Code No: R1622031 **R16** SET - 1

II B. Tech II Semester Regular/Supplementary Examinations, April/May - 2019
KINEMATICS OF MACHINARY
(Com to ME, AME, MIN)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) What is a machine? Giving example, differentiate between a machine and a structure? (2M)
   b) Explain the difference between Davis & Ackermann's steering gear? (2M)
   c) State and prove the 'Aronhold Kennedy's Theorem' of three instantaneous centres? (2M)
   d) Explain the terms: **(i)** Module, **(ii)** Pressure angle, and **(iii)** Addendum. (2M)
   e) Write short notes on cams and followers with examples? (3M)
   f) Discuss briefly the various types of belts used for the transmission of power. (3M)

PART -B

2. a) Sketch and describe the working of two different types of quick return mechanisms. Give examples of their applications. (7M)
   b) Sketch and explain any two inversions of a double slider crank chain? (7M)

3. a) What are straight line mechanisms? Describe exact straight line motion mechanisms with the help of sketches? (7M)
   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. (7M)

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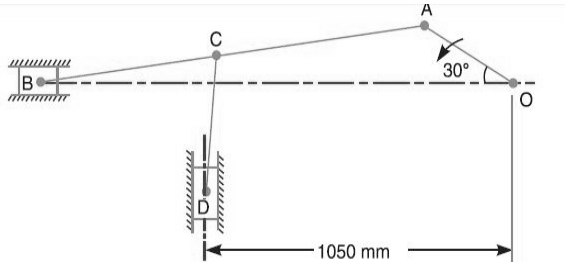
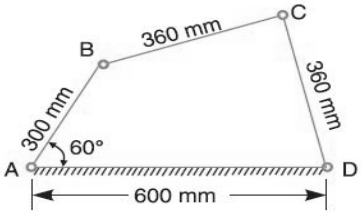
4. a) In the mechanism, as shown in Fig. the crank OA rotates at 20 r.p.m. A.C.W direction and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. (7M)
For the given configuration, determine: **1.** velocities of sliding at B and D, **2.** angular velocity of CD, **3.** linear acceleration of D, and **4.** angular acceleration of CD



b) In a pin jointed four bar mechanism, as shown in Fig. below AB = 300 mm, BC = CD = 360mm, and AD = 600 mm. The angle BAD = 60°. The crank AB rotates uniformly at 100 r.p.m. Locate all the instantaneous centres and find the angular velocity of the link BC. (7M)



5. a) Construct the profile of a cam to suit the following specifications: Cam shaft diameter = 40 mm; Least radius of cam = 25 mm; Diameter of roller = 25 mm; Angle of lift = 120° ; Angle of fall = 150°; Lift of the follower = 40 mm; Number of pauses are two of equal interval between motions. During the lift, the motion is S.H.M. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line of stroke of the follower is off-set 12.5 mm from the centre of the cam. (7M)

b) Derive expressions for displacement, velocity and acceleration for a tangent cam operating on a radial-translating roller follower when the contact is on straight flank. (7M)

6. a) Explain the difference between cycloidal and involute profiles with sketches? (7M)

b) Derive an expression for Length of path of contact and Arc of contact? (7M)

7. 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? (7M)

b) Discuss briefly the various types of belts used for the transmission of power. (7M)

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PART –A

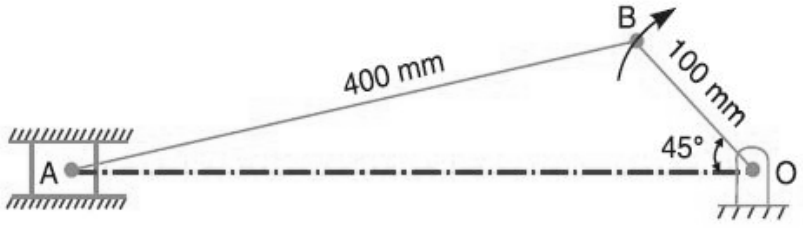
1. a) Explain different kinds of kinematic pairs giving example for each one of them? (2M)
   b) Explain working of pantograph with neat sketch? (2M)
   c) Define the terms 1.Centrode 2. Axode (2M)
   d) Write short notes on reverted gear train with neat sketch? (2M)
   e) Define the terms (a) Base circle, (b) Pitch circle, (c) Pressure angle? (3M)
   f) What do you understand by the term 'interference' as applied to gears? (3M)

