II B. Tech I Semester Regular/Supplementary Examinations, December-2023
KINEMATICS OF MACHINERY
(Mechanical Engineering)

Time: 3 hours   Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Discuss various types of constrained motion.   [7M]

   b) Use the Kutzbach's criterion to determine the mobility of the mechanism   [7M]
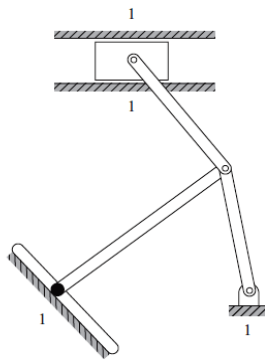   shown in figure 1.

Figure 1.

OR

2 a) Explain different kinds of kinematic pairs giving example for each one of them.   [7M]

   b) What is Kutzback's criterion for degree of freedom of plane mechanisms? In   [7M]
       what way is Grubler's criterion different from it?

UNIT-II

3 a) Sketch a Paucellier mechanism. Show that it can be used to trace a straight line.   [7M]

   b) What is the condition for correct steering? Sketch and explain Davis Steering   [7M]
       gear mechanism.

OR

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

   b) What is Grasshopper mechanism? What is its limitation?   [7M]

UNIT-III

5 a) Explain with sketch the instantaneous centre method for determination of   [7M]
       velocities of links and mechanisms.

   b) Draw the acceleration diagram of a slider crank mechanism.   [7M]

OR

6	a)	Locate all instantaneous centres of the slider crank mechanism; the length of crank OB and Connecting rod AB are 125 mm and 500 mm respectively. The crank speed is 600 rpm clockwise. When the crank has turned 45° from the IDC. Determine Angular Velocity of connecting rod 'AB'.	[10M]
	b)	Write the graphical approach for the velocity & acceleration diagram.	[4M]

UNIT-IV

7	a)	Derive an expression for displacement, velocity and acceleration of a tangent cam with roller follower. When roller is in contact with flank.	[7M]
	b)	Discuss the effect of slip of belt on the pulleys on velocity ratio of a belt drive.	[7M]

OR

8	a)	Derive relations for velocity and acceleration for a convex cam with a flat faced follower.	[7M]
	b)	Obtain an expression for the length of a belt in an open belt drive.	[7M]

UNIT-V

9	a)	Derive an equation to determine the length of path of contact by a pair of mating spur gear.	[7M]
	b)	Explain briefly the differences between simple, compound, and epicyclic gear trains. What are the special advantages of epicyclic gear trains?	[7M]

OR

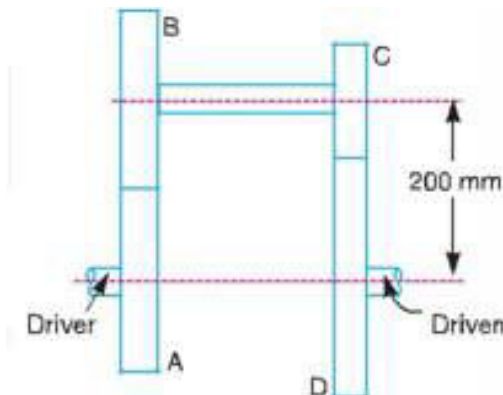|			
10	a)	What is a worm and worm wheel? Where is it used?	[4M]
	b)	The speed ratio of the reverted gear train, as shown in Figure 2, is to be 12. The module pitch of gears A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth.	[10M]

Figure 2

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SET - 2

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UNIT-I

1   a) 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.   [7M]

    b) Explain Grash off's law criterion for determining degree of freedom for mechanisms   [7M]

OR

2   a) Explain different types of Links.   [7M]

    b) What is the significance of degrees of freedom of a kinematic chain when it functions as a mechanism? Give examples.   [7M]

UNIT-II

3   a) What is Scott-Russel mechanism? What is its limitation? How is it modified?   [7M]

    b) What is the condition for correct steering? Sketch and explain Ackermans Steering gear mechanism.   [7M]

OR

4   a) Explain with neat sketch about Robert's mechanism.   [7M]

    b) The track arm of a Davis steering gear is at a distance of 185 mm from the front main axle where as the difference between their lengths is 90 mm. If the distance between steering pivots of the main axle is 1.2 m, determine the length of the chassis between the front and the rear wheels. Also find the inclination of the track arms to the longitudinal axis of the vehicle.   [7M]

