



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; June - 2017

Theory of Machines

Time: 3 hrs

Max. Marks: 100

Note: Answer FIVE full questions, selecting ONE full question from each unit.

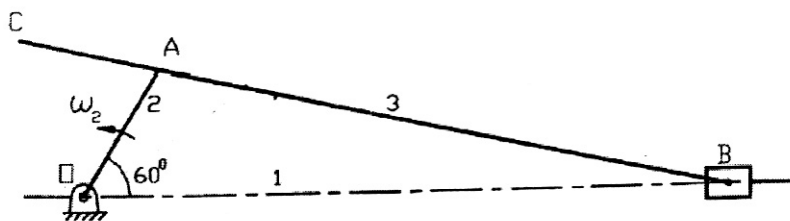
UNIT - I

- 1 a. Explain the following with an example : 8
 - i) Kinematic link ii) Kinematic pair iii) Kinematic chain iv) Inversion.
- b. Show with kinematic link diagram, how quick return in crank and slotted lever mechanism is achieved? 6
- c. Give Examples for mechanism with 1, 2 and 0 degree of freedom using the equation of Grubler's criterion of mobility. 6
- 2 a. Draw a kinematic diagram for elliptical trammel. 4
- b. What is the condition for exact straight line motion mechanism? Show how peaucellier straight line motion satisfies it. 10
- c. With a neat sketch, explain Ratchet and Paul mechanism. 6

UNIT - II

- 3. In a slider crank mechanism shown below the crank is 400 mm long and rotates at 25 rad/s in the counter clockwise direction. The length of connecting rod is 1600 mm. At the instant when the crank has turned through 60° from the inner dead center. Determine :
 - i) Velocity of slider
 - ii) Velocity of a point C 400 mm on the connecting rod extended
 - iii) Angular velocity of connecting rod
 - iv) Velocity and position of a point D on the connecting rod having least absolute velocity.

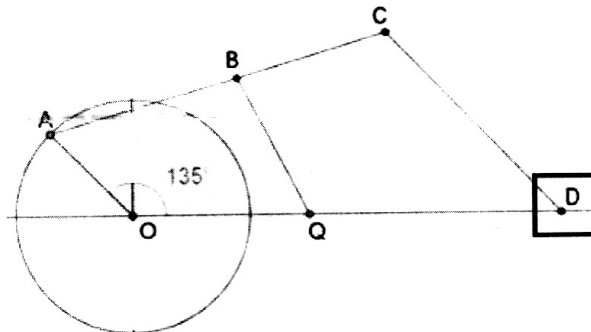
OA = 400 mm
 AB = 1600 mm
 CA = 400 mm
 $\omega_2 = 25 \text{ rad/s}$



Configuration diagram

20

4. Find the velocity of slider D for the given configuration, if the link OA rotates at 1000 rpm in clockwise direction. Link AC is a single straight link. Dimensions of the links are as follows :
 OA = 150 mm, OQ = 225 mm, QB = 200 mm, AB = 250 mm, AC = 450 mm and CD = 325 mm.

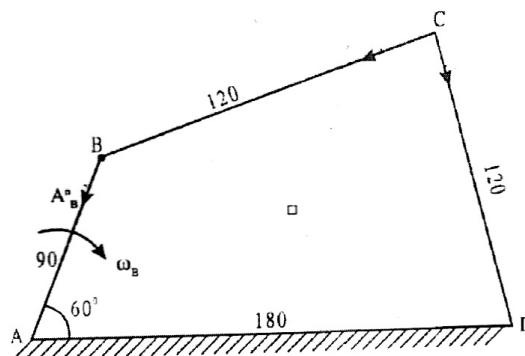


20

UNIT - III

5. A four bar mechanism ABCD is made up of four links, pin jointed at the ends. AD is fixed link which is 180 mm long. The links AB, BC and CD are 90 mm, 120 mm and 120 mm long respectively. At certain instant, the link AB makes an angle of 60° with the link AD. If the link AB rotates at uniform speed of 100 rpm clockwise direction. Find:

- i) Angular velocity of links BC and CD ii) Angular acceleration of the link CD and CB.



20

6. In a reciprocating engine the length of crank is 25 cm and length of connecting rod is 100 cm. The crank rotates at a uniform speed of 300 rpm. By Klein's construction determine:
- The velocity and acceleration of the piston
 - Angular velocity and angular acceleration of connecting rod
 - Velocity and acceleration of a point on the connecting rod 40 cm from the crank rod, when the crank is 30° from inner dead centre.

20

UNIT - IV

- Construct a diagram for a pair of mating teeth to analyze how constant velocity ratio can be achieved and prove it with a mathematical equation.
- Two involutes gears in mesh have 60 and 40 teeth respectively. The module is 3 mm, pressure angle 20° and addendum is 3 mm. Determine the angle of action of the two gears and the maximum velocity of sliding, if pinion is the driver and rotates at 600 rpm.

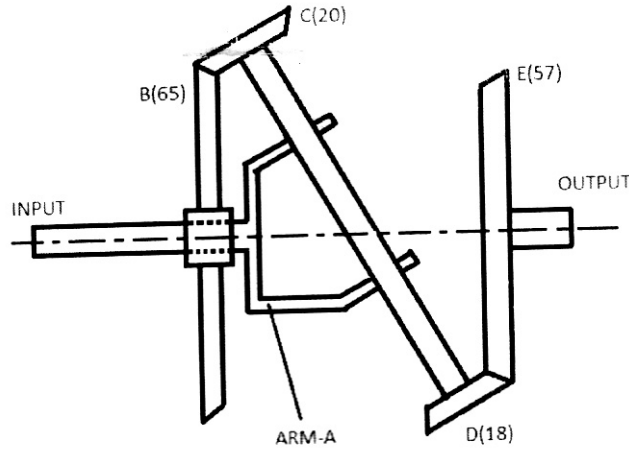
10

10

8. Figure below shows the bevel epicyclic gear train. The arm A is keyed to the driving shaft and wheel E is keyed to the output shaft. Gear C and D are mounted on the shaft. The driving shaft rotates at 200 rpm in CW looking from the left. Find the speed of driven shaft when:

- i) Wheel B is fixed
- ii) Wheel B rotates at 400rpm in the same direction of the driving shaft.

20



UNIT - V

9. A Cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. Minimum radius of the cam is 3 cm. The lift of the follower is 3 cm. The follower moves outward during 150° with UARM, dwells for the next 30° and returns during next 120° and SHM. The follower axis is offset by a distance of 1 cm. Draw the profile of the cam and find the maximum velocity and acceleration.

20

10 a. Show the classification of cams and followers.

8

b. A cam rotating clockwise operates a knife edge follower. Minimum radius of the cam is 4 cm. The lift of the follower is 5 cm. The follower moves outward during 150° with cycloidal, dwells for the next 30° and returns during the next 120° with uniform velocity. The follower axis is offset by a distance of 1 cm. Draw the profile of the cam.

12

* * * *