SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603203

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

IV SEMESTER

1909401 - KINEMATICS OF MACHINERY

Regulation–2019

Academic Year 2022-2023 (Even Semester)

Prepared by

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SUBJECT CODE / NAME : 1909401 / KINEMATICS OF MACHINERY

SEMESTER / YEAR : IV SEMESTER / II YEAR

UNIT I - BASICS OF MECHANISMS

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler‟s criterion – Grashof‟s Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

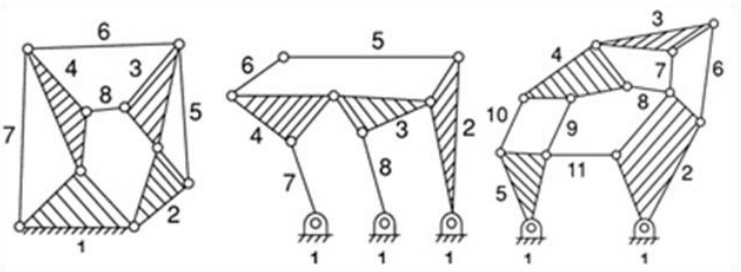
PART – A (2 MARKS)

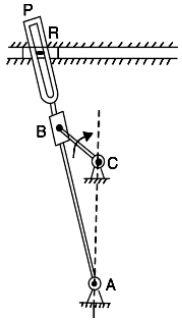
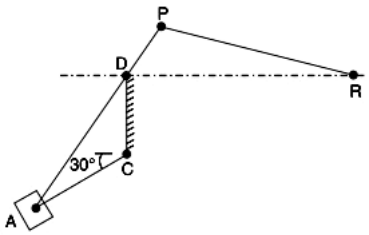
Sl.No	QUESTIONS	LEVEL	COMPETENCE
1	Define “kinematic link”.	BTL1	Remember
2	Compare Machine and Structure.	BTL4	Analyze
3	Classify the types of links.	BTL1	Remember
4	What is meant by successfully constrained motion?	BTL2	Understand
5	Compare lower and higher pair of joints.	BTL4	Analyze
6	What are some important inversions of four chain mechanism?	BTL1	Remember
7	What is meant by toggle position?	BTL2	Understand
8	What is the use of pantograph?	BTL2	Understand
9	Give the applications of single slider crank mechanism.	BTL1	Remember
10	Write down Kutzbach criterion to find the mobility of a planar mechanism.	BTL1	Remember
11	List the purpose of Elliptical trammel.	BTL2	Understand
12	Define kinematic pair.	BTL1	Remember
13	Define mechanical advantage with suitable sketch.	BTL1	Remember
14	What is meant by transmission angle?	BTL2	Understand
15	What is the mechanism used in Ackermann steering?	BTL2	Understand

16	State the Grashof‟s Law for a four bar mechanism.	BTL1	Remember
17	State the working principle of bicycle bells.	BTL1	Remember
18	What is meant by motion adjustment mechanism?	BTL2	Understand
19	Whether a cycle chain is kinematic chain or not?	BTL2	Understand
20	State the purpose of using offset slider crank mechanism.	BTL2	Understand
21	Under what conditions a kinematic chain become a mechanism?	BTL2	Understand
22	Differentiate between machine and mechanism.	BTL4	Analyze
23	Name some straight line generating mechanisms.	BTL1	Remember
24	Define mechanical advantage.	BTL1	Remember
25	Name the inversions of 4 bar mechanism.	BTL1	Remember

PART – B (13 MARKS)

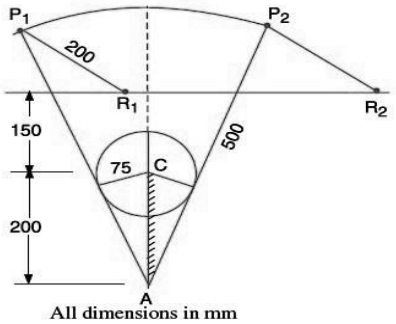
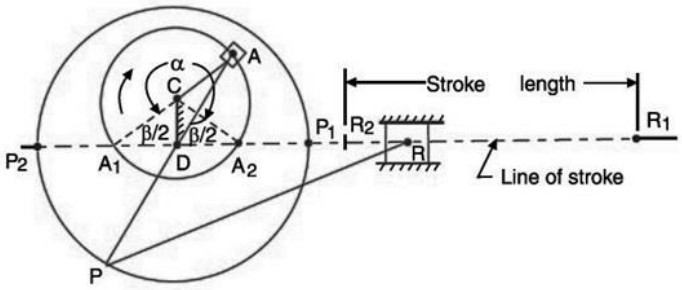
S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	a) Describe different types of constrained motions.	(6)	BTL2	Understand
	b) Describe the various types of Kinematic pair.	(7)	BTL2	Understand
2	With the help of sketch, describe inversions of four bar chain.	(13)	BTL2	Understand
3	Explain the inversion of Single Slider Crank Chain with neat sketch.	(13)	BTL1	Remember
4	Explain the inversion of Double Slider crank chain with neat sketch.	(13)	BTL1	Remember
5	a) Explain the offset slider crank mechanism.	(6)	BTL1	Remember
	b) Explain Straight line mechanism with neat sketch.	(7)	BTL1	Remember
6	Describe the working of Oldham's coupling with a neat sketch and state its application.	(13)	BTL2	Understand
7	Discuss the steering gear mechanism with neat sketch.	(13)	BTL2	Understand
8	Explain the working of Whitworth quick return mechanism with a neat sketch.	(13)	BTL2	Understand
9	Explain the working of crank and slotted lever quick return motion mechanism with a neat sketch.	(13)	BTL2	Understand
10	What is straight line mechanism? Sketch the peaucellier straight line motion mechanism and prove that the	(13)	BTL6	Create

