Code No: R09220302 | R09 | SET-1

B.Tech II Year - II Semester Examinations, April-May, 2012
KINEMATICS OF MACHINERY
(Common to AME, ME, MCT, MIM)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1. Two shafts have their axes parallel and 2.5 cm apart. One of the shafts drives the other through an Oldham coupling. Sketch the arrangement and prove that the angular velocity ratio is unity. If the speed of the shaft is 100 rpm, what is the maximum velocity of sliding in cm per minute of the intermediate disc on either of the side discs? [15]

2.a) Prove that the tracing point, giving the horizontal straight line motion in Tchebicheff mechanism, lies at the mid point of the coupler.
b) Prove that a point on one of links of a Hart mechanism traces a straight line on the movement of its links? [8+7]

3.a) State and prove the Kennedy's theorem as applicable to instantaneous centres of rotation of three bodies. How is it helpful in locating various instantaneous centres of a mechanism?
b) In a four bar chain ABCD, AD is the fixed link 12 cm long, crank AB is 3 cm long and rotates uniformly at 100 r.p.m. clockwise while the link CD is 6 cm long and oscillates about D. Link BC is equal to link AD. Find the angular velocity of link DC when angle BAD is 60^0. [6+9]

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) Two shafts are to be connected by a Hooke's joint. The driving shaft rotates at a uniform speed of 500 rpm and the speed of the driven shaft must lie between 475 and 525 rpm. Determine the maximum permissible angle between the shafts. [6+9]

5.a) Explain the procedure to layout the cam profile for a reciprocating follower.
b) Derive relations for velocity and acceleration for a convex cam with a flat faced follower. [6+9]

6.a) Make a comparison of cycloidal and involute tooth forms.
b) Two 20^0 pressure angle involute gears in mesh have a module of 10mm. Addendum is 1 module. Large gear has 50 teeth and the pinion has 13 teeth. Does interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? [6+9]

7.a) What is an idler pulley? What are its main purposes? How does it increase the life of a belt? How does it accommodate or achieve a large velocity ratio?
b) The pulleys of two parallel shafts 8 m apart are 600 mm and 800 mm in diameters and are connected by a crossed belt. It is needed to change the direction of rotation of the driven shaft by adopting the open-belt drive. Calculate the change in length of the belt. [7+8]

8.a) What is the difference between a simple gear train and a compound gear train? Explain with the help of sketches.

b) In a reverted gear train, as shown in Figure.1, two shafts A and B are in the same straight line and are geared together through an intermediate parallel shaft C. The gears connecting the shafts A and C have a module of 2 mm and those connecting the shafts C and B have a module of 4.5 mm. The speed of shaft A is to be about but greater than 12 times the speed of shaft B, and the ratio at each reduction is same. Find suitable number of teeth for gears. The number of teeth of each gear is to be a minimum but not less than 16. Also find the exact velocity ratio and the distance of shaft C from A and B. [6+9]

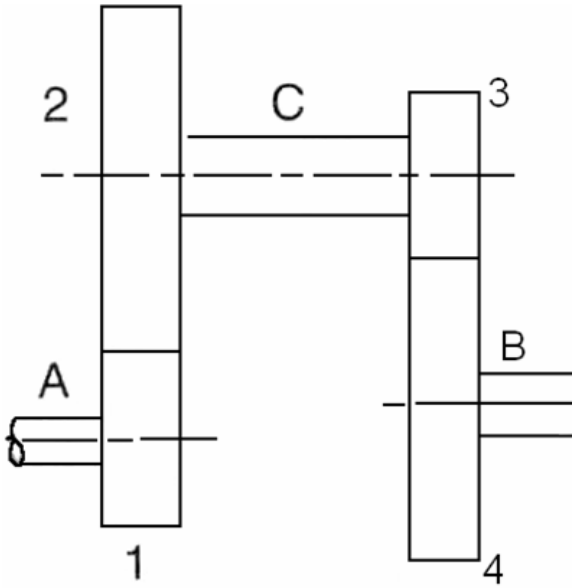

Figure.1

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Code No: R09220302 | R09 | SET-2

B.Tech II Year - II Semester Examinations, April-May, 2012
KINEMATICS OF MACHINERY
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Time: 3 hours **Max. Marks: 75**

Answer any five questions
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- - -

1. What is meant by inversion of a mechanism? Describe with the help of suitable sketches the inversion of
   a) Slider crank chain and b) double slider chain.
   What are the different forms of quadric cycle chain? [15]

2.a) Under what conditions Scott-Russel mechanism traces out a straight line and an ellipse? State the limitations of Scott-Russel mechanism.
   b) Sketch a pantograph, explain its working and show that it can be used to reproduce to an enlarged scale a given figure. [8+7]

