Kinematics of Machine VTU CBCS Question Paper Set 2018

CBCS Scheme

USN | | | | | | | | | | |

15AU43

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define following :
i) Link
ii) Kinematic pair
iii) Structure
iv) Degree of freedom. **(04 Marks)**

b. Calculate mobility of mechanism as shown in Fig.Q1(b). **(03 Marks)**

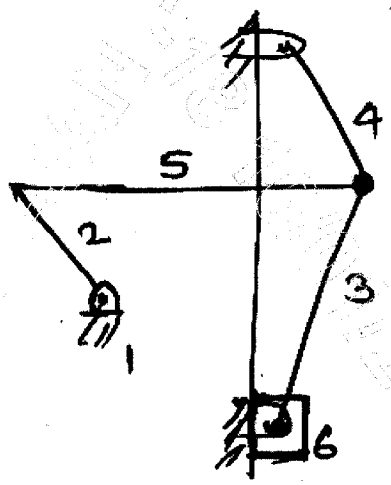

Fig.Q1(b)

c. Explain with neat sketch construction and working of crank and slotted lever quick return mechanism. **(09 Marks)**

OR

2 a. Draw and explain construction and working of Peaucellier's straight line mechanism. **(04 Marks)**

b. Write short note on the following mechanism with neat sketch :
i) Geneva wheel
ii) Ratchet and Pawl mechanism
iii) Pantograph. **(12 Marks)**

Module-2

3 a. State and prove Kennedy's theorem of instantenous centers. **(04 Marks)**

b. The mechanism shown in Fig.Q3(b) has following dimensions OA = 100mm, AB = 280mm, BC = 240mm and CD = 120mm. The centre of gravity of link AB is located at a distance of 120mm from A. Determine the velocity of G, D and angular velocity of link AB and the bell crank lever BCD. The crank OA rotates uniformly at 30 rad/sec. Use instantenous centre method. **(12 Marks)**

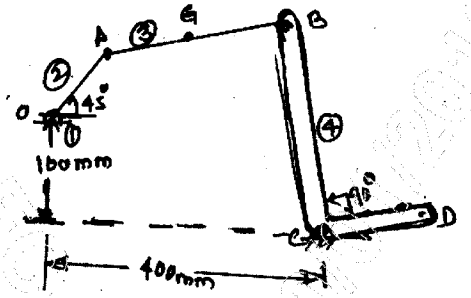

Fig.Q3(b)

OR

4 For four bar mechanism as shown in Fig.Q4, determine the acceleration of C and angular acceleration of link 3, when crank 2 rotates at 20 rad/sec. O_2O_4 = 200mm, O_2A = 150mm, AB = 450 mm, O_4B = 300mm and O_4C = 200mm. **(16 Marks)**

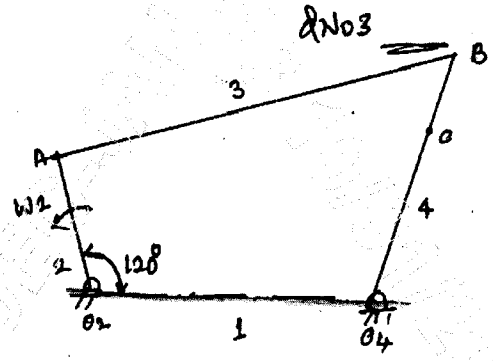

Fig.Q4

Module-3

5 In a four bar mechanism ABCD (Fig.Q5) link AB = 300mm, BC = 360mm, CD = 360mm and fixed link AD = 600mm. The link AB makes 60° with fixed link AD. The link AB has an angular velocity of 10 rad/sec and angular acceleration 30 rad/sec^2 both clockwise. Determine the angular velocity and angular acceleration of link BC and CD. **(16 Marks)**