	generating points moves in a straight line.			
11	 For the kinematic linkages shown below calculate: (i) Number of binary links (Nb) (ii) Number of ternary links (Nt) (iii) Number of other links (No) (iv) Number of total links (N) (v) Number of joints or pairs (P1) (vi) Number of degrees of freedom (F)	(13)	BTL5	Evaluate
12	a) Classify kinematic pairs based on degrees of freedom.	(7)	BTL2	Understand
	b) Explain mechanical advantage and transmission angle related to four bar mechanism.	(6)	BTL2	Understand
13	In a crank and slotted lever quick return mechanism, the distance between the centers is 150 mm and the driving crank is 75 mm long. Determine the ratio of the time taken on the cutting and the return strokes.	(13)	BTL3	Apply
14	The Whitworth quick return motion mechanism has the driving crank 150 mm long. The distance between fixed centers is 100 mm. The line of stoke of the ram passed through the centre of rotation of the slotted lever whose free end is connected to the ram by a connecting link. Find the ratio of time of cutting to time of return.	(13)	BTL3	Apply
15	In a crank and slotted lever quick return motion mechanism, the distance between the fixed centres is 240 mm and the length of the 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 the return stroke. If the length of the slotted bar is 450 mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever.	(13)	BTL3	Apply
16	Fig. 1 shows the lay out of a quick return mechanism of the oscillating link type, for a special purpose machine.	(13)	BTL3	Apply

	The driving crank BC is 30 mm long and time ratio of the working stroke to the return stroke is to be 1.7. If the length of the working stroke of R is 120 mm, determine the dimensions of AC and AP. 			
17	In a Whitworth quick return motion mechanism, as shown in Fig. 2, the distance between the fixed centers is 50 mm and the length of the driving crank is 75 mm. The length of the slotted lever is 150 mm and the length of the connecting rod is 135 mm. Find the ratio of the time of cutting stroke to the time of return stroke and also the effective stroke. 	(13)	BTL3	Apply
18	Write notes on complete and incomplete constraints in lower and higher pairs, illustrating your answer with neat sketches.	(13)	BTL2	Understand

PART – C (15 MARKS)

S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke.	(15)	BTL3	Apply
2	Sketch and describe the working of two different types of quick return mechanism. Give examples of their application. Derive an expression for the ratio of time taken in forward and return stoke for one of this mechanism.	(15)	BTL2	Understand

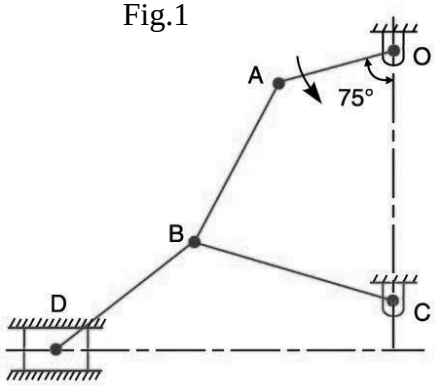
3	In a crank and slotted lever quick return mechanism, as shown in Fig 1. The driving crank length is 75mm. The distance between the fixed centres is 200 mm and the length of the slotted lever is 500 mm. Find the ratio of the times taken on the cutting and idle strokes. Determine the effective stroke also.  Fig.1	(15)	BTL3	Apply
4	A Whitworth quick return motion mechanism, as shown in Fig.2 , has the following particulars : Length of stroke = 150 mm ; Driving crank length = 40 mm; Time of cutting stroke / Time of return stroke = 2. Find the lengths of CD and PD. Also determine the angles α and β.  Fig.2	(15)	BTL5	Evaluate
5	Draw the sketch of a mechanism in which a point traces an exact straight line. The mechanism must be made of only revolute pairs. Prove that the point traces an exact straight line motion.	(15)	BTL2	Understand

