R09

Code No: 54014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2017
KINEMATICS OF MACHINERY
(Common to ME, AME)

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

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

1.a) What do you mean by degree of freedom of a kinematic pair? How are pairs classified? Give examples.

b) The mechanism, as shown in figure 1, is a four bar kinematic chain of which the centres A and B are fixed. The lengths are:
AB = 600 mm, AC = BD = CD = 300 mm. Find the point G on the centre line of the cross arm of which the locus is an approximately straight line even for considerable displacements from the position. [7+8]

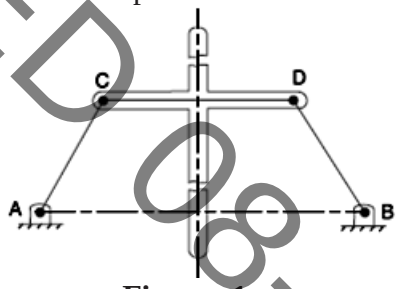

Figure: 1

2.a) Sketch and explain any two inversions of a double slider crank chain.

b) Sketch a pantograph, explain its working and show that it can be used to reproduce to an enlarged scale a given figure. [7+8]

3.a) Locate all the instantaneous centers of the slider crank mechanism as shown in figure 2. The lengths of crank 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.

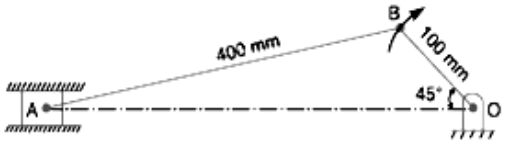

Figure: 2

b) Derive an expression for the magnitude and direction of coriolis component of acceleration. [8+7]

4.a) Four bar mechanism has the following dimensions:
DA = 300 mm; CB = AB = 360 mm; DC = 600 mm. The link DC is fixed and the angle ADC is 60^0. The driving link DA rotates uniformly at a speed of 100 r.p.m. clockwise and the constant driving torque has the magnitude of 50 N-m. Determine the velocity of the point B and angular velocity of the driven link CB. Also find the actual mechanical advantage and the resisting torque if the efficiency of the mechanism is 70 %.

b) Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an automobile. [8+7]

5. A cam consists of a circular disc of diameter 75 mm with its centre displaced 25 mm from the camshaft axis. The follower has a flat surface (horizontal) in contact with the cam and the line of action of the follower is vertical and passes through the shaft axis as shown in figure 3. The mass of the follower is 2.3 kg and is pressed downwards by a spring which has a stiffness of 3.5 N/mm. In the lowest position the spring force is 45 N. (a) Derive an expression for the acceleration of the follower in terms of the angle of rotation from the beginning of the lift. (b) As the cam shaft speed is gradually increased, a value is reached at which the follower begins to lift from the cam surface. Determine the camshaft speed for this condition. [15]

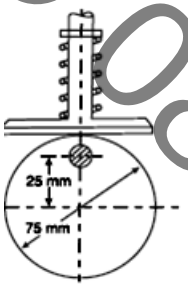

Figure: 3

6. Two mating gears have 20 and 40 involute teeth of module 10 mm and 20^0 pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum height for each gear wheel, length of the path of contact, arc of contact and contact ratio. [15]

7.a) Obtain an expression for the length of a chain.

b) Derive an expression for the ratio of the driving tensions in a rope drive assuming the angle of the groove of the pulley to be as 2 β. [7+8]

8.a) Two shafts A and B are co-axial. A gear C (50 teeth) is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. The gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. Sketch the arrangement and find the number of teeth on internal gear G assuming that all gears have the same module. If the shaft A rotates at 110 r.p.m., find the speed of shaft B.

b) An epicyclic gear train consists of a sun wheel 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 sun wheel S. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 N-m. Determine : (i) Number of teeth on different wheels of the train, and (ii) Torque necessary to keep the internal gear stationary. [8+7]

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Code No: 54014 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2018
KINEMATICS OF MACHINERY
(Common to ME, AME)

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

Answer any five questions
All questions carry equal marks
Illustrate your answers with NEAT sketches wherever necessary
- - -

1.a) Explain the terms**:** Kinematic link, Kinematic pair, Mechanism, and Inversion of a mechanism. Give two examples for each.
b) Which inversion of the double slider crank chain is used to connect two shafts whose axes are parallel and a short distance apart? Draw its sketch and explain how it works. [8+7]

2.a) Draw the sketch of Pantograph, and show how it can be used to regenerate the path of a point, either to an enlarge or reduced scale.
b) Draw the sketch of Tchebicheff mechanism, and derive the proportion of its links Required for a point in the mechanism to move in a straight line path. [7+8]

3. A mechanism with the dimensions of its links is shown in Figure 1. The crank OA is rotating *clockwise* with a uniform speed of 48 rpm. Determine the velocity and acceleration of the slider 'C'. [15]