PART -B

2. a) Sketch and explain inversions of four bar chain mechanism. Why it is considered to be the basic chain? (7M)
   b) Sketch and explain **i)** Crank and slotted bar inversion **ii)** Elliptical trammel (7M)

3. a) What is the condition for correct steering? Sketch and show the two main types of Steering gears and discuss their relative advantages? (7M)
   b) What are straight line mechanisms? Describe any four approximate straight line motion mechanisms with the help of sketches? (7M)

4. a) PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ= 62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS? (7M)
   b) Locate all the instantaneous centres of the slider crank mechanism as shown in Fig. 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: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod AB. (7M)



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5. a) A cam drives a flat reciprocating follower in the following manner: During first 120° rotation of the cam, follower moves outwards through a distance of 20 mm with simple harmonic motion. The follower dwells during next 30° of cam rotation. During next 120° of cam rotation, the follower moves inwards with simple harmonic motion. The follower dwells for the next 90° of cam rotation. The minimum radius of the cam is 25 mm. Draw the profile of the cam. (7M)

   b) Derive the expressions for displacement, velocity and acceleration for a circular arc cam operating a flat-faced follower when the contact is on the circular flank. (7M)

6. a) Derive an expression for the minimum number of teeth required on the pinion in order to avoid interference in involute gear teeth when it meshes with wheel. (7M)

   b) State and prove the law of gearing. (7M)

7. a) A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at a speed of 90 r.p.m. The angle of lap is 160° ; the angle of groove 45° ; the coefficient of friction 0.28 ; the mass of rope 1.5 kg / m and the allowable tension in each rope 2400 N. Find the number of ropes required. (7M)

   b) Explain working of differential gear of an automobile with neat sketch? (7M)

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PART –A

1. a) Explain the terms: i. Lower pair, ii. Higher pair, iii. Kinematic chain, and iv. Inversion. (2M)
   b) What is the condition for correct steering? (2M)
   c) Define rubbing velocity at a pin joint. What will be the rubbing velocity at pin joint when the two links move in the same and opposite directions? (2M)
   d) Write the relation between the number of instantaneous centres and the number of links in a mechanism. (2M)
   e) What are the methods to avoid 'interference' in gears? (3M)
   f) Explain the phenomena of 'slip' and 'creep' in a belt drive? (3M)

PART -B

2. a) Sketch and explain any two inversions of a double slider crank chain. (7M)
   b) Explain different kinds of kinematic pairs giving example for each one of them. (7M)

3. a) Give a neat sketch of the straight line motion 'Hart mechanism.' Prove that it produces an exact straight line motion. (7M)
   b) Explain the difference between Davis & Ackermann's steering gear? (7M)

4. a) In a slider crank mechanism, the length of crank OB and connecting rod AB are 125 mm and 500 mm respectively. The centre of gravity G of the connecting rod is 275 mm from the slider A. The crank speed is 600 r.p.m. clockwise. When the crank has turned 45° from the inner dead centre position, determine: 1. velocity of the slider A, 2. velocity of the point G, and 3. angular velocity of the connecting rod AB. (7M)
   b) State and prove the 'Aronhold Kennedy's Theorem' of three instantaneous centres. (7M)