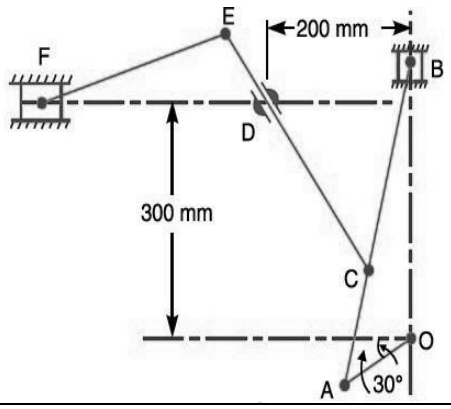
UNIT II - KINEMATICS OF LINKAGE MECHANISMS			
Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.			
PART – A (2 MARKS)			
Sl.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	What is kinematic analysis?	BTL2	Understand
2.	Write about the properties of instantaneous centre.	BTL1	Remember
3.	State Kennedy's theorem.	BTL2	Understand
4.	What is meant by fixed instantaneous centre?	BTL2	Understand
5.	Differentiate between velocity and speed.	BTL4	Analyze
6.	What is the formula to find out rubbing velocity at joint of a pin?	BTL1	Remember
7.	Write the different types of graphical method for velocity and acceleration calculation.	BTL1	Remember
8.	Define acceleration.	BTL1	Remember
9.	What is deceleration?	BTL2	Understand
10.	State angular velocity ratio theorem.	BTL1	Remember
11.	Why coincident points used in the shaper mechanisms?	BTL2	Understand
12.	What is centrode?	BTL2	Understand
13.	Define space centrode.	BTL1	Remember
14.	Write the formula to calculate the Instantaneous centers.	BTL1	Remember
15.	What meant by Instantaneous axis?	BTL2	Understand
16.	Define axode.	BTL1	Remember
17.	Write down the different types of Instantaneous centres.	BTL1	Remember
18.	Give any two methods of reducing interference in gears.	BTL1	Remember
19.	What are the effects of centrifugal tension in belt drives?	BTL2	Understand
20.	Compare the two components of acceleration.	BTL4	Analyze
21.	Write the equation to find number of instantaneous centres of mechanism with 'n' links.	BTL1	Remember
22.	What is meant by permanent instantaneous centre?	BTL2	Understand

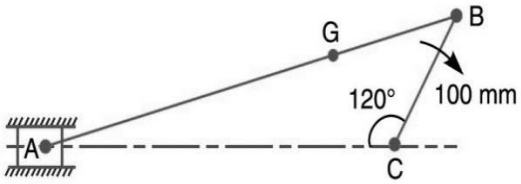
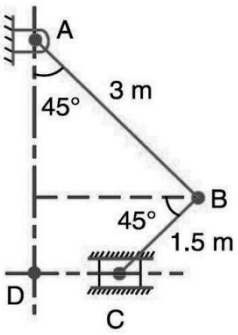
23.	Mention the instantaneous centres which are classified under primary instantaneous centre.	BTL1	Remember
24.	What is centripetal component of acceleration?	BTL1	Remember
25.	Define Coriolis component of acceleration.	BTL1	Remember

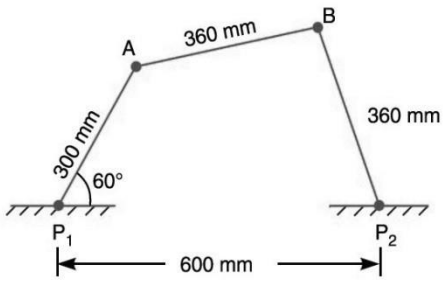
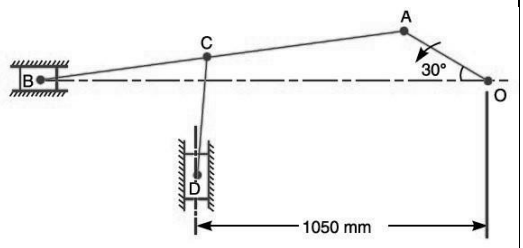
PART – B (13 MARKS)

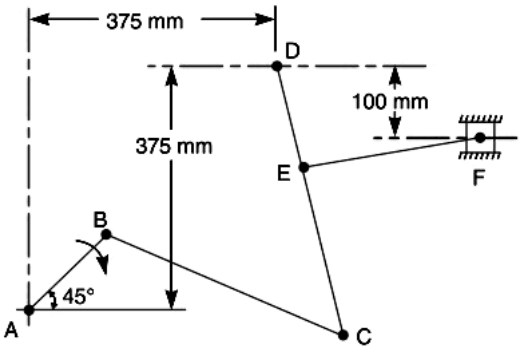
S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	In a four bar chain ABCD, AD is fixed and is 150 mm long.The crank AB is 40 mm long and rotates at 120 r.p.m. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°	(13)	BTL3	Apply
2	The crank and connecting rod of a theoretical steam engine are 0.5 m and 2 m long respectively. The crank makes 180 r.p.m. in the clockwise direction. When it has turned 45° from the inner dead centre position, determine : 1. velocity of piston, 2. angular velocity of connecting rod, 3. velocity of point E on the connecting rod 1.5 m from the gudgeon pin, 4. velocities of rubbing at the pins of the crank shaft, crank and crosshead when the diameters of their pins are 50 mm, 60 mm and 30 mm respectively, 5. position and linear velocity of any point G on the connecting rod which has the least velocity relative to crank shaft.	(13)	BTL3	Apply