3. In a Whitworth quick return motion, a crank AB rotates about the fixed centre A. The end B operates a slider reciprocating in a slotted link, rotating about a fixed centre D, 5 cm vertically above A. The crank AB which is 10 cm long, rotates in a clockwise direction at a speed of 100 r.p.m. Find the angular acceleration of the slotted link for the configuration in which AB has turned through an angle of 45 degrees past its lowest position. [15]

4.a) What conditions must be satisfied by the steering mechanism of a car in order that the wheels may have a pure rolling motion when rounding a curve? Deduce the relationship connecting the inclinations of the front stub axles to the rear axle, the distance between the pivot centres for the front axles and wheel base of the car.
   b) Give salient features of the speed of driven shaft of a Hooke's joint by drawing a polar diagram. [8+7]

5. Draw a cam profile which would impart motion to a flat faced follower in the following desired way. The stroke of the follower being 5 cm.
   i) The follower to move with uniform acceleration upward for 90^0, dwell for next 90^0.
   ii) The follower to return downward with uniform retardation for 120^0 and dwell for next 60^0.
   The minimum radius of the cam being 3 cm. [15]

6.a) What is a worm and worm wheel? Where is it used?
   b) Two 20^0 involute spur gears mesh externally and give a velocity ratio of 3. Module is 3 mm and the addendum is equal to 1.1 module. If the pinton rotates at 120 r.p.m. find:
   i) The minimum number of teeth on each wheel to avoid interference.
   ii) The number of pairs of teeth in contact. [5+10]

7. A rope drive is required to transmit 35 kW at 160 RPM. The grooved pulley has a mean diameter to the rope center of 1.2 m and the groove angles are 45^0. Taking $\mu = 0.25$ and the angle of contact of the ropes as 190^0, determine the number of ropes required, if the maximum pull in each rope is 700 N. [15]

8.a) Describe a differential with the help of a sketch. Prove that the two rear wheels will rotate at different speeds with its help when rounding a curve.

b) Two spur gears A and B of an epicyclic gear train have 24 and 30 teeth respectively. The arm connecting the two gears rotates at 100 rpm in CW direction. Find the speed of gear B, when gear A is fixed. [8+7]

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Code No: R09220302 | R09 | SET-3

B.Tech II Year - II Semester Examinations, April-May, 2012
KINEMATICS OF MACHINERY
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Time: 3 hours **Max. Marks: 75**

Answer any five questions
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- - -

1.a) What is a Kinematic pair? State different methods of classifying them and state the salient features of each method of classification.
b) What is the difference between quick return motion of crank and slotted lever type and that of Whitworth type? What is the ratio of time taken on cutting and return strokes? [7+8]

2.a) Show that the Peaucellier mechanism generates an exact straight line as its path.
b) A circle has OR as its diameter and a point Q lies on its circumference. Another point P lies on the line OQ produced. If OQ turns about O as centre and the product OQ x OP remains constant, show that the point P moves along a straight line perpendicular to the diameter OR. [8+7]

3. Refer to Figure.1. The following dimensions are given.
O_2A = 4cm, AB = 7cm,

$\angle AO_2B = 45^0$, ω_2 = 25 rad/s cw.

Determine the angular velocity of the connecting rod and velocity of piston. Also, determine the velocity of the center of gravity of the connecting rod which is at a distance of 3 cm from the crank pin A. Use the Instantaneous center method. [15]

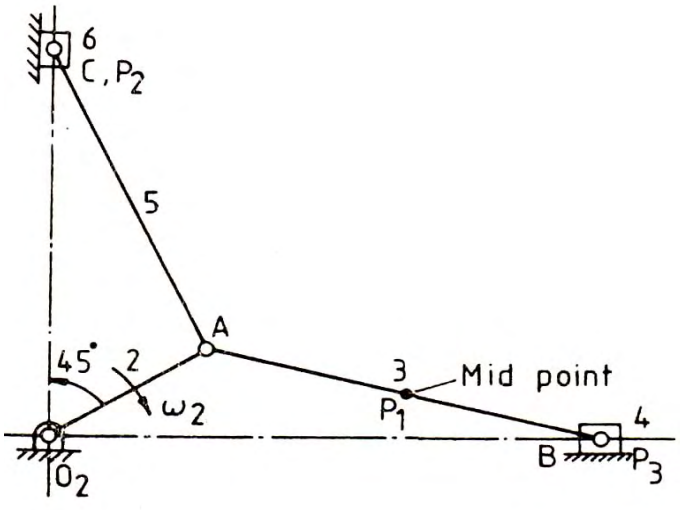

Figure.1

4.a) Derive an expression for the ratio of angular velocities of the shafts of a Hooke's joint.
b) Using Davis steering gear, find the inclination of the track arms to the longitudinal axis of the car if the length of car between axles is 2.3 m, and the steering pivots are 1.3 m apart. The car is moving in a straight path. [10+5]

5.a) Compare the performance of Knife –edge, roller and mushroom followers.

