Code: 9A03401

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

KINEMATICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Define the term kinematic link. Explain different types of links with the help of examples.

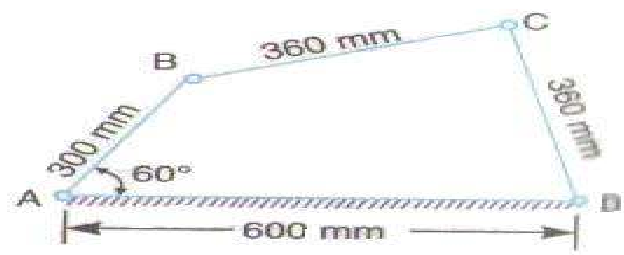
(b) Explain different inversions of four bar chain with the of line diagrams.

2 (a) Sketch and describe the Hart's straight line mechanism indicating clearly the conditions under which the point P on the corners of the rhombus of the mechanism generates a straight line.

(b) Prove geometrically that the above mechanism is capable of producing straight line.

3 (a) Draw and explain Klien's construction for determining the velocity and acceleration of the piston in a slider crank mechanism.

(b) In a pin jointed four bar mechanism, as shown in fig. AB = 300 mm, BC = CD = 360 mm, and AD = 600 mm, the angle BAD = 60^0. The crank AB rotates uniformly at 100 r.p.m. locate ball the instantaneous centers and find the angular velocity of the link BC.



4 (a) What is fundamental equation of steering gears? Which steering gear fulfils this condition?

(b) In a double universal coupling joining two shafts, the intermediate shaft is inclined at 10^0 to each. The input and the output forks on the intermediate shaft have been assembled inadvertently at 90^0 to one another. Determine the maximum and the least velocities of the output shaft if the speed of the input shaft is 500 r.p.m. Also find the coefficient of fluctuation in speed.

Contd. in Page 2

Code: 9A03401

1

5 (a) Why a roller follower is preferred to that of a knife-edged follower.

(b) From the following data draw the profile of a cam in which the follower moves with S.H.M. during ascent while it moves uniformly accelerated motion during descent:
Lift of follower = 4 cm; Least radius of cam = 5 cm; Angle of ascent = 48^0; Angle of dwell between ascent and descent = 42^0; Angle of descent = 60^0; The diameter of roller = 3 cm; Distance between line of action of the follower and the axes of cam = 2 cm. If the cam rotates at 360 r.p.m. anticlockwise, find the maximum velocity and acceleration of the follower during descent.

6 (a) State and prove the law of gear tooth action for constant velocity ratio and show how the involute teeth profile satisfies the condition.

(b) Derive an expression for the velocity of sliding between a pair of in volute teeth. State the advantages of in volute profile as a gear tooth profile.

7 In a flat belt drive the initial tension is 2000 N, the coefficient of friction between the belt and the pulley is 0.3 and the angle of lap on the smaller pulley is 150^0. The smaller pulley has a radius of 200 mm and rotates at 500 r.p.m. find the power in KW transmitted by the belt.

8 In an epicyclic gear train, the internal wheels A and B and the compound wheels C and D rotate independently about axis O. the wheels E and F rotate on pins fixed to the arm G.E gear with A and C and F gear with B and D. All wheels have the same module and the number of teeth are: $T_C = 28$, $T_D = 26$, $T_E = T_F = 18$
(i) Sketch the arrangement ;
(ii) Find the number of teeth on A and B;
(iii) If the arm G makes 100 r.p.m clockwise and A is fixed, find the speed B;
(iv) If the arm G makes100 r.p.m clockwise and wheel A makes 10 r.p.m counter clockwise, find the speed of wheel B.

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2

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

KINEMATICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

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1 (a) Differentiate between: (i) Lower pair and higher pair. (ii) Turning pair and sliding pair. (iii) Screw pair and spherical pair. (iv) Closed pair and unclosed pair.

(b) With a neat sketch explain the 'Whitworth Quick Return Mechanism.

2 (a) Describe the Watt's parallel mechanism for straight line motion and derive the condition under which the straight line is traced.

(b) Describe Hart's mechanism with a neat sketch and prove that the tracing point describes a straight line path

3 The crank of a slider crank mechanism is 15 cm and the connecting rod is 60 cm long. The crank makes 300 r.p.m in the clock wise direction. When it has turned 45 from the inner dead centre position, determine; (i) Acceleration of the mid-point of the connecting rod and (ii) Angular acceleration of the connecting rod.