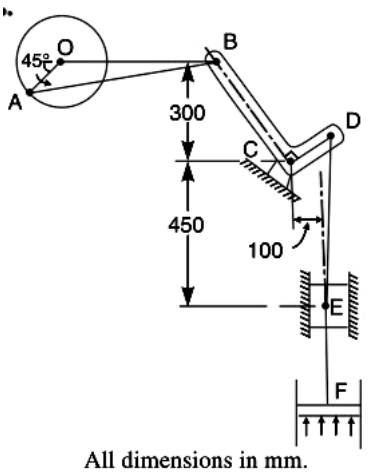
3	In Fig.1, the angular velocity of the crank OA is 600 r.p.m. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are : OA = 28 mm ; AB = 44 mm ; BC 49 mm ; and BD = 46 mm. The centre distance between the centres of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical. Fig.1 	(13)	BTL5	Evaluate
4	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.	(13)	BTL5	Evaluate
5	In a mechanism shown in Fig. 2 , the crank OA is 100 mm long and rotates clockwise about O at 120 r.p.m. The connceting rod AB is 400 mm long. At a point C on AB, 150 mm from A, the rod CE 350 mm long is attached. This rod CE slides in a slot in a trunnion at D. The end E is Fig.2	(13)	BTL3	Apply

	connected by a link EF, 300 mm long to the horizontally moving slider F. For the mechanism in the position shown, find 1**.** velocity of F, 2**.** velocity of sliding of CE in the trunnion, and 3**.** angular velocity of CE.  			
6	Locate all instantaneous centers 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 (i) velocity of slider "A" (ii) Angular Velocity of connecting rod "AB".	(13)	BTL5	Evaluate
7	Explain the procedure for locating the instantaneous centre for four bar mechanism with suitable sketch.	(13)	BTL2	Understand
8	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: 1. linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.	(13)	BTL3	Apply

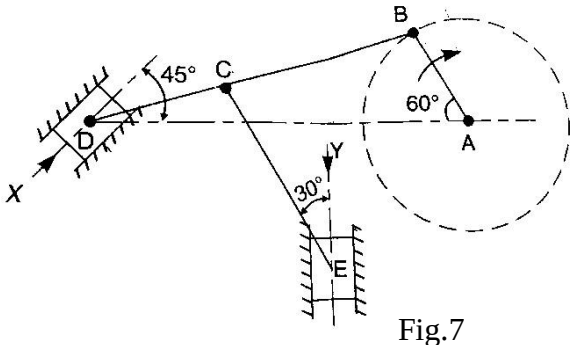
9	An engine mechanism is shown in Fig.3. The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75rad/s and an angular acceleration of 1200 rad/s2. Find: 1.velocity of G and angular velocity of AB, and 2. acceleration of G and angular acceleration of AB.  Fig.3	(13)	BTL3	Apply
10	In the mechanism shown in Fig.4, the slider C is moving to the right with a velocity of 1 m/s and an acceleration of 2.5 m/s^2. The dimensions of various links are AB = 3 m inclined at 45° with the vertical and BC = 1.5 m inclined at 45° with the horizontal. Determine: 1. the magnitude of vertical and horizontal component of the acceleration of the point B, and 2. the angular acceleration of the links AB and BC.  Fig.4	(13)	BTL5	Evaluate
11	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.	(13)	BTL5	Evaluate

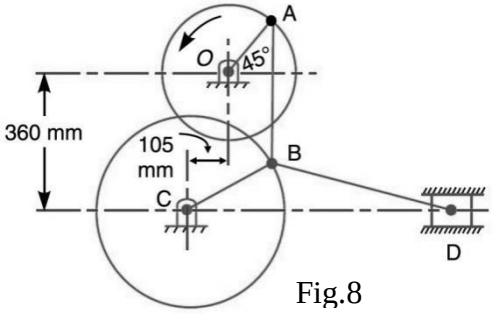
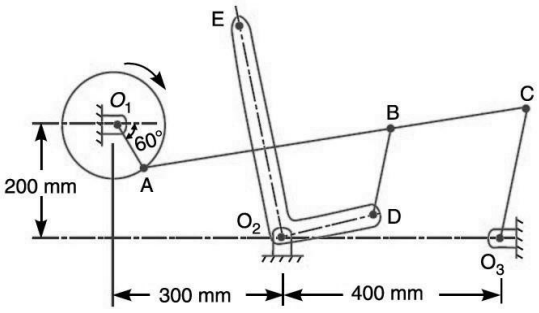
12	The dimensions and configuration of the four bar mechanism, shown in Fig.5, are as follows: P_1A = 300 mm; P_2B = 360 mm; AB = 360 mm, and P_1P_2 = 600 mm. The angle AP_1P_2 = 60°. The crank P_1A has an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s^2, rotates clockwise. Determine the angular velocities and angular accelerations of P_2B, and AB and the velocity and acceleration of the joint B.  Fig.5	(13)	BTL3	Apply
13	In the mechanism, as shown in Fig.6, the crank OA rotates at 20 r.p.m. anticlockwise 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. 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.  Fig.6	(13)	BTL5	Evaluate
14	In a pin jointed four bar mechanism, the dimensions are AB = 200 mm, BC = CD = 350 mm, and AD = 590 mm. The angle BAD = 45°. The crank AB rotates uniformly at 100 r.p.m. Locate all the instantaneous centres and find the angular velocity of the link BC.	(13)	BTL3	Apply

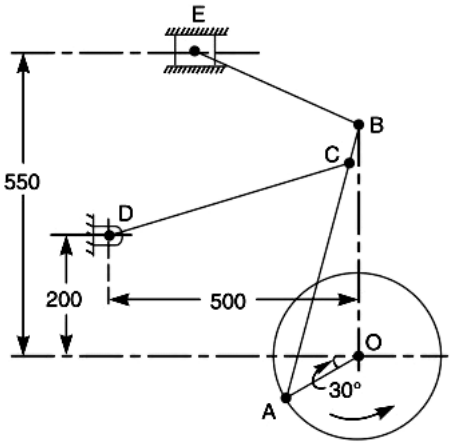
15	The mechanism, as shown in Fig. 3, has the dimensions of various links as follows : AB = DE = 150 mm ; BC = CD = 450 mm ; EF = 375 mm. The crank AB makes an angle of 45° with the horizontal and rotates about A in the clockwise direction at a uniform speed of 120 r.p.m. The lever DC oscillates about the fixed point D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides, being driven by the link EF. Determine: 1. velocity of the block F, 2. angular velocity of DC, and 3. rubbing speed at the pin C which is 50 mm in diameter. 	(13)	BTL3	Apply
16	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°. 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 per cent.	(13)	BTL3	Apply
17	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 : 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.			