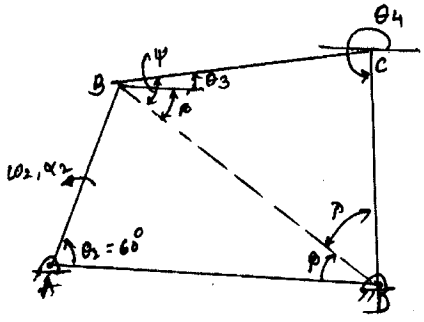

Fig.Q5

OR

6 a. The crank of an engine is 200mm long and ratio of length of connecting rod to crank radius is 4. Determine acceleration of piston when crank turns through 45°from inner dead centre position and moving towards centre at 240 rpm by complex algebra method. **(08 Marks)**

b. The crank and connecting rod of reciprocating engine are 200mm and 700mm respectively. the crank is rotating in clockwise direction at 120rad/sec. Using Klein's construction find : i) Velocity and acceleration of piston ii) Velocity and acceleration of the midpoint of the connecting rod iii) Angular velocity and angular acceleration of connecting rod at instant when crank is at 30° from inner dead centre. **(08 Marks)**

Module-4

7 a. Sate and prove law of gearing. **(05 Marks)**

b. A pair of 20° full depth involute spur gear having 30 and 50 teeth of module 4mm are in mesh. The smaller gear rotates at 1000rpm. Determine : i) sliding velocities at engagement and disengagement of pair of teeth ii) contact ratio. **(11 Marks)**

OR

8 a. Explain different types of gear trains with neat sketches. **(08 Marks)**

b. An epicyclic gear train consists of a sun wheel S, a stationery internal gear E and three identical planet gears P carried on a carrier C. The size of different toothed wheels are such that planet carrier C rotates at $\frac{1}{5}^{th}$ speed of sun wheel S. Minimum number of teeth on any sun wheel is 16. The driving torque on sun wheel is 100N–m. Determine :

i) Number of teeth on different wheels of gear train

ii) Torque necessary to keep the internal gear stationery. **(08 Marks)**

Module-5

9 a. Define following with respect to cams :

i) Prime circle ii) Pressure angle iii) Pitch point iv) Trace point. **(04 Marks)**

b. A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower having roller of 10mm diameter. The following motions defined below :

i) Moves outward during 120° of cam rotation with UARM

ii) Dwell in lifted position for next 30° of cam rotation

iii) returns with SHM for next 120° of cam rotation stroke of the follower is 30mm. The minimum radius of cam is 20mm. Draw profile of cam when line stroke of follower passes through centre of cam shaft. Also calculate maximum velocity and acceleration of follower during out stroke. **(12 Marks)**

OR

10 Draw a cam profile the drive oscillating follower as per following specifications :

i) Flower to move outward through angular displacement of 20° during first 120° of cam rotation

ii) Follower to return to its initial position during next 120° of cam rotation

The distance between follower pivot centre and roller centre is 120 mm; distance between pivot centre and roller axis is 130mm; minimum radius of cam is 40mm; radius of roller is 10mm. Inward and outward strokes takes place with SHM. **(16 Marks)**

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following terms with example:
i) Kinematic pair ii) Kinematic chain iii) Mechanism
iv) Degree of freedom v) Structure **(08 Marks)**

b. Explain with a neat sketch any two inversions of double slider crank chain mechanism. **(08 Marks)**

OR

2 Sketch and explain the following mechanism:
a. Crank and slotted lever quick return mechanism **(06 Marks)**
b. Peaucellier's mechanism **(04 Marks)**
c. Ackermann steering gear mechanism **(06 Marks)**

Module-2

3 a. What is Coriolis component of acceleration? Derive the expression for the same. **(06 Marks)**

b. In the mechanism shown in Fig,Q3(b), the slider C is moving to the right with a velocity of 1 m/s and an acceleration of 2.5 m/s^2. The dimensions of various links are AB = 3 m inclined at 45° with the vertical and BC = 1.5 m inclined at 45° with the horizontal. Determine: i) The magnitude of vertical and horizontal component of acceleration of the point B and (ii) The angular acceleration of the links AB and BC. **(10 Marks)**