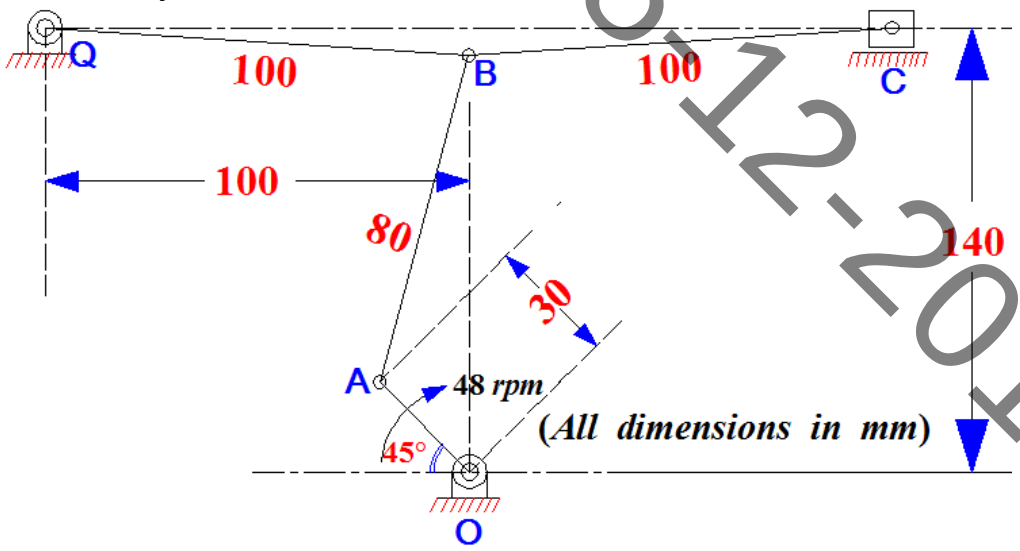

Figure: 1

4.a) Derive the condition for correct steering of an automobile.
b) A Hooke's joint connects two shafts which are having 160^0 as included angle. The driving shaft is rotating at 500 rpm. Find the maximum angular acceleration of the driven shaft and the maximum torque required, if the driven shaft carries a flywheel of mass 12 kg and radius of gyration 100 mm. [6+9]

5.a) What are the different types of motions used for the followers in Cams? Draw the displacement, velocity, and acceleration diagrams w.r.t. the angular motion of the Cam.

b) Derive the expressions for the velocity and acceleration of a roller follower when it moves over the flank portion of a circular arc cam. [7+8]

6.a) Explain the following with respect to belt drives**:**
Initial tension, Creep, Centrifugal tension.

b) A V – belt weighing 1.6 kg/m run has an area of cross section of 750 mm^2. The angle of lap is 165^0 on the smaller pulley which has a groove angle of 40^0. The maximum safe stress of the belt material is 9.5 N/mm^2. What is the power that can be transmitted by the belt at a speed of 20 m/s? Take $\mu = 0.12$. [6+9]

7.a) Explain what is meant by 'Interference' in involute gears, and derive a relation for the minimum number of teeth on the pinion and gear wheel required to avoid interference.

b) Two meshing spur gears with 20^0 pressure angle have a module of 4 mm. The centre distance is 220 mm, and the number of teeth on the pinion is 40. To what value should the centre distance be increased so that the pressure angle can be increased to 22^0? [8+7]

8.a) How do you select a suitable gear box for an automobile? Give reasons.

b) In an epicyclic gear train shown in Figure 2, an annular wheel 'A' having 54 teeth meshes with a planet wheel 'B' which gears with a sun wheel 'C'. The wheels 'A' and 'C' are co – axial. The wheel 'B' is carried on a pin fixed on one end of the arm 'P' which rotates about the axes of the wheels 'A' and 'C'. If 'A' makes 20 rpm *clockwise*, the arm rotates at 100 rpm *ccw*, and the wheel 'C' has 24 teeth, determine the speed and sense of rotation of the wheel 'C'. [7+8]

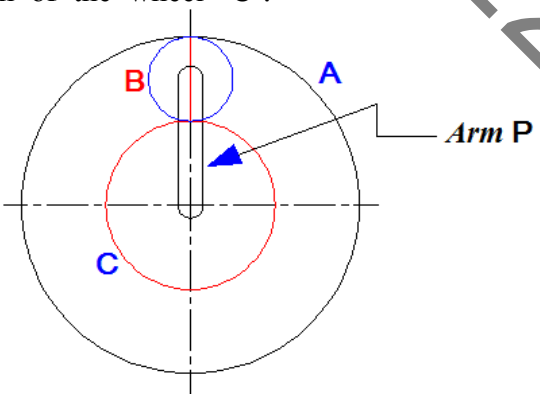

Figure: 2

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Code No: 54014 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, May - 2019
KINEMATICS OF MACHINERY
(Common to ME, AME)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.
ILLUSTRATE YOUR ANSWERS WITH NEAT SKETCHES WHEREVER NECESSARY

PART - A

(25 Marks)