18	A pump is driven from an engine crank-shaft by the mechanism as shown in Fig.. The pump piston shown at F is 250 mm in diameter and the crank speed is 100 r.p.m. The dimensions of various links are as follows: OA = 150 mm ; AB = 600 mm ; BC = 350 mm ; CD = 150 mm; and DE = 500 mm. Determine for the position shown : 1. The velocity of the cross-head E, 2. The rubbing velocity of the pins A and B which are 50 mm diameter. 3. The torque required at the crank shaft to overcome a presure of 0.35 N/mm^2, and 4. The acceleration of the cross-head E.  All dimensions in mm.			

PART – C (15 MARKS)

S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	The dimensions of the mechanism, as shown in Fig.7, are as follows : AB = 0.45 m; BD = 1.5 m : BC = CE = 0.9 m. The crank AB turns uniformly at 180 r.p.m. in the clockwise direction and the blocks at D and E are working in frictionless guides.Draw the velocity diagram for the mechanism and find the velocities of the sliders D and E in their guides. Also determine the turning moment at A if a force of 500 N acts on D in the direction of arrow  Fig.7	(15)	BTL5	Evaluate

	X and a force of 750 N acts on E in the direction of arrow Y.			
2	Derive the expression for velocity and acceleration of slider by analytical method.	(15)	BTL6	Create
3.	In the toggle mechanism shown in Fig.8, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 r.p.m. increasing at the rate of 50 rad/s^2. The dimensions of the various links are as follows: OA = 180 mm ; CB = 240 mm ; AB = 360 mm ; and BD = 540 mm. For the given configuration, find 1. Velocity of slider D and angular velocity of BD, and 2. Acceleration of slider D and angular acceleration of BD.  Fig.8	(15)	BTL3	Apply
4	The mechanism of a warping machine, as shown in Fig.9 has the dimensions as follows: O_1A = 100 mm; AC = 700 mm ; BC = 200 mm ; BD = 150 mm ; O_2D = 200 mm ; O_2E = 400 mm ; O_3C = 200 mm. The crank O1A rotates at a uniform speed of 100 rad/s. For the given configuration, determine: **1.** Linear velocity of the point E on the bell crank lever, **2.** acceleration of the points E and B, and **3.** angular acceleration of the bell crank lever.  Fig.9	(15)	BTL5	Evaluate
5	Fig. 10 shows the mechanism of a radial valve gear. The crank OA turns uniformly at 150 r.p.m and is	(15)	BTL5	Evaluate

	pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and DC as radius. The dimensions of various links are: OA = 150 mm ; AB = 550 mm ; AC = 450 mm ; DC = 500 mm ; BE = 350 mm. Determine velocity and acceleration of the ram E for the given position of the mechanism.  All dimensions in mm.			

UNIT III - KINEMATICS OF CAM MECHANISMS			
Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.			
PART – A (2 MARKS)			
S. No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	What is a cam?	BTL2	Understand
2.	Give some examples of cam.	BTL1	Remember
3.	Define tangent cam.	BTL1	Remember
4.	What are the different motions of the follower?	BTL2	Understand
5.	How can high surface stress in flat follower be minimized?	BTL1	Remember
6.	Where are the roller followers extensively used?	BTL1	Remember
7.	Define dwell period.	BTL1	Remember
8.	What is meant by offset follower?	BTL2	Understand
9.	Define trace point.	BTL1	Remember
10.	Describe pressure angle with respect to cams.	BTL2	Understand
11.	What is meant by lift or stroke in cam?	BTL2	Understand
12.	How undercutting occurs in cam?	BTL2	Understand
13.	What do you know about nomogram?	BTL2	Understand
14.	Define the basic requirements for high speed cam.	BTL1	Remember
15.	What do you know about gravity cam?	BTL2	Understand
16.	Write the different types of follower.	BTL1	Remember
17.	What are the uses of cam profile?	BTL2	Understand
18.	Define base circle.	BTL1	Remember
19.	Write the formula to find the maximum velocity of simple harmonic motion.	BTL2	Understand
20.	What is meant by pitch curve?	BTL2	Understand
21.	What is meant by pitch circle in cams?	BTL1	Remember
22.	Classify the follower types based on surface in contact.	BTL1	Remember
23.	Define pitch point.	BTL1	Remember
24.	Which type of cam follower is used in automobile engines?	BTL2	Understand
25.	Cycloidal motion followers is applied in which type of	BTL2	Understand

	engines?		