UNIT-III

5   a) State and prove the Kennedy's theorem as applicable to instantaneous centres of rotation of three bodies.   [7M]

    b) Describe the procedure to construct velocity diagram of a four-bar linkage.   [7M]

OR

6   a) Derive the expression for Coriolis component of acceleration with neat sketch.   [7M]

    b) 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.   [7M]

UNIT-IV

7   a) With the help at neat sketches explain the types of cams.   [7M]

|'''|'|'|'|'||'''||||

    b) A flat belt is required to transmit 35 kW from a pulley of 1.5 m effective diameter running at 300 r.p.m. The angle of contact is spread over 11/24 of the circumference and the coefficient of friction between belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1.1 Mg/m^3 and the related permissible working stress is 2.5 MPa.   [7M]

<div align="center">OR</div>

8   a) Derive the expression for velocity and acceleration during outstroke and return stroke of the follower.   [7M]

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

<div align="center">UNIT-V</div>

9   a) Derive a relation for minimum number of teeth on a gear wheel to avoid interference.   [7M]

    b) Explain the common materials used for gears.   [7M]

<div align="center">OR</div>

10 a) What is meant by interference in involute gears? Explain.   [7M]

    b) A pair 20° full depth involute spur gear having 30 and 50 teeth respectively module 4 mm arc in mesh, the smaller gear rotates at 1000 rpm. Determine
(i) Sliding velocities at engagement and disengagement of a pair of teeth and
(ii) Contact ratio   [7M]

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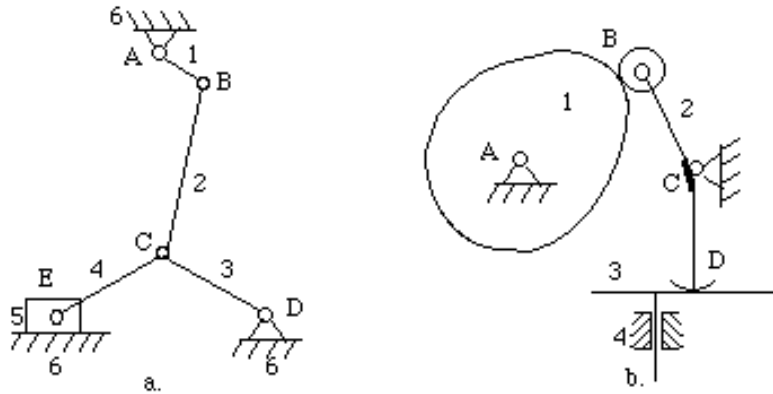(Mechanical Engineering)

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UNIT-I

1 a) Calculate the degrees of freedom of the mechanisms shown in Figure a and b   [10M]

b) Write down the Grashoff's law for a four-bar mechanism.   [4M]

OR

2 a) Sketch and explain the various inversions of a four-bar chain.   [7M]

b) Explain about various types of constrained motion.   [7M]

UNIT-II

3 a) Explain the difference between Davis & Ackermann's steering gear.   [7M]

b) Give a neat sketch of the straight-line motion 'Hart mechanism'. Prove that it produces an exact straight-line motion.   [7M]

OR

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

b) How can we ensure that a Chebicheff traces on approximate straight line?   [7M]

UNIT-III

5 a) Derive the expressions for Velocity and acceleration of piston in reciprocating steam engine mechanism with neat sketch.   [7M]

b) Explain the procedure to determine the velocity and acceleration of a slider crank mechanism by Klein's construction.   [7M]

OR

|'''|'|'|'||'''||||

6　a)　For a single slider crank chain mechanism, crank OB=100mm, connecting rod AB=400mm. if the crank rotates at an angular velocity of 10 rad/Sec clockwise. Determine velocity and acceleration of slider by Klein's construction method.　[7M]

　　b)　In a slider crank mechanism, the length of the crank and the connecting rod are 100 mm and 400 mm respectively. The crank position is 45° from IDC, the crank shaft speed is 600 r.p.m. clockwise. Using analytical method Determine Velocity and acceleration of the slider.　[7M]

UNIT-IV

7　a)　Draw the displacement, velocity and acceleration diagrams for a follower when it moves with uniform acceleration and retardation.　[7M]

　　b)　What are the different types of follower motion explain them?　[7M]