4 (a) Describe with a neat sketch the working of Davis steering gear mechanism. Also prove that for Davis steering gear Tan $\alpha = w/2L$.

(b) A Hooke's joint is used to connect two shafts. The driving shaft is rotating uniformly with a speed of 600 r.p.m the maximum speed of the driven shaft is 630 r.p.m. Determine the greatest permissible angle between the two shafts. Also find the minimum speed of the driven shaft.

5 Draw the profile of a cam operating a knife-edge follower when the axis of the follower passes through the axis of the cam shaft from the following data:

(i) Follower to move outwards through 30 mm during 90º of cam rotation,

(ii) Follower to dwell for the next 45º,

(iii) Follower to return to its original position during next 60º,

(iv) Follower to dwell for the rest of the cam rotation.

The displacement of the follower is to take place with simple harmonic motion during both the outward and the return strokes. The least radius of the cam is 50 mm. if the cam rotates at 600 r.p.m. Determine the maximum velocity and acceleration of the follower during outward stroke and return stroke.

Contd. in Page 2

6 (a) Prove that the velocity of sliding is proportional to the distance of the point of contact from the pitch point.

(b) Two in volute gears of 20^0 pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find: (i) The angle turned through by pinion when one pair of teeth is in mesh; and
(ii) The maximum velocity of sliding.

7 (a) Distinguish between slip and creep in a belt drive. Derive an expression for the ratio of tensions in the tight and slack sides in terms of μ and θ, when the belt is just on the point of slipping.

(b) A shaft running at 120 r.p.m is to drive a parallel shaft at 180 r.p.m the pulley on the driving shaft is 75 cm in diameter, calculate the diameter of the pulley on the driven shaft (i) neglecting belt thickness (ii) taking belt thickness into account which is 15 mm, (iii) assuming in the latter case a total slip of 4 %.

8 Two parallel shafts are connected with the help of two gears one gear on each shaft. The number of teeth on one gear is 40 and speed of the shaft is 500 r.p.m. If the speed ratio is 2.5 and circular pitch of the gears is 24 mm, and then find;
(i) Number of teeth and speed of other shaft and
(ii) Centre distance between the two shafts.

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Code: 9A03401

3

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

KINEMATICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

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1 (a) Define the term 'Inversion of a mechanism. Explain any one inversion of a double slider crank mechanism.

(b) In a crank and slotted lever quick return mechanism, the distance between the fixed centres is 150 mm and the driving crank is 75 mm long. Determine the ratio of the time taken on the cutting and return strokes.

2 (a) What do you mean by straight line mechanism? Name the different mechanisms which are used for exact straight line motion

(b) Describe any one type of exact straight line motion mechanism with the help of a sketch.

3 (a) What do you mean by Coriolis component of acceleration? When it will exist?

(b) Locate all the instantaneous centers of the slider crank mechanism as shown in figure. The lengths of cranks OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: (i) Velocity of the slider A, and (ii) Angular velocity of the connecting rod AB.

4 (a) What is a Hooke's joint? Where is it used? Sketch a polar velocity diagram of a Hooke's joint and mark its salient features.

(b) Derive an expression for the ratio of angular velocities of the shafts of a Hooke's joint.

Contd. in Page 2

5 Differentiate between:

(a) Pitch point and trace point and

(b) Period of ascent and period of decent.

(c) Draw the profile of a cam which raises a value with S.H.M. through 3 cm in 1/3 of revolution, keep it fully raised through 1/12 revolution and it is closed in next 1/3 revolution with S.H.M. the valve remains closed during the rest of the revolution. The diameter of the roller is 1 cm and minimum radius of the cam is to be 2 cm. The axis of the valve rod is offset by 1.0 cm from the axis of cam shaft.

6 (a) Derive an expression for the centre distance of a pair of spiral gears.

(b) The pitch circle diameter of the smaller of the two spur wheels which mesh externally and have involute teeth is 100 mm. The numbers of teeth are 16 and 32. The pressure angle is 20^0 and the addendum is 0.32 of the circular pitch. Find the length of the path of contact of the pair of teeth.

7 The following data relate to a flat belt drive:

Power transmitted = 18 kW.

Pulley diameter = 180 cm.

Angle of contact = 175^0.

Speed of pulley = 300 r.p.m.