PART – B (13 MARKS)

S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	A cam is to give the following motion to a knife edged follower: a. Outstroke during 60° of cam rotation. b. Dwell for the next 30° of cam rotation. c. Return stroke during next 60° of cam rotation and d. Dwell for the remaining of cam rotation. The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower passes through the axis of the cam shaft.	(13)	BTL5	Evaluate
2	Draw the profile of a cam operating a Knife-edged follower from the following data: (a) Follower to move outward through 40 mm during 60° of a cam rotation; (b) Follower to dwell for the next 45° (c) Follower to return its original position during next 90° (d) Follower to dwell for the rest of cam rotation. The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50 mm. If the cam rotates at 300 rpm. Determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke.	(13)	BTL3	Apply
3	A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife- edged follower the motion as described below: (a) To move outwards through 40 mm during 100° rotation of the cam; (b) to dwell for next 80° (c)	(13)	BTL5	Evaluate

	To return to its starting position during next 90° and (d) To dwell for the rest period of revolution. Draw the profile of the cam (i) When the line of stroke of the follower passes through the centre of the cam shaft and (ii) When the line of stroke of the follower is to take place with Uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 r.p.m.			
4	Draw the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam = 25 mm; lift = 30 mm; Roller diameter = 15 mm. The cam lifts the follower for 120° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and retardation followed by a dwell period. If the cam rotates at a uniform speed of 150 rpm. Calculate the maximum velocity and acceleration of follower during the descent period.	(13)	BTL3	Apply
5	It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact surface: (i) Follower to have a stroke of 20 mm during 120° of cam rotation, (ii) Follower to dwell for 50° of cam rotation, (iii) Follower to return to its initial position during 90° of cam rotation, (iv) Follower to dwell for remaining period of cam rotation. The minimum radius of the cam is 25 mm. The out stroke of the follower is performed with SHM and return stroke with equal uniform acceleration and retardation	(13)	BTL5	Evaluate
6	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	(13)	BTL3	Apply

	20 mm in diameter. Find the cam proportions and plot displacement, velocity and acceleration for one full cycle.			
7	Construct a tangent cam and mention the important terminologies on it. Also derive the expression for displacement, velocity, acceleration of a reciprocating roller follower when the roller has contact with the nose.	(13)	BTL6	Create
8	Layout the profile of a cam operating a roller reciprocating follower for the following data. Lift of follower = 30mm; Angle during the follower rise period =120°; angle during the follower after rise = 30°; angle during the follower return period = 150°. Angle during which follower dwell after return= 60° ; minimum radius of cam = 25mm; Roller diameter =10mm. The motion of follower is uniform acceleration and deceleration during the rise and return period.	(13)	BTL5	Evaluate
9	Design a cam to raise a valve with simple harmonic motion through 15mm is 1/3rd of a revolution, keep it fully raised through 1/12th of a revolution and to lower it with SHM in 1/6th of a revolution. The valve remain closed during the rest of the revolution. The diameter of the roller is 20mm and the minimum radius of the cam is 25mm. The axis of the valve rod passes through the axis of the cam shaft. If the cam shaft rotates at uniform speed of 100 rpm; find the maximum velocity and acceleration of the valve during raising and lowering. Also draw the profile of the cam.	(13)	BTL3	Apply
10	a) Classify with neat sketches the cam follower according to their shape, location and motion. State also their advantages, if any, with respect to other followers	(7)	BTL4	Analyze

	b) Sketch neatly the displacement, velocity and acceleration curves of a cycloidal motion follower. Why is it superior over other motion curves?	(6)	BTL4	Analyze
11	The following particular relate to symmetric circular cam operating a flat faced follower: least radius = 25 mm nodes radius = 8 mm, lift of the valve = 10 mm, angle of the action = 120° ,cam shaft speed = 1000 rpm. Determine the flank radius abs the maximum velocity, acceleration and retardation of the follower. If the mass of follower and the value with which it is in contact is 4 kg, find the minimum force to be exerted by the spring to overcome inertia of the valve parts.	(13)	BTL5	Evaluate
12	A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed, is to designed to give motion to a roller follower. At the end of valve rod as described below (i) to rise the valve through 50 mm during 120° rotation of the cam. (ii) To keep the valve fully raised through next 30° (iii) To lower the valve during next 60° (iv) to keep the valve closed during rest of the revolution The dia of the roller is 20mm and the dia of the cam shaft is 25 mm. the line of stroke is offset by 15 mm from the axis of the cam shaft. The displacement of the valve while being raised and lowered is to take place with SHM. draw the displacement diagram. Sketch roughly the space of velocity and acceleration diagrams, draw the profile of cam.	(13)	BTL3	Apply
13	In a system tangent cam operating a roller follower. The radius of the cam is 30mm and roller radius is 17.5 mm. the angle of ascent is 75° and the total lift is 17.5 mm. The speed of the cam is 600rpm. assume that there is no dwell between ascent and decent.(i) calculate the principal dimension of the cam (ii) find the acceleration of follower at the	(13)	BTL5	Evaluate