OR

8　a)　A tangent cam to drive a roller follower through a total lift of 12.5 mm for a cam rotation of 75°.The cam speed is 600 rpm. The distance between cam centre and follower centre at full lift is 45 mm and the roller is 20 mm in diameter. Find the velocity and acceleration for one full cycle.　[7M]

　　b)　Derive the expression for displacement, velocity, acceleration of a reciprocating roller follower when the roller has contact with the nose.　[7M]

UNIT-V

9　a)　What is a worm and worm wheel? Where is it used?　[7M]

　　b)　A pair 20° full depth involute spur gear having 30 and 50 teeth respectively module 4 mm arc in mesh, the smaller gear rotates at 1000 rpm. Determine (i) Sliding velocities at engagement and disengagement of a pair of teeth and (ii) Contact ratio　[7M]

OR

10　a)　Differentiate between a compound and simple gear　[7M]

　　b)　Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and pinions 13 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference?　[7M]

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UNIT-I

1 a) Explain the term kinematic link. Give the classification of kinematic link.   [7M]

    b) Distinguish among complete, incomplete and successful constraint relative motion between two elements or links.   [7M]

OR

2 a) Classify and explain the Kinematic pairs.   [7M]

    b) What is the significance of degrees of freedom of a kinematic chain when it functions as a mechanism? Give examples.   [7M]

UNIT-II

3 a) What are the different types of exact straight line motion mechanisms and explain each of them   [7M]

    b) What is the condition for correct steering? Sketch and show the two main types of steering gears and discuss their relative advantages   [7M]

OR

4 a) For an Ackermann steering gear, derive the expression for the angle of inclination of the track arms to longitudinal axis of the vehicle.   [7M]

    b) In a Davis steering gear, the length of the car between axles is 2.4m and steering pivots are 1.35m apart. Determine inclination of track arms to longitudinal axis of car when car moves in a straight path.   [7M]

UNIT-III

5 a) Explain with sketch the instantaneous centre method for determination of velocities of links and mechanisms   [7M]

    b) Explain the procedure to determine the velocity and acceleration of a four-bar mechanism by Klein's construction.   [7M]

OR

6 a) link AB of the mechanism shown in the figure rotates uniformly in a clockwise direction at 200 r.p.m. If the lengths of the links are AB= 60 mm, BC= 160 mm, CD=100 mm, AD=200 mm, EF=200 mm and EC=40 mm, determine the linear velocity and acceleration of F for the position shown   [7M]
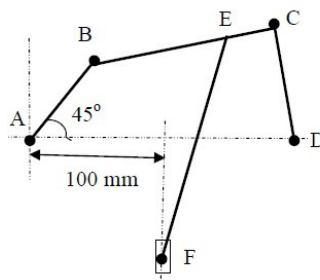
b) Describe the procedure to construct velocity diagram of a four-bar linkage. [7M]

UNIT-IV

7 a) Discuss briefly the various types of belts used for the transmission of power. [7M]
 b) Obtain an expression for the length of a belt in an open belt drive. [7M]

OR

8 a) Derive the ratio of friction tensions in a V-belt drive. [7M]
 b) What are the materials used for belt and rope drives. [7M]

UNIT-V

9 a) In a reverted epicyclic gear train, the arm A carries two gears B and C and a [7M]
 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
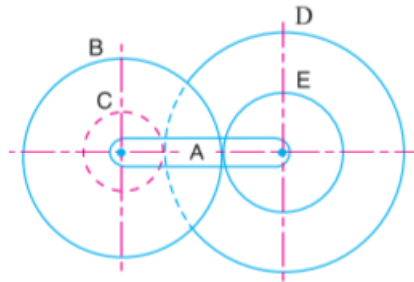
 b) What is the helical gear? What is the advantage of helical gears? [7M]

OR

10 a) A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm [7M]
 isin mesh. The number of teeth on pinion is 16 and its rotational speed is
 240r.p.m.When the gear ratio is 1.75, find in order that the interference is just
 avoided; i) the addenda on pinion and gear wheel; ii) the length of path of
 contact; and iii) the maximum velocity of sliding of teeth on either side of the
 pitch point.

 b) Define and explain the term with the help of a neat sketch (i) path of approach, [7M]
 (ii)path of recess (iii) path of contact between two mating gears.