1.a) Define Link, and give two examples for flexible links. [2]

b) What is *Gruebler's criterion* to find the degrees of freedom of a mechanism? Why is it sufficient to use the *Gruebler's criterion* instead of the *Kutzback's criterion* for plane mechanisms? [3]

c) Define and explain the 'Instantaneous Center of Rotation' of a kinematic link. What is its significance? [2]

d) If two links OA and OB are pin – jointed together at O as shown in the figure 1, define the terms**:** *Relative angular velocity* of OA with respect to OB, and the *Rubbing velocity* at the joint 'O'. [3]

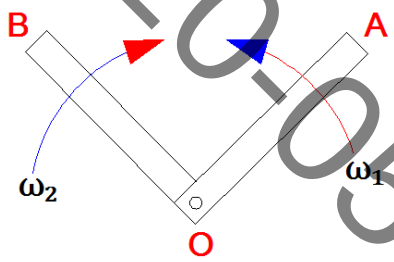

Figure: 1

e) What are the advantage and disadvantage of Davis steering gear? [2]

f) What is a Double Universal joint? What is its main advantage? [3]

g) Give the classification of cams according to the**:**
i) direction of displacement of the follower with respect to the axis of the cam
ii) shape of that part of the follower which is in contact with the cam. [2]

h) Define pressure angle with respect to cams. [3]

i) State the law of gearing. [2]

j) What are the three externally applied torques used to keep a gear train in equilibrium? [3]

PART - B

(50 Marks)

2. Describe, with neat sketches, the mechanisms obtained by the inversions of four bar chain. [10]

OR

3. In a crank and slotted lever quick return mechanism, the distance between the fixed centers is 240 mm , and the length of driving crank is 120 mm. Find the inclination of the slotted bar with the vertical in the extreme position, and the time ratio of cutting stroke to return stroke. If the length of slotted bar is 450 mm, find the length of stroke, if the line of stroke passes through the extreme positions of the free end of the lever. [10]

4. Locate all the instantaneous centers for the crossed four – bar mechanism shown in Figure 2 whose dimensions (in mm) are **:** CD = 65; CA = 60; DB = 80; AB = 55; ∠DCA = 30^0; Also find the angular velocities of the links AB and DB, if the crank CA rotates uniformly at 100 rpm *ccw*. [10]

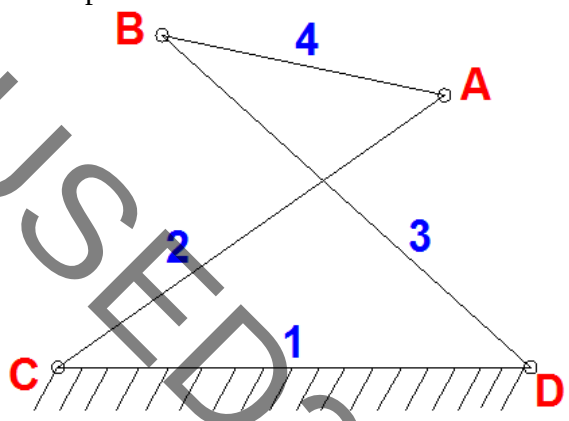

Figure: 2

OR

5. A four–bar mechanism is represented by a quadrilateral ABCD in which the fixed link AD is 400 mm long. The crank AB 75 mm long rotates at 120 rpm in *clockwise* direction, and drives the link CD 125 mm long by means of the coupler link BC which is 350 mm long. Find the angle through which CD oscillates. Also find the angular acceleration of BC, and acceleration of a point E on BC such that EC is 90 mm. [10]

6.a) For a Hooke's joint, prove that the maximum speed of the driven shaft (ω_1) is equal to **ω** cos α, where ω = angular velocity of the driving shaft, and α = angle of inclination of the driven shaft with the driving shaft.

b) Draw a neat sketch of the *Robert's mechanism*, and explain its working. How do you find the location of the (tracing) point *P* which produces the approximate straight line motion. [5+5]

OR

7.a) Draw a neat sketch of the *Ackermann Steering Gear Mechanism*, and describe its construction and working.

b) A circle, with AD as diameter, has a point B on its circumference. There is a point C on AB produced such that if B turns about A, the product AB × AC remains constant. Prove that the point C moves in a straight line perpendicular to AB produced. [5+5]

8. A cam rotating at 150 rpm operates a reciprocating roller follower of radius 25 mm. The least radius of the cam is 50 mm, and the follower lift is 40 mm. The line of stroke of the follower is offset 10 mm from the axis of the cam. The ascent of follower occurs with uniform and equal acceleration and retardation, and descent takes place with SHM. Ascent takes place during 75^0 of cam rotation, and descent occurs during 90^0 of cam rotation. Dwell between ascent and descent corresponds to 60^0 of cam rotation. Draw the profile of the cam, and compute the maximum velocity and acceleration during the outstroke and return stroke. [10]

OR

9. For a tangent cam operating a reciprocating roller follower, derive the expressions for displacement, velocity, and acceleration of the follower when the follower is in contact with the cam (a) between the roller and straight flank, and (b) between the roller and nose. Also find the maximum and minimum velocities and accelerations of the follower in both the above cases. [10]