	beginning of the lift (iii) draw the profile of the cam.			
14	a) Draw the displacement, velocity and acceleration curves, when the follower moves with simple harmonic motion and deriver the expression for maximum velocity and maximum acceleration	(7)	BTL2	Understand
	b) Depict the type of cam	(6)	BTL2	Understand
15	A cam is to be designed for a knife edge follower with the following data : 1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. 2. Dwell for the next 30°. 3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. 4. Dwell during the remaining 180°. Draw the profile of the cam when (a) the line of stroke of the follower passes through the axis of the cam shaft, and (b) the line of stroke is offset 20 mm from the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.	(13)	BTL5	Evaluate
16	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	(13)	BTL5	Evaluate

	profile of the cam.			
17	Draw the profile of the cam when the roller follower moves with cycloidal motion during out stroke and return stroke, as given below : 1. Out stroke with maximum displacement of 31.4 mm during 180° of cam rotation, 2. Return stroke for the next 150° of cam rotation, 3. Dwell for the remaining 30° of cam rotation. The minimum radius of the cam is 15 mm and the roller diameter of the follower is 10 mm. The axis of the roller follower is offset by 10 mm towards right from the axis of cam shaft.	(13)	BTL5	Evaluate
18	In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 17.5 mm. The angle of ascent is 75° and the total lift is 17.5 mm. The speed of the cam shaft is 600 r.p.m. Calculate : 1. The principal dimensions of the cam ; 2. the accelerations of the follower at the beginning of the lift, where straight flank merges into the circular nose and at the apex of the circular nose. Assume that there is no dwell between ascent and descent.	(13)	BTL5	Evaluate

PART – C (15 MARKS)

S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	Follower type = roller follower, lift = 25 mm, base circle radius = 20 mm, roller radius = 5 mm, out stroke with UARM, for 120° cam rotation, dwell for 60° cam rotation. Return stroke with UARM, for 90° cam rotation, dwell of the remaining period. Determine max velocity and acceleration during out stoke and return stoke if the cam rotates at 1200rpm in counter clockwise direction. Draw the cam profile for condition with follower off set to right to cam center by 5mm.	(15)	BTL3	Apply

2	A cam is designed for a knife follower with the following data. (i) Cam lift = 40 mm during 90° of cam rotation with SHM (ii) Dwell for the next 30° (iii) During the next 60° of cam rotation, the follower returns to original position with SHM. (iv) Dwell for the reaming 180° Draw the profile of the cam when the line of stroke is offset 20 mm from the axis of the cam shaft.	(15)	BTL5	Evaluate
3	In a cam with translating roller follower, the follower axis is offset to the right of cam hinged by 12 mm. The roller is 10 mm and the cam rotates in counter clockwise direction. Layout the rise portion of the cam profile meet the following specification. Rise taken place during 180° of the cam rotation of which for the first 90° the rise is with constant acceleration and the rest is with constant radiation., taken seven station point only. the lift of cam is 30mm and the least radius of the cam is 25 mm.	(15)	BTL3	Apply
4	A cam rotation clockwise a uniform speed of 200rpm is required to move an offset roller follower with a uniform and equal acceleration and retardation on both the outward and return stokes. The angle of ascent, the angle of dwell and angle of descent is 120°, 60° and 90° respectively. The follower dwells for the rise of cam rotation. The least radius of the cam is 50mm.the lift of follower is 25mm and the dia of roller is 10mm.the line of stoke of the follower is offset by 20mm from the axis of the cam. Draw the cam profile and find the maximum velocity and acceleration of the follower during the outstroke.	(15)	BTL5	Evaluate
5	A symmetrical circular cam operating a flat-faced follower has the following particulars :	(15)	BTL5	Evaluate

	Minimum radius of the cam = 30 mm ; Total lift = 20 mm ; Angle of lift = 75° ; Nose radius = 5 mm ; Speed = 600 r.p.m. Find : 1. the principal dimensions of the cam, and 2. 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.			

UNIT IV - GEARS AND GEARTRAINS			
Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains- Compound gear trains- reverted gear trains-cyclometer- differential gear.			
PART – A (2 MARKS)			
Sl.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	What is an angle of obliquity in gear?	BTL2	Understand
2.	Classify the gears.	BTL1	Remember
3.	Define arc of approach.	BTL1	Remember
4.	What is meant by arc of recess?	BTL2	Understand
5.	What is the purpose of using gears?	BTL2	Understand
6.	State law of gearing.	BTL1	Remember
7.	Define normal and axial pitch in helical gears.	BTL1	Remember
8.	What are the methods to avoid interference?	BTL2	Understand
9.	What is the advantage when arc of recess is equal to arc of approach in a meshing gears?	BTL2	Understand
10.	Define contact ratio.	BTL1	Remember
11.	Where will the interference occur in an involute pinion and gear are in mesh having same size of addendum?	BTL2	Understand
12.	What is meant by interference?	BTL2	Understand
13.	Define cycloidal tooth profile and involute tooth profile.	BTL1	Remember
14.	Mention the drawbacks of Backlash.	BTL2	Understand
15.	Compare gear and gear train.	BTL4	Analyze
16.	Give the types of gear trains.	BTL1	Remember
17.	Where the epicyclic gear trains are used?	BTL2	Understand
18.	Write about the uses of differential gear trains.	BTL1	Remember
19.	What is meant compound gear train?	BTL2	Understand
20.	Write the advantages of co-axial gearbox.	BTL2	Understand
21.	What is toothed wheel?	BTL1	Remember

