GUJARAT UNIVERSITY
BE SEMESTER III (MECH/AUTO) EXAMINATION
KINEMATICS
Question Bank

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1) Derive an equation of condition of correct steering of a vehicle.
2) Define inversion. List the different types of inversions of single slider crank and double slider crank mechanism. Explain any one of them.
3) Explain: Completely, incompletely and successfully constrained motions
4) Write a short note on Pantograph.
5) The dimensions and configuration of the four bar mechanism, shown in 2.1, The angle AP1P2 = 60°. The crank P1A has an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s^2, both clockwise. Determine the angular velocities and angular accelerations of P2B, and AB and the velocity and acceleration of the joint B.

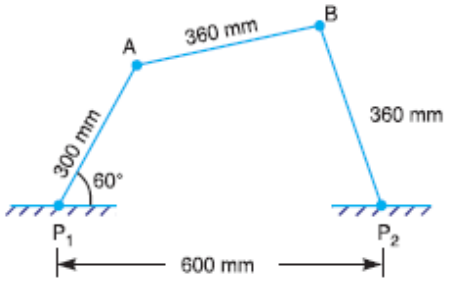


Figure 2.1

6) In the mechanism, as shown in Fig. 2.2, the crank OA rotates at 20 r.p.m. anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. For the given configuration, determine: 1. velocities of sliding at B and D, 2. Angular velocity of CD, 3. linear acceleration of D, and 4. angular acceleration of CD.

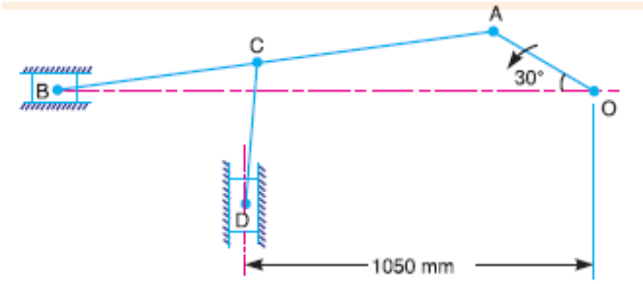


Figure 2.2

7) What is the cam? Explain different types of cams with neat sketch.
8) What is the function of cam follower? Explain different types followers used with neat sketch.
9) A cam drives a flat reciprocating follower: during first 90^0 rotations of the cam, follower moves outwards through a distance of 3 cm with SHM. The follower dwells during next 90^0 cam rotation. During next 90^0 cam rotation, the follower moves outwards with SHM. Follower dwells for the remaining cam rotation.
   i) draw cam profile.

ii) calculate the maximum values of velocity, acceleration and retardation when cam rotates at 10 rad/ sec.

10) A cam is to be designed for a knife edge follower with the following data :
1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.
2. Dwell for the next 30°.
3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.
4. Dwell during the remaining 180°.
Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft, The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

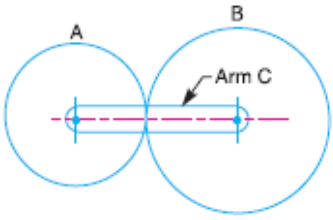
11) Explain the following terms,
a) Friction b) Limiting force of friction
c) Angle of friction d) coefficient of friction

12) In a thrust bearing, the external and internal diameters of the contacting surfaces are 320 mm and 200 mm respectively. The total axial load is 80 KN and the intensity of pressure is 0.35 N/mm^2. The shaft rotates at 400 rpm. Taking the coefficient of friction as 0.06, calculate the power lost in overcoming the friction. Also, find the number of collars required for the bearing.

13) An open belt drive connects two pulleys 120 cm and 50 cm diameter, on parallel shafts 4 meters apart. The mass of the belt is 0.9 Kg per meter length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 0.3. The 120 cm diameter pulley, which is driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. Calculate the torque on each of the shafts, the power transmitted and power lost in friction. What is the efficiency of the drive?

14) Classify gear trains. Give suitable application of each type of gear train. Explain with neat sketch sun and planet type gear.

15) 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 rpm. 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 rpm. in the clockwise direction, what will be the speed of gear B ?



16) What is the function of dynamometer? What is the difference between absorption and transmission dynamometers? What are torsion dynamometers?

17) An epicyclic train of gears is arranged as shown in Fig.5.1. 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.