10.a) With the help of a neat sketch, explain the working of a reverted gear train. Give at least two applications of the same. How do you find the train value for it?

b) A standard 20^0 pressure angle involute teeth gear with 32 teeth and module of 6 mm meshes with a rack without interference. Find (i) the addendum of the rack, and (ii) the minimum number of teeth on the gear wheel, if the rack has a standard addendum. [5+5]

OR

11.a) Draw a neat sketch and explain the working of differential gear in an automobile in obtaining different speeds for the inner and outer rear wheels of the automobile, while moving along a curved path.

b) A pair of involute spur gears have 12 and 13 teeth respectively, module of 10 mm, addendum of 10 mm, and pressure angle of 20^0. Check whether the gears have interference. [5+5]

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R09

Code No: 54014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, November/December - 2020
KINEMATICS OF MACHINERY
(Mechanical Engineering)

Time: 2 hours **Max. Marks: 75**

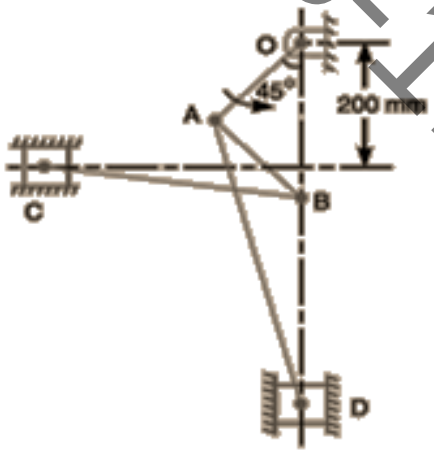
Answer any five questions
All questions carry equal marks
- - -

1.a) Explain different kinds of kinematic pairs giving example for each one of them.
b) Show that slider crank mechanism is a modification of the basic four bar mechanism. [7+8]

2.a) Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an automobile.
b) Two shafts are connected by a universal joint. The driving shaft rotates at a uniform speed of 1200 rpm. Determine the greatest permissible angle between the shaft axes so that the total fluctuation of speed does not exceed 100 rpm. Also calculate the maximum and minimum speeds of the driven shaft. [7+8]

3. Describe the Watt's parallel mechanism for straight line motion and derive the condition under which the straight line is traced. [15]

4. Explain how the velocities of a slider and the connecting rod are obtained in a slider crank mechanism. [15]



The dimensions of the various links of a pneumatic riveter are OA=175mm, AB=180 mm, AD=500mm and BC=325mm. Find the velocity ratio between C and ram D when OB is vertical. What will be the efficiency of the machine if a load of 2.5 kN on the piston C causes a thrust of 4 kN at the ram D? [15]

5.a) Why a roller follower is preferred to that of a knife edged follower?
b) Derive the expression for displacement, velocity and acceleration for a circular arc cam operating a flat faced follower when the contact is on circular nose. [7+8]

6.a) What do you understand by gear train? Discuss the various types of gear trains.
b) Explain the procedure adopted for designing the spur wheels. [8+7]

7.a) How does the velocity ratio of a belt drive effect, when some slip is taking place between the belt and the two pulleys?
b) Explain what do you understand by initial tension in a belt. [8+7]

8.a) What are the various types of the torques in an epicyclic gear train?
b) Explain with a neat sketch the sun and planet wheel. [8+7]

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R13

Code No: 114CZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, April - 2018
KINEMATICS OF MACHINES
(Common to ME, MCT)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Classify the kinematic pairs. [2]
b) What are equivalent mechanisms? [3]
c) What is Coriolis acceleration? [2]
d) Describe one application of relative velocity method. [3]
e) What is the purpose of pantograph mechanism? [2]
f) Describe one application of hook's joint. [3]
g) Differentiate radial and cylindrical cams. [2]
h) When does the maximum velocity is attained in SHM during forward stroke. [3]
i) What is the phenomenon of interference? [2]
j) What method is followed in drawing an involute profile? [3]

PART-B

(50 Marks)

2. Describe all the possible inversions of double slider crank chain mechanism. Give atleast one practical application for each inversion. [10]

OR

3.a) What is the mechanical advantage of a mechanism?
b) Find the maximum and minimum transmission angle for the mechanism as shown in figure 1. [5+5]
AB = 4 cm
AD = 12 cm
BC = 10 cm
CD = 7 cm

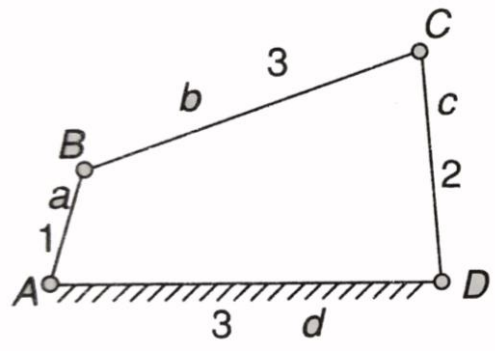

Figure: 1

4. In a four bar chain ABCD, AB is the driving link, CD the driven link and AD the fixed link. Show that the angular velocity of CD is to that of AB as QA is to QD, where Q is the point of intersection of BC and AD, produced if necessary. When the links AB,BC, CD and DA are respectively 62 mm, 175 mm, 112 mm and 200 mm long, the angle BAD is 60^0, AB and DC are on opposite sides of AD and the velocity of B is 3m/sec, find the velocity of C and the angular velocity of BC. [10]

