LNM Institute of Information Technology, Jaipur

Department of Mechanical-Mechatronics Engineering

Mid Semester Examination: 2017-18 | Total Time: 90 Minutes

Subject: Kinematics and Dynamics | Maximum Marks: 40

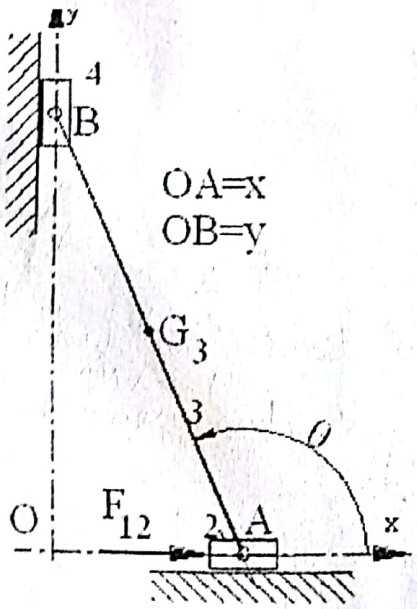
Date: 22/02/2018 | No. of Page/s: 01

Note:

a. Sketch figures where necessary.

b. Assume suitable data if required.

Q1. Figure shows a double slide. Link 2 is moving with a constant velocity at 2 m/s in positive x direction. Link 3 is a thin rod of mass $m_3 = 5$ kg and length AB = 500 mm. The masses of links 2 and 4 are negligible. Determine the force $\mathbf{F_{12}}$ acting on link 2 and the joint forces that occur when the mechanism is in the given state of motion and when x = 200 mm. Assume the mechanism is operating on a horizontal plane so that we can neglect the gravitational acceleration. Also neglect friction.



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The LNM Institute of Information Technology

LNM Institute of Information Technology, Jaipur

Department of Mechanical-Mechatronics Engineering

End Semester Examination: 2017-18

Subject: Kinematics and Dynamics

Date: 03/05/2018

Total Time: 180 Minutes

Maximum Marks: [redacted] 100

No. of Page/s: [redacted] 3

Note:

a. The answers to be written in order of the section.
b. Sketch figures where necessary.
c. All Questions are compulsory.
d. Assume suitable data if required.

Q1. A mechanism, as shown in ***Fig. 1***, has the following dimensions: OA = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm and BE = 400 mm. If crank OA rotates uniformly at 120 RPM clockwise, find

1. The velocity of B, C and D,

2. The angular velocity of the links AB, BC and CD. [10]

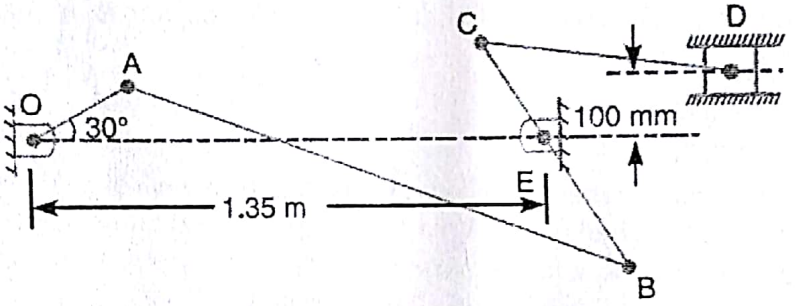

Figure 1

Q2. In a Whitworth quick return motion, as shown in ***Fig. 2***. OA is a crank rotating at 30 r.p.m. in a clockwise direction. The dimensions of various links are : OA = 150 mm; OC = 100 mm; CD = 125 mm; and DR = 500 mm. Determine the acceleration of the sliding block R and the angular acceleration of the slotted lever CA. All dimensions in mm. [10]