5. a) A disc cam is to give uniform motion to a knife edge follower during out stroke of 50 mm during the first half of the cam revolution. The follower again returns to its original position with uniform motion during the next half of the revolution. The minimum radius of the cam is 50 mm and the diameter of the cam shaft is 35 mm. Draw the profile of the cam when 1. the axis of follower passes through the axis of cam shaft, and 2. the axis of follower is offset by 20 mm from the axis of the cam shaft. (7M)
   b) Explain with sketches the different types of cams and followers. (7M)

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6. a) The pitch circle diameter of the smaller of the two spur wheels which mesh externally and have involute teeth is 100 mm. The number of teeth are 16 and 32. The pressure angle is 20° and the addendum is 0.32 of the circular pitch. Find the length of the path of contact of the pair of teeth. (7M)
   b) Derive an expression for Length of path of contact and Arc of contact? (7M)

7. a) Power is transmitted using a V-belt drive. The included angle of V-groove is 30°. The belt is 20 mm deep and maximum width is 20 mm. If the mass of the belt is 0.35 kg per metre length and maximum allowable stress is 1.4 MPa, determine the maximum power transmitted when the angle of lap is 140°. μ = 0.15. (7M)
   b) Two parallel shafts, about 600 mm apart are to be connected by spur gears. One shaft is to run at 360 r.p.m. and the other at 120 r.p.m. Design the gears, if the circular pitch is to be 25 mm. (7M)

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PART –A

1. a) In what way a mechanism differ from a machine? (2M)

   b) Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an Automobile. (2M)

   c) Write the relation between the number of instantaneous centres and the number of links in a mechanism. (2M)

   d) What are the different types of motion with which a follower can move? (2M)

   e) Write a short note on law of gearing? (3M)

   f) Explain with a neat sketch the 'sun and planet wheel? (3M)

PART -B

2. a) Explain the terms: i. Lower pair, ii. Higher pair, iii. Kinematic chain, and iv.Inversion. (7M)

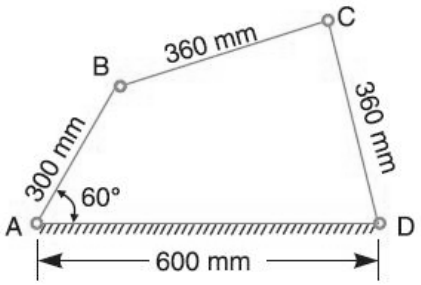
   b) Sketch and explain Whitworth quick return motion mechanism? (7M)

3. a) Give a neat sketch of the straight line motion 'Hart mechanism.' Prove that it produces an exact straight line motion (7M)

   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. (7M)

4. a) Derive an expression for the magnitude and direction of coriolis component of acceleration. (7M)

   b) In a pin jointed four bar mechanism, as shown in Fig. below AB = 300 mm, BC = CD = 360mm, and AD = 600 mm. The angle BAD = 60°. The crank AB rotates uniformly at 100 r.p.m. Locate all the instantaneous centres and find the angular velocity of the link BC. (7M)



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5. a) Define the following terms as applied to cam with a neat sketch: (7M)
(i) Base circle, (ii) Pitch circle, (iii) Pressure angle, and (iv) Stroke of the follower.
b) Derive expressions for displacement, velocity and acceleration for a tangent cam operating on a radial-translating roller follower, when the contact is on straight flank? (7M)

6. a) A pair of gears, having 40 and 30 teeth respectively are of 25° involute form. The addendum length is 5 mm and the module pitch is 2.5 mm. If the smaller wheel is the driver and rotates at 1500 r.p.m., find the velocity of sliding at the point of engagement and at the point of disengagement. (7M)
b) Derive an expression for Length of path of contact and Arc of contact? (7M)

7. a) 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 the other at 360 r.p.m., find the number of teeth on each wheel, if the module is 8 mm. Also determine the exact distance apart of the shafts. (7M)
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 the other at 360 r.p.m., find the number of teeth on each wheel, if the module is 8 mm. Also determine the exact distance apart of the shafts. (7M)

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