OR

5. The mechanism of a whitworth quick return motion is shown in figure 2. The distance between the fixed centres O and C is 37 mm. The driving crank CP is 125 mm long, the slotted link OQ is 4 in long and the connecting link QR is 375 mm long. If CP makes 60 rpm, find for the given position the acceleration of R. What is the acceleration of R when it occupies the same position but is on the return stroke? [10]

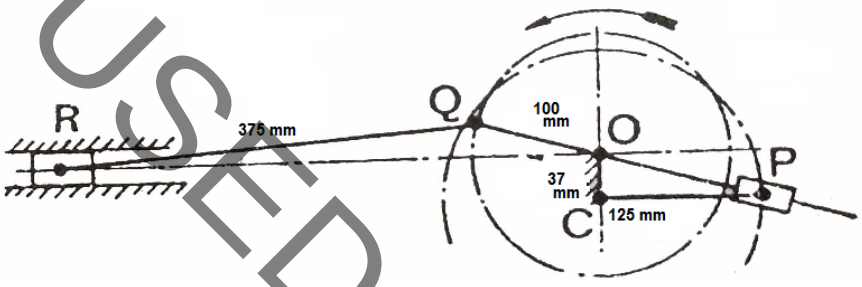

Figure: 2

6.a) Differentiate approximate and exact straight line mechanism.
b) Explain the principle of hart mechanism. [5+5]

OR

7. Explain the Peaucellier and Tchebicheff's straight line motion mechanisms. [10]

8. Construct the displacement diagram and cam profile for a plate cam with an oscillating radial flat face follower that rises through 30^0 with cycloidal motion with 150^0 of counter clockwise cam rotation, then dwells for 30^0, return with cycloidal motion with in 120^0 and dwells for 60^0. Determine the necessary length of the follower face allowing 5 mm clearance at each end. The prime circle radius is 30 mm and the follower pivot is 120 mm to the right. [10]

OR

9.a) Analyze the tangent cam with roller follower.
b) How many types of follower are used with the cam? Sketch and explain the same. [5+5]

10. An internal wheel B with 80 teeth is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel DE gears with the two internal wheels: D has 28 teeth and gears with C, while E gears with B. The compound wheel revolves freely on a pin which projects from a disc keyed to a shaft A coaxial with F. if the wheels all have the same itch and the shaft A makes 800 rpm, what is the speed of shaft F? If torque input to shaft A is 60 N.m, what is the load torque on shaft F and the holding torque on Wheel C? [10]

OR

11. Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20^0. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, find the a) Contact ratio b) Angle of action of the pinion and the gear wheel c) Ratio of the sliding to rolling velocity at the beginning of contact, pitch point and end of contact. [10]

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R13

Code No: 114CZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2017
KINEMATICS OF MACHINES
(Common to ME, MCT)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Define mechanical advantage and transmission angle of a mechanism. [2]
b) What is a kinematic pair? Classify kinematic pairs according to nature of relative motion. [3]
c) Name all the inversions of slider-crank mechanism with one application for each Inversion. [2]
d) Briefly explain about coriolis acceleration component. [3]
e) What is scott-russel mechanism? What is its limitation? [2]
f) Briefly explain Ackermann steering gear. [3]
g) Define base circle, pitch circle and pressure angle for cams. [2]
h) What is undercutting in cams? Explain. [3]
i) What type of gears are used for intersecting shafts? Explain. [2]
j) What is the difference between simple and compound gear trains? [3]

PART-B

(50 Marks)

2.a) What are the inversions of a four bar chain? Explain in detail.
b) A crank-rocker mechanism has a 60 mm fixed link, a 30mm crank, 50mm coupler and a 60 mm rocker. Draw the mechanism and determine the maximum and minimum transmission angles. [4+6]

OR

3.a) What are different types of constrained motion? Explain them in detail.
b) The length of a fixed link of a crank and slotted-lever mechanism is 250 mm and that of crank is 100 mm. Determine the Inclination of the slotted lever with the vertical in the extreme position and also find the quick-return ratio. [5+5]

4.a) Define instantaneous centre of rotation. State and prove Kennedy's theorem as applicable to instantaneous centres of rotation of three bodies.

b) In a slider crank mechanism, the lengths of the crank and the connecting rod are 200 mm and 800mm respectively. When the crank has turned 30^0 from its inner dead centre and it rotates at 40 rad/sec, find the velocity of slider. [5+5]

OR

5. For the configuration of a slider-crank mechanism shown in the figure 1, calculate the:
   a) Acceleration of the slider B
   b) Acceleration of the point E
   c) Angular acceleration of the link AB, OA rotates at 20rad/s CCW. [10]