b) A knife edged follower for the fuel valve of a four stroke diesel engine has its centre line coincident with the vertical centre line of the cam. It rises 2.5 cm with SHM during 60^0 rotation of cam, then dwells for 20^0 rotation of cam and finally descends with uniform acceleration and deceleration during 45^0 rotation of cam, the deceleration period being half the acceleration period. The least radius of the cam is 5 cm.
Draw the profile of the cam to full size. [6+9]

6. Two gears in mesh have a module of 10 mm and a pressure angle of 25^0. The pinion has 20 teeth and the gear has 52. The addendum on both the gears is equal to one module. Determine
i) The number of pairs of teeth in contact
ii) The angles of action of the pinion and the wheel
iii) The ratio of the sliding velocity to the rolling velocity at the pitch point and at the beginning and end of engagement. [15]

7.a) Explain what is meant by the phenomenon of creep in belts. How is the creep under varying conditions of belt material determined?

b) What maximum HP can be transmitted per square cm of cross-section, if the tension in the belt is not to exceed 25 kg/cm^2 and the ratio of the tension in the tight side to the tension in the slack side is 1.8? Assume the weight of 1 cu cm of belt as 0.0011 kg. [6+9]

8.a) State how you will determine the torques and the tooth loads on epicyclic gear train.

b) The axes of two parallel shafts are 100 cm apart. Motion is transmitted from one shaft to another by spur gears whose pitch in module is 1.5 cm. If one shaft is to rotate 3.5 times as fast as the other, find the number of teeth in each and the exact centre distance. If the distance between the shaft axes cannot be changed, what is the resulting velocity ratio? [7+8]

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Time: 3 hours **Max. Marks: 75**

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- - -

1.a) What are resistant bodies? Is it necessary that the resistant bodies be rigid? Give reasons for your answer.
b) Describe elliptical trammels. How does it enable you to describe a true ellipse? [7+8]

2.a) Sketch a Paucellier mechanism. Show that it can be used to trace a straight line.
b) How can you show that a Watt mechanism traces an approximate straight line? [8+7]

3. Prove Klein's construction for determining the acceleration of a slider in a slider-crank mechanism. Hence show that the acceleration of the piston of an engine at inner and outer dead centre positions is given by

$$f_p = \omega^2 r \left[1 + \frac{1}{n}\right] \text{ and } f_p = \omega^2 r \left[1 - \frac{1}{n}\right] \text{ respectively}$$

where f_p = acceleration of piston,
ω = angular velocity of crank,
r = crank radius,
L = length of connecting rod,

and $n = \frac{L}{r}$ [15]

4. Two inclined shafts are connected by means of a universal joint. The speed of the driving shaft is 1000 rpm. If the total fluctuation of speed of driven shaft is not to exceed 12.5% of this, what is the maximum possible inclination between the two shafts? With this angle, what will be the maximum acceleration to which the driven shaft is subjected and when this will occur? [15]

5. A cam profile consists of two circular arcs of radii 24 mm and 12 mm joined by straight lines giving the follower a lift of 12 mm. The follower is a roller of 24 mm radius and its line of action is a straight line passing through the cam shaft axis. When the cam shaft has a uniform speed of 500 r.p.m., find the maximum velocity and acceleration of the follower while in contact with the straight flank of the cam. [15]

6.a) Sketch two teeth of a gear and show the following: face, flank, top land, bottom land, addendum, dedendum, tooth thickness, space width, face width and circular pitch.

b) Derive a relation for minimum number of teeth on the gear wheel and the pinion to avoid interference. [8+7]

7.a) State the basis on which the chain drive is classified? What are the common types of chains?

b) A motor shaft drives a main shaft of a workshop by means of a flat belt, the diameters of the pulleys being 500 mm and 800 mm respectively. Another pulley of diameter 600 mm on the main shaft drives a counter-shaft having a 750 mm diameter pulley. If the speed of the motor is 1600 rpm, find the speed of the countershaft neglecting the thickness of the belt and considering a slip of 4% on each drive. [5+10]

8. In a reverted epicyclic train, the arm A carries two wheels B and C and a compound wheel D-E. The wheel B gears with wheel E and wheel C gears with wheel D. The number of teeth on wheels B, C and D are 75, 30 and 90 respectively. Find the speed and direction of wheel C, when wheel B is fixed, and the arm A makes 100 RPM clock-wise. (Figure.1) [15]

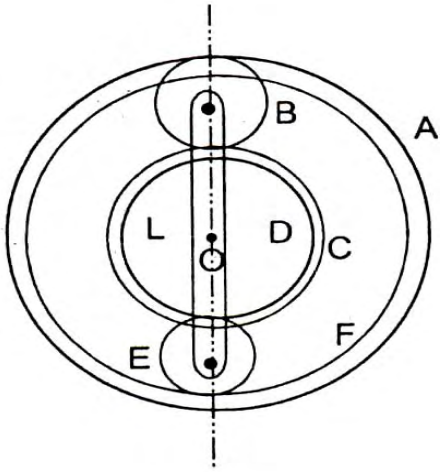

Figure.1

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