337454(37)

B. E. (Fourth Semester) Examination, April-May 2020

(New Scheme)
(Mech., Production and Automobile Branch)

KINEMATICS of MACHINES

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

*Note : Solve all the **five** questions. Attempt each question worth 16 marks. Assume suitable data if required. The figures in the right-hand margin indicate marks.*

Unit-I

1. (a) Define Kinematic Pair. 2

   (b) The crank and connecting rod of a theoretical steam engine are 0·5 m and 4 m long respectively. The crank makes 180 r.p.m. in the clockwise direction. When it has turned 45° from the inner dead center

position, determine : (i) velocity of piston, (ii) angular velocity of connecting rod, (iii) velocity of point E on the connecting rod 1·5 m from the gudgeon pin, (iv) position and linear velocity of any point G on the connecting rod which has the least velocity relative to crank shaft. 14

(c) In Figure 1, the angular velocity of the crank OA is 600 r.p.m. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are $OA = 28$ mm; $AB = 44$ mm; $BC = 49$ mm and $BD = 46$ mm. The center distance between the centers of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical. 14
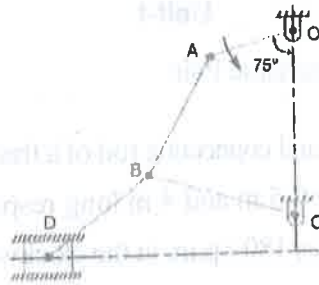

Figure 1

Unit-II

2. (a) What is Pantograph? 2

(b) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine : (i) linear velocity and acceleration of the midpoint of the connecting rod, and (ii) angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead center position. 14

(c) In the mechanism shown in Figure 2, the slider C is moving to the right with a velocity of 1 m/s and an acceleration of 2·5 m/s². The dimensions of various links are $AB = 3$ m inclined at 45° with the vertical and $BC = 1·5$ m inclinded at 45° with the horizontal. Determine : (i) the magnitude of vertical and horizontal component of the acceleration of the point B, and (ii) the angular acceleration of the links AB and BC. 14
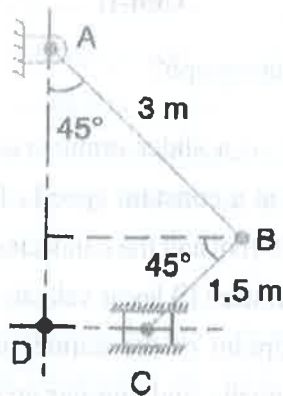
Figure 2

Unit-III

3. (a) Define pitch curve and pressure angle of the cam profile.   2

(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 the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the life and the return?   14

(c) Draw the profile of a cam operating a_ roller reciprocating follower and with the following data : Minimum radius of cam = 25 mm Lift = 30 mm Roller diameter = 15 mm the cam lifts the follower for 120° with SHM followed by a dwell period of 30°. Then the follower lowers down during 150° of the cam rotations with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150 rpm, calculate the maximum velocity and acceleration of the follower during the descent period.   14

Unit-IV

4. (a) Define Addendum circle and Module.   2

(b) What is path of contact? Derive relation for its magnitude.   7

(c) A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion.is 16 and its rotational speed is 240 r.p.m. When the gear ratio is 1·75, find in order that the interference is just avoided; (i) the addenda on pinion and gear wheel; (ii) the length of path of contact; and (iii) the maximum

velocity of sliding of teeth on either side of the pitch point. 7

(d) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B? 7

Unit-V

5. (a) What is Dynamometer? 2

(b) A 100 mm wide and 10 mm thick belt transmit 5 kW between two parallel shafts. The distance between the shaft centres is 1·5 m and the diameter of the smaller pulley is 440 mm. The driving and the driven shafts rotate at 60 rpm and 150 rpm respectively. The coefficient of friction is 0·22. Find the stress in the belt if the two pulleys are connected by (i) an open belt, and (ii) a cross belt. Take pt = 0·22. 14

(c) The simple band brake, as shown in Figure 3, is applied to a shaft carrying a flywheel of mass 400 kg. The radius of gyration of the flywheel is 450 mm and runs at 300 r.p.m. If the coefficient of friction is 0·2 and the brake drum diameter is 240 mm, find : (i) the torque applied due to a hand load of 100 N, (ii) the number of turns of the wheel before it is brought to rest, and (iii) the time required to bring it to rest, from the moment of the application of the brake. 14
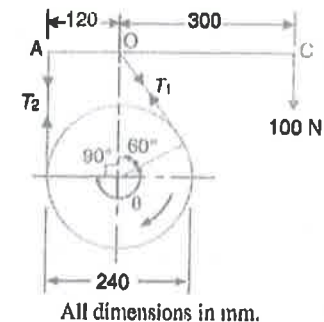

All dimensions in mm.

Figure 3