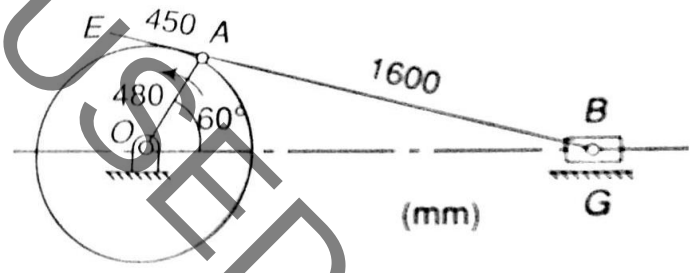

Figure: 1

6.a) Enumerate straight-line mechanisms. Why are they classified into exact and approximate straight-line mechanisms? Sketch all the mechanisms.

b) Sketch a paucellier mechanism. Prove that it can be used to trace a straight line. [5+5]

OR

7.a) What is an automobile steering gear? What are its types? Which steering gearing is preferred and why?

b) Derive an expression for the ratio of angular velocities of the shafts of a hooke's joint. [5+5]

8. 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 150^0 of the rotation followed by a period of dwell for 60^0. The follower descends for the next 100^0 rotation of the cam with uniform velocity again followed by a dwell period. The cam rotates at uniform velocity of 120 rpm and has a least radius of 20mm. [10]

OR

9.a) What is a follower? Discuss about different types of followers.

b) Deduce the expressions for the velocity and acceleration of the follower when it moves with simple harmonic motion. [5+5]

10.a) Discuss the various terms used in gear terminology and explain them with a neat sketch.

b) Derive expressions for arc of contact of pinion and gear with a neat sketch. [5+5]

OR

11.a) What is meant by interference in involute gears? Explain.

b) Below figure 2 shows a gear train in which gears D-E and F-G are compound gears. D gears with F; and G gears with C. the numbers of teeth on each gear are A=30 B=120, C=135, D=30, E=75, F=30, G=60. If the wheel A is fixed and the arm makes20 revolutions clockwise, find the revolutions of B and C. [4+6]

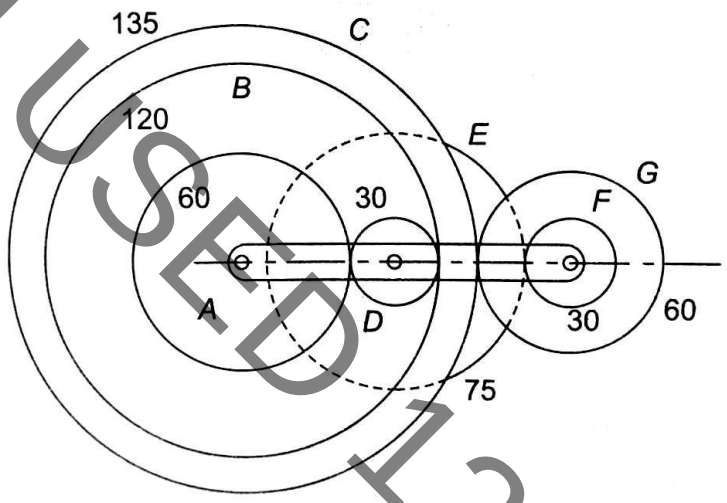

Figure: 2

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R13

Code No: 114CZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2018
KINEMATICS OF MACHINES
(Common to ME, MCT)

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

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Part A is compulsory which carries 25 marks. Answer all questions in Part A.
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Each question carries 10 marks and may have a, b, c as sub questions.
Illustrate your answers with NEAT sketches wherever necessary.

PART- A **(25 Marks)**

1.a) What is 'Inversion' of a mechanism? Give one example. [2]
b) Distinguish between Rigid Link, flexible link, and fluid link. [3]
c) Write the *approximate* expressions for the displacement, velocity and acceleration of slider of a single slider crank mechanism with the usual notation. [2]
d) Draw the velocity diagram of a single slider crank mechanism by Klien's construction and write the expressions for the velocity of crank, connecting rod, and piston in terms of the uniform angular speed of the crank. [3]
e) What is a Pantograph, and why is it used? [2]
f) Derive the condition for correct steering. [3]
g) Explain how do you draw the displacement diagram for a follower having a motion of uniform acceleration and retardation, the acceleration being twice the retardation? [2]
h) What is the difference between a tangent cam and circular arc cam with convex flanks? [3]
i) Draw and explain the different types of helical gears. [2]
j) Sketch a reverted gear train. Where is it used? [3]

PART-B

(50 Marks)

2.a) Explain the different types of constrained motion for a kinetic chain.
b) Determine the degrees of freedom of the mechanisms shown in figure 1. [4+6]