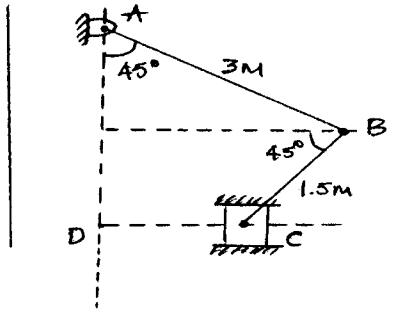

Fig.Q3(b)

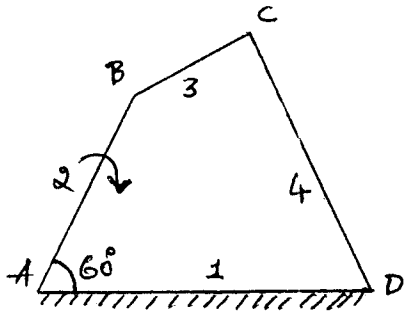

Fig.Q4

OR

4 A pin jointed four bar mechanism ABCD is shown in Fig.Q4. Link AB = 150 mm, BC = 180 mm, CD = 180 mm and the fixed link AD = 300 mm. Link AB makes 60° with the link AD, and rotates uniformly at 100 rpm. Locate all the instantaneous centres and find the angular velocity of link BC and the linear velocity of link CD. **(16 Marks)**

Module-3

5 a. Explain in brief loop closure equation. **(05 Marks)**

b. In four bar mechanism ABCD, link AB = 300 mm, BC = 360 mm, CD = 360 mm and fixed link AD = 600 mm. The angle BAD = 60°. The link AB has an angular velocity of 10 rad/sec and angular acceleration of 30 rad/sec^2 both clockwise.
Determine the angular velocity and angular acceleration of link BC and CD by using Raven's approach. **(11 Marks)**

OR

6 In a reciprocating engine, the length of crank is 250 mm and length of connecting rod is 1000 mm. 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 the connecting rod is 400 mm away from the crank end. By Klein's construction, determine:
i) Velocity and acceleration of piston
ii) Angular velocity and angular acceleration of connecting rod
iii) Velocity and acceleration at the centre of gravity of the connecting rod. **(16 Marks)**

Module-4

7 a. State and prove law of gearing or condition for correct steering. **(06 Marks)**
b. Two 20° involute spur gears mesh externally and give a velocity of ratio 3. Module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine:
i) Minimum number of teeth on each wheel to avoid interference.
ii) Number of pairs of teeth in contact. **(10 Marks)**

OR

8 a. Sketch and explain an automobile differential. **(06 Marks)**
b. In an epicyclic gear train shown in Fig.Q8(b), the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pins fixed to the arm 'a'. All the wheels are of the same module. The number of teeth on the wheels are $T_A = 52$, $T_E = T_F = 36$. Determine the speed of C if:
i) The wheel D is fixed and arm rotates at 200 rpm clockwise.
ii) The wheel D rotates at 200 rpm counter clockwise and arm 'a' rotates at 20 rpm in CCW direction.

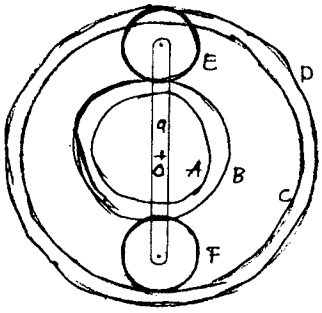

Fig.Q8(b) **(10 Marks)**

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 follower axis is offset to right by 1 cm. **(16 Marks)**

OR

10 a. Define the following terms as applied to a cam with a neat sketch:
i) Base circle ii) Pitch circle
iii) Pressure angle iv) Stroke of the follower **(04 Marks)**
b. Draw the profile of a cam operating a knife edge follower having a lift of 30 mm. The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates in an anticlockwise sense at a uniform velocity of 120 rpm and has a least radius of 25 mm. What will be the maximum velocity and acceleration of the follower during the lift? **(12 Marks)**