Coefficient of friction between belt and pulley surface = 0.30.

Permissible stress for belt = 300 N/cm^2.

Thickness of belt = 8 mm.

Density of belt material = 0.95 x 10^{-3} gm/cm^3.

Determine the width of belt required taking centrifugal tension into account.

8 (a) Explain the term, sun and planet gears. With a neat sketch explain the working of an epicyclic gear train with a sun and planet gear.

(b) Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600 mm. If one shaft runs at 120 r.p.m and other at 360 r.p.m. Find number of teeth on each wheel if module is 8 mm. Also determine the exact distance apart of the shafts.

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Code: 9A03401

4

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

KINEMATICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1 (a) What is a machine? Giving example, differentiate between a machine and structure.

(b) Sketch and describe the working of two different types of quick return mechanisms. Give examples of their applications. Derive an expression for the ratio of times taken in forward and return stroke for one of these mechanisms.

2 (a) Sketch and describe the Peaucellier straight line mechanism indicating clearly the conditions under which the point P on the corners of the rhombus of the mechanism generates a straight line.

(b) Prove geometrically that the above mechanism is capable of producing straight line.

3 In a four bar chain ABCD, AD is fixed and is 15 cm long. The crank AB is 4 cm long and rotates at 120 r.p.m clockwise, while the link CD (8 cm) oscillates about D. BC and AD are of equal length. Find:

(i) The angular velocity and angular acceleration of link CD when angle BAD = 60°.

(ii) The velocity and acceleration of the points B and C.

4 (a) An Ackermann steering gear does not satisfy the fundamental equation of steering gear at all positions. Yet it is widely used. Why?

(b) The driving shaft of a double Hooke's joint rotates at 400 rpm. The angle of the driving and of the driven shaft with the intermediate shaft is 20^0. If somehow the forks of the intermediate shaft lie in planes perpendicular to each other. Determine the maximum and the minimum velocities of the driven shaft.

5 Draw the profile for the disc cam offset 20 mm to the right of the centre of the cam shaft. The base circle diameter is 75 mm and the diameter of the roller is 10 mm, the follower is to move outward a distance of 40 mm with S.H.M. in 140^0 of the cam rotation to dwell for 40^0 of cam rotation to move inward with 150^0 of cam rotation with uniform acceleration and retardation. Calculate the maximum velocity and acceleration of the follower during each stroke if the cam shaft rotates at 90 r.p.m.

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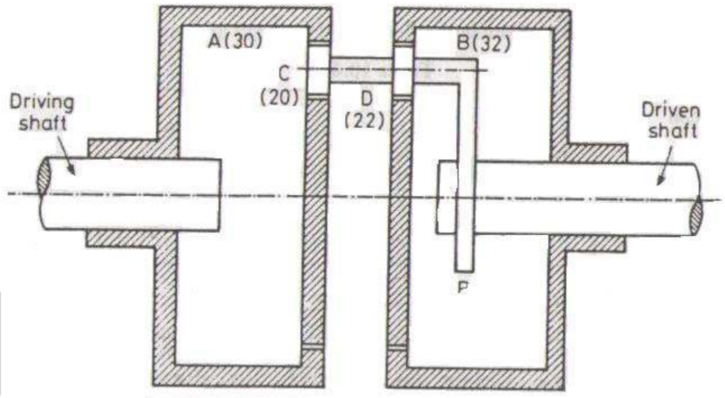
6 (a) Explain what interference is and how it is prevented.

(b) A spur gear has a module of 3 mm and its pitch line velocity is 942.45 mm/s. if the number of teeth of this spur gear is 20, find the speed of the gear. Also determine its circular pitch.

7 A leather belt 200 mm x 10 mm is of density 1.1 gm /cc. its maximum permissible tension is 200 N/ cm^2. If the ratio of tensions is 1.8, determine at what velocity should it be run so as to transmit maximum power? Also, determine the maximum power transmitted.

8 An epicyclic train is shown in figure Internal gear A is keyed to the driving shaft and has 30 teeth. Compound wheel C and D of 20 and 22 teeth respectively are free to rotate on the pin fixed to the arm P which is rigidly connected to the driven shaft. Internal gear B which has 32 teeth is fixed. If the driving shaft runs at 60 r.p.m. clockwise, determine the speed of the driven shaft. What is the direction of rotation of driven shaft with reference to driving shaft?



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