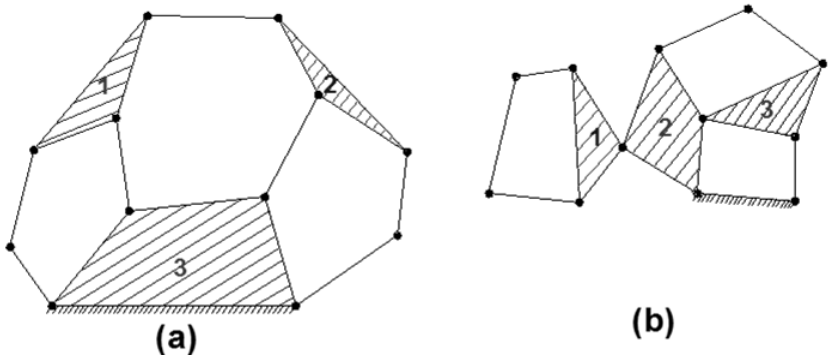

Figure: 1

OR

3.a) Draw and explain the working of the double-crank mechanism as an inversion of a four-bar chain.

b) In a crank and slotted lever mechanism, the distance between fixed centers is 180 mm, and the crank length is 70 mm. If the length of the slotted lever is 450 mm, find the ratio of the times taken during the cutting and return strokes and also determine the effective stroke length. [5+5]

4. A sewing machine needle-bar mechanism shown in figure 2 has the following dimensions of links**:** O_1A = 1.6 cm; O_2B = 2.2 cm; Vertical distance between O_1 and O_2 = 4 cm; Horizontal distance between O_1 and O_2 = 1.3 cm; AB = 3.5 cm; BC = 1.6 cm; 'D' lies vertically below O_1. If the crank O_1A rotates clockwise uniformly at 150 rpm, find the velocity of the needle at the point 'D'. Solve by the Instantaneous Center Method. [10]

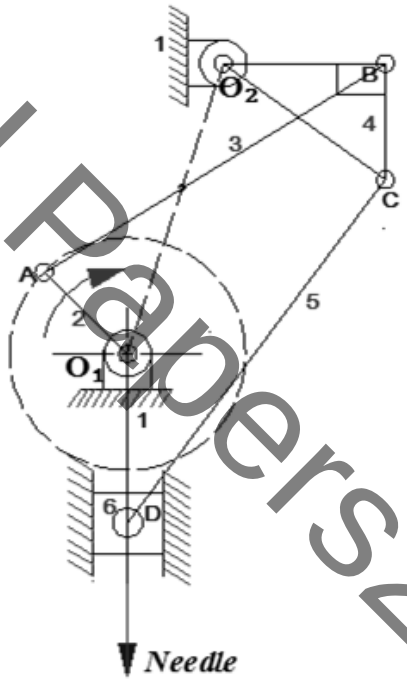

Figure: 2

OR

5. In the mechanism shown in Figure 3, O_1O_2 = 210 mm; O_1B = 300 mm; and O_2A = 60 mm. The crank O_2A rotates uniformly at 300 rpm *ccw*. Find the:
a) velocity, b) acceleration of the slider and c) linear acceleration of the point 'B'. [3+3+4]

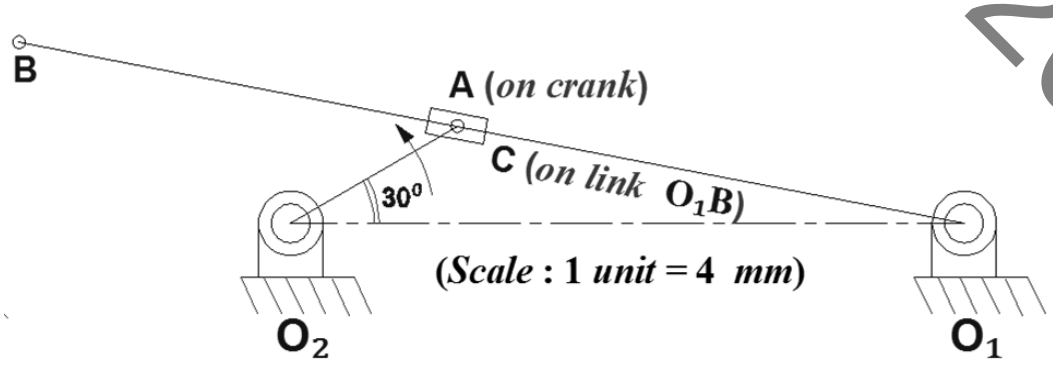

Figure: 3

6.a) Derive the relation to show how a pantograph can be used as a copying mechanism.

b) Show how the Hart mechanism satisfies the condition for exact straight line motion. [5+5]

OR

7. Draw a neat diagram of the Davis steering gear, and prove that it exactly satisfies the condition for correct steering. [10]

8. In a cam having a speed of 300 rpm, the distance between the axes of Follower and Cam is 20 mm. Each of the angles of ascent and descent is 75^0, and the angle of dwell between ascent and descent is 30^0. Lift of the follower is 25 mm, and roller diameter is 37.5 mm. The outward stroke of the follower takes place with uniform and equal acceleration and retardation, and the inward stroke with SHM. Draw the profile of the Cam, and determine the maximum velocity and acceleration of the follower during ascent and descent. [10]