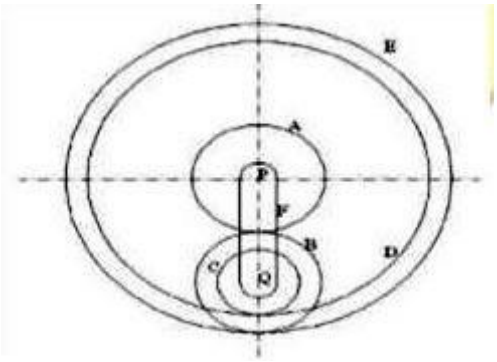
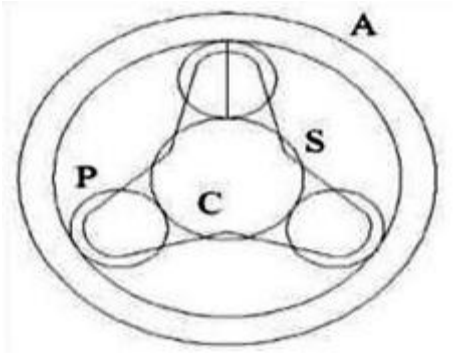
22.	Write the advantages of gear drive.	BTL2	Understand
23.	What is addendum circle?	BTL1	Remember
24.	Define clearance in gear terminology.	BTL2	Understand
25.	What is module?	BTL1	Remember

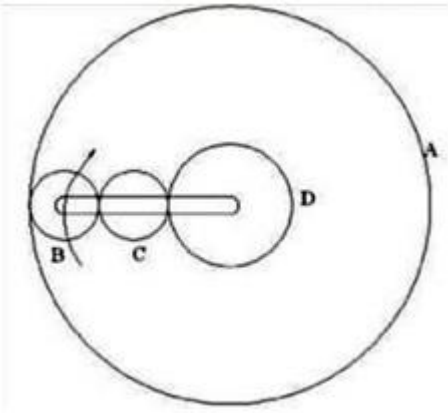
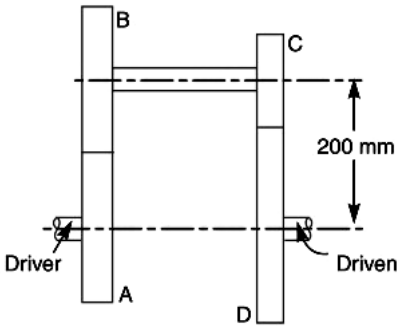
PART – B (13 MARKS)

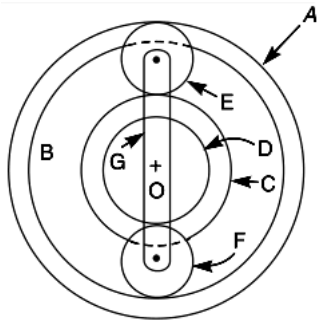
S. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gear is involute with 20 degree pressure angle 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.	(13)	BT4	Analyze
2	Two involute gears of 20 degree 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 a).The angle turned through by pinion when one pair of teeth is in mesh and b).The maximum velocity of sliding.	(13)	BT4	Analyze
3	A pair of gears having 40 and 20 teeth respectively are rotating in mesh, the speed of the smaller being 2000 rpm. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20 degree involute form, addendum length is 5 mm and the module is 5 mm. Also find the angle through which the pinion turns while any pairs of teeth are in contact.	(13)	BT3	Apply
4	The following data relate to a pair of 20 degree involute gears in mesh. Module = 6 mm, Number of teeth on pinion =17, Number of teeth on gear =	(13)	BT4	Analyze

	49, Addendum on pinion and gear wheel = 1 module. Find the number of pairs of teeth in contact, the angle turned through by the pinion and the gear wheel when one pair of teeth is in contact and 3.The ratio of sliding to rolling motion when the tip of a tooth on the larger wheel (i) is just making contact(ii)is just leaving contact with its mating tooth and is (iii) at the pitch point.			
5	Two mating spur gear with module pitch of 6.5 mm have 19 and 47 teeth of 20° pressure angle and 6.5 mm addendum. Determine the number of pair of teeth and angle turned through by the larger wheel for one pair of teeth in contact. Determine also the sliding velocity at the instant (i) engagement commences (ii) engagement terminates. When the pitch line velocity is 1.2 m/s.	(13)	BT4	Analyze
6	a) 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? b) Two mating involute spur gears 16° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 15 and its speed is 240 rpm. The module pitch of the teeth is 5 mm. if the addendum on each wheel recess on each side are half the maximum possible length each, find (1) the addendum for pinion and gear wheel (2) the length of arc of contact (3) the maximum velocity of sliding during approach and recess. Assume pinion to be driver.	(7) (6)	BT4	Analyze
7	a) A pair of spur gear with involute teeth is to give a gear ratio of 4:1. The arc of approach is not be less than the circular pitch and the smaller wheel is the driver. The angle of pressure is 14.5 What is the least number	(7)	BT4	Analyze

	of teeth that can be used on each wheel? What is the addendum of the wheel in terms of circular pitch? 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 (a) Sliding velocities at engagement and disengagement of a pair of teeth and (b) Contact ratio.	(6)		
8	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 rpm. Determine (1) the number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel, (2) The length of path and arc of contact, (3) the number of pairs of teeth in contact.(4) Maximum velocity of sliding.	(13)	