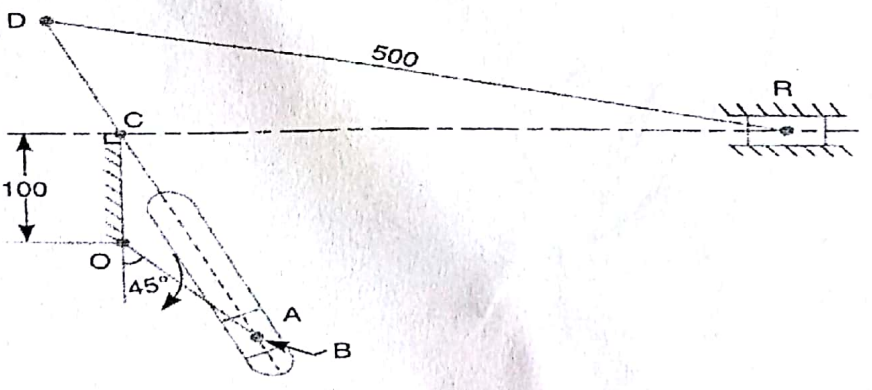

Figure 2

Q3. A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below :

1. To raise the valve through 50 mm during 120° rotation of the cam;
2. To keep the valve fully raised through next 30°;
3. To lower the valve during next 60°; and
4. To keep the valve closed during rest of the revolution i.e. 150°;

The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of the stroke is offset 15 mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 RPM. Draw the displacement, the velocity and the acceleration diagrams of valve rod for one complete revolution of the cam. [20]

Q4. The following data relate to a pair of 20° involute gears in mesh: Module = 6 mm, Number of teeth on pinion = 17, Number of teeth on gear = 49 ; Addendum on pinion and gear wheel = 1 module. Find: **1.** The number of pairs of teeth in contact; **2.** The angle turned through by the pinion and the gear wheel when one pair of teeth is in contact, and **3.** The ratio of sliding to rolling motion when the tip of a tooth on the larger wheel **(i)** is just making contact, **(ii)** is just leaving contact with its mating tooth, and **(iii)** is at the pitch point. [10]

Q5. An epicyclic train of gears is arranged as shown in **Fig.3.** How many revolutions does the arm, to which the pinions B and C are attached, make: **1.** when A makes one revolution clockwise and D makes half a revolution anticlockwise, and **2.** when A makes one revolution clockwise and D is stationary? The number of teeth on the gears A and D are 40 and 90 respectively. [10]

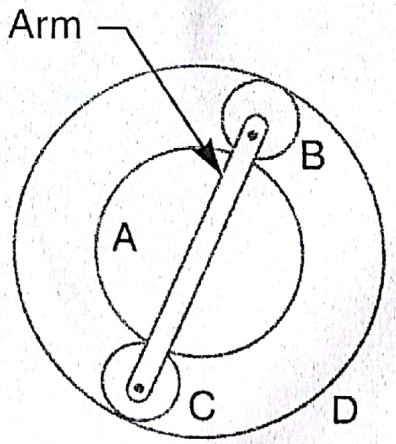

Figure 3

be designed.

Q6. A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke. [10]

Q7. A four-wheeled trolley car of total mass 2000 kg running on rails of 1.6 m gauge, rounds a curve of 30 m radius at 54 km/h. The track is banked at 8°. The wheels have an external diameter of 0.7 m and each pair with axle has a mass of 200 kg. The radius of gyration for each pair is 0.3 m. The height of centre of gravity of the car above the wheel base is 1 m. Determine, allowing for centrifugal force and gyroscopic couple actions, the pressure on each rail. [10]

Q8. A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of speed of the governor. [10]

Q9. A coil of spring stiffness 4 N/mm supports vertically a mass of 20 kg at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude at the beginning of the fourth cycle is 0.8 times the amplitude of the previous vibration. Determine the damping force per unit velocity. Also find the ratio of the frequency of damped and undamped vibrations.

OR

Derive the equation of natural frequency of a vibrating spring mass system using equilibrium method and also analyze different manners of operation. [10]