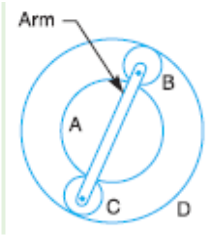
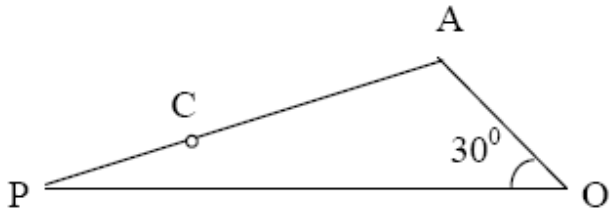


Figure 5.1

18) A simple band brake is operated by a lever of length 600 mm long. The brake drum has a diameter of 560 mm and the brake band embraces 5/8 of the circumference. One end of the band is attached to the fulcrum of the lever while the other is attached to a pin on the lever 100 mm from the fulcrum. If the effort applied at the lever is 2.2 KN and the μ = 0.25, find the maximum braking torque on the drum.
19) List the different mechanisms which give the approximate straight line motion and explain any one.
20) What is a machine? Giving example, differentiate between a machine and a structure.
21) Explain different kinds of kinematic pairs giving example for each one of them.
22) How the velocity ratio of epicyclic gear train is obtained by tabular method?
23) A simple band brake is operated by a lever of length 500 mm long. The brake drum has a diameter of 500 mm and the brake band embraces 5/8 of the circumference. One end of the band is attached to the fulcrum of the lever while the other is attached to a pin on the lever 100 mm from the fulcrum. If the effort applied at the lever is 2 KN and the μ = 0.25, find the maximum braking torque on the drum.
24) A vehicle having a wheel base 32 cm has its center of mass is 1.4 meter from the rear wheels and the 55 mm from the ground level. It moves on a level ground at a speed of 54 Km/hr. Determine the distance moved by the car before coming to rest on applying the brakes to
    i) the rear wheels
    ii) the front wheel
    iii) all the four wheels.
    Take the coefficient of friction between the tyres and the road is 0.5.
25) Explain the following terms:
    (i)Lower pair (ii) Higher pair (iii) Kinematics Chain (iv) Inversion
26) Derive an expression for the magnitude and direction of Coriolis component of acceleration.
27) What is meant by inversions of mechanism? Sketch double slider crank chain and draw it's inversion.
28) Explain instantaneous centre method for finding out the velocity of a point on link.
29) Derive the expression for limiting tension ratio incase of flat belt drive.
30) Determine the minimum no of teeth required on pinion and wheel to avoid interference when gear ratio is 3 and when number of teeth on pinion and wheel is equal(take pressure angle= 20 and addendum of wheel is 1 module.)
31) Explain (1) Peaucellier mechanism and (2) Roberts mechanism with neat sketch
32) Derive the equation of displacement, velocity and acceleration of slider in a slider crank mechanism by analytical method
33) Define: (1) Contact Ratio (2) Module (3) Circular pitch (4) Addendum
    What do you mean by interference in gear?

34) Following data relates to reciprocating steam engine as shown in fig. Uniform speed of crank = 240 rpm
Radius of crank = 150 mm
Length of connecting rod between center = 600 mm
Direction of rotation of crank is clockwise. When the crank has turned 300 from I.D.C. Find:
(1) Acceleration of piston
(2) Acceleration of C.G. of connecting rod, C.G. being 200 mm from big end centre.



35) Write a short note on centrifugal clutch.
36) Construct cam profile for a knife edge follower. Minimum radius of cam = 30mm, Stroke of follower = 24mm, Angle of rise = 900, Dwell after rise = 600, Angle of return = 1200, Dwell after return for rest of the period. Follower to move outwards with uniform velocity and return back with simple harmonic motion. The follower is offset to right by 15mm. The cam is to rotate in anticlockwise direction
37) The crank of oscillating cylinder engine mechanism is 50 mm longhand it rotates at 300 rpm.The piston rod is 150mm long and distance between crank shaft and trunnion is 250mm. Draw velocity and acceleration diagram at the instant when crank is at 60 degree from IDC. And determine
1. velocity and acceleration of sliding piston.
2. Angular velocity of a connecting rod.
3.Sliding acceleration of a piston relative to cylinder walls.
38) An epicyclic gear train consists of sun wheels S, a stationary internal gear E and three identical planet wheels P carried on a star-shaped planet carrier C.The size of Different toothed wheels are such that the planet carrier C rotates at 1/5th of the speed Of the sunwheel S.The minimum number of teeth on any wheel is 16.The driving Torque On the sun wheel is 100N-M.Determine
1.Numbers of teeth on different wheels of the train.
2.Torque necessary to keep the internal gear stationary
39) Two bevel gears A and B having 40 teeth and 30 teeth are rigidly mounted on two Coaxial shafts X and Y.A bevel gear C having 50 teeth meshes with A and B and rotates freely one end of an arm.At the other end of the arm is welded a sleeve and the sleeve is riding freely loose on the axes of the shafts X and Y.Sketch the arrangement.If the shaft X rotates at 100 r.p.m. clock wise and arms rotates at 100r.p.m. anticlockwise Find the speed of shaft Y.
40) Sketch and describe the working of whit-worth Quick return motion mechanism.