch of Peacellier straight line mechanism. Explain with proof how the tracing point describes a straight line path. **(08 Marks)**

Module-2

3 A four bar mechanism ABCD is pin jointed at ends and the link AD is fired of length 600 mm. The links AB, BC and CD are 300 mm, 360 mm and 360 mm respectively. At certain instant the link AB makes an angle of 60° with link AD. If the link AB rotates at an angular velocity of 10 rad/s and an angular acceleration of 30 r/s^2 both clockwise. Determine angular velocity and angular accelerator of links BC and CD by graphical method. **(16 Marks)**

OR

4 a. Define Coriol's component of acceleration. Derive an expression for the same. **(08 Marks)**

b. Determine the velocity and acceleration of the piston by Klein's construction for a steam engine to the following specifications:
Stroke of piston = 300 mm
Ratio of length of connecting rod to crank radius = 4
Speed of engine = 300 rpm
Clockwise position of crank = 45° with inner dead centre. **(08 Marks)**

Module-3

5 a. Derive analytical expressions for the determination of velocity and acceleration of piston of a reciprocating engine. **(12 Marks)**

b. If the crank and connecting rod are 150 mm and 600 mm long respectively and the crank rotates at a constant speed of 100 rpm, determine the velocity and acceleration of piston. The angle which the crank makes with the inner dead centre is 30°. **(04 Marks)**

OR

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

b. Explain function generation for four bar mechanism. **(06 Marks)**

Module-4

7 a. State and prove the law of gear tooth action for constant velocity ratio. **(08 Marks)**

b. Two mating spur gears with module of 6.5 mm have 19 and 47 teeth of 20° pressure angle, and 6.5 mm addendum. Determine the number of pairs of teeth in contact. Also determine the sliding velocity at the instant (i) engagement commences, (ii) engagement terminates. The pitch line velocity is 1.2 m/s. **(08 Marks)**

OR

8 a. Define: (i) Interference in gears, (ii) Epicyclic gear train. **(04 Marks)**

b. Fig.Q8(b) shows an epicyclic gear train. Pinion A has 15 teeth and is rigidly fixed to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular fixed wheel D. Pinion C has 15 teeth and is integral with B (B, C being a compound gear wheel), gear C meshes with annular wheel E, which is keyed to the machine shaft. The arm rotates about the same shaft on which A is fixed, and carries the compound wheel B, C. If the motor runs at 1000 rpm, find the speed of the machine shaft. Find the torque exerted on the machine shaft if the motor develops a torque of 100 Nm.

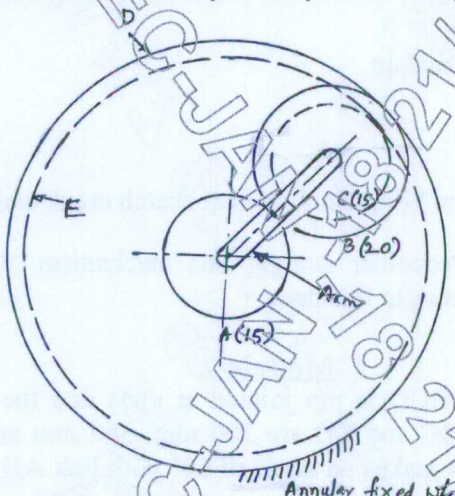

Fig.Q8(b) **(12 Marks)**

Module-5

9 A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below:

i) Outward during 150° with UARM.
ii) Dwell for next 30°.
iii) Return during next 120° with SHM.
iv) Dwell for the remaining period.

Stroke of the follower is 3 cm. Minimum radius of the cam is 3 cm. Draw the cam profile, when the follower axis passes through the cam axis. Find the maximum velocity and acceleration during outstroke. **(16 Marks)**

OR

10 a. Define the terms:

i) Cam profile
ii) Base circle
iii) Prime circle
iv) Pitch curve **(04 Marks)**

b. Derive expressions for displacement, velocity and acceleration of the follower when the flat faced follower is in contact with any point on the circular flank. **(12 Marks)**

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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)**

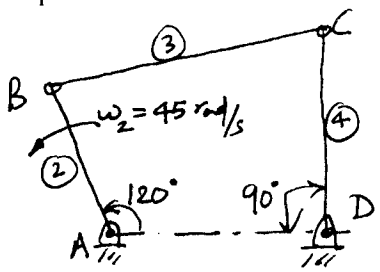
OR

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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