OR

9. A symmetrical circular cam operates a flat-faced follower with a lift of 30 mm. The minimum radius of the cam is 50 mm, and the nose radius is 12 mm. The angle of lift is 80^0. If the speed of the cam is 210 rpm, find the main dimensions of the cam, and the acceleration of the follower at:
a) the beginning of the lift, and
b) the apex of the nose. [5+5]

10.a) The figure 4 shows a compound gear train. The power is transmitted from a motor shaft to output shaft. The motor shaft is connected to gear 1 whereas the output shaft is connected to gear 4. The gears 2 and 3 are mounted on the same shaft. The gear 1 meshes with gear 2 whereas gear 3 meshes with gear 4. The motor shaft is rotating at 1200 r.p.m. in the clockwise direction. Find the direction and speed of output shaft if the no. of teeth on gears 1, 2, 3 and 4 are 25, 50, 20, and 40.

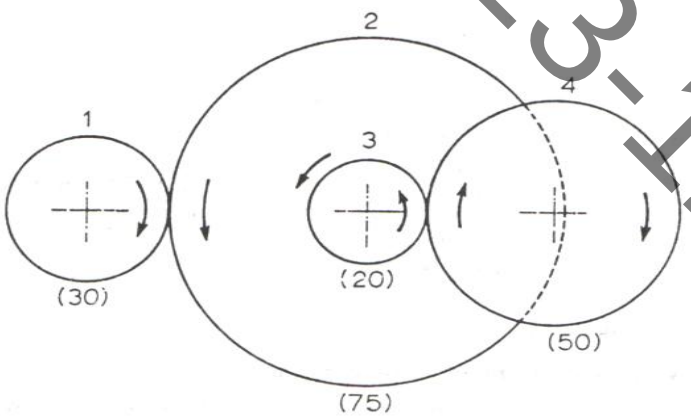

Figure: 4

b) Describe the selection of gear box for an automobile. [5+5]

OR

11. Two 20^0 pressure angle involute gears in mesh have a module of 10 mm. 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? [10]

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R09

Code No: 54014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, April - 2018
KINEMATICS OF MACHINERY
(Common to ME, AME)

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

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

1.a) What is the significance of degree of freedom of a kinematic chain when it functions as a mechanism? Give examples.

b) The figure 1 shows the link GAB which oscillates on a fixed centre at A and the link FD on a fixed centre at F. The link AB is equal to AC and DB, BE, EC and CD are equal in length.

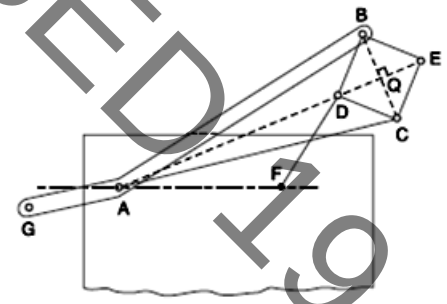

Figure: 1

i) Find the length of AF and the position of centre F so that the point E may move in a straight line.
ii) If the point E is required to move in a circle passing through centre A, what will be the path of point D? [7+8]

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. [8+7]

3.a) State and prove the 'Aronhold Kennedy's Theorem' of three instantaneous centres.

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
ii) Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45^0 from inner dead centre position. [7+8]

4.a) Locate all the instantaneous centers for a four bar mechanism as shown in figure 2. The lengths of various links are:
AD = 125 mm; AB = 62.5 mm; BC = CD = 75 mm.
If the link AB rotates at a uniform speed of 10 r.p.m. in the clockwise direction, find the angular velocity of the links BC and CD.

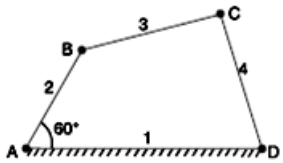

Figure: 2

b) Derive an expression for the ratio of shafts velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed. [8+7]

5. A symmetrical circular cam operating a flat-faced follower has the following particulars:
Minimum radius of the cam = 30 mm ; Total lift = 20 mm ; Angle of lift = 75^0; Nose radius = 5 mm ; Speed = 600 r.p.m. Find: (a) the principal dimensions of the cam (b) the acceleration of the follower at the beginning of the lift, at the end of contact with the circular flank, at the beginning of contact with nose and at the apex of the nose. [15]

6. Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20°. The pinion rotates at 90 r.p.m. Determine: (a) The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel, (b) The length of path and arc of contact, (c) The number of pairs of teeth in contact, and (d) The maximum velocity of sliding. [15]

7.a) Derive the condition for transmitting the maximum power in a flat belt drive.
b) Explain the phenomena of 'slip' and 'creep' in a belt drive. [8+7]

8.a) Two bevel gears A and B (having 40 teeth and 30 teeth) are rigidly mounted on two co-axial shafts X and Y. A bevel gear C (having 50 teeth) meshes with A and B and rotates freely on 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. clockwise and arm rotates at 100 r.p.m. anitclockwise, find the speed of shaft Y.
b) In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 r.p.m. clockwise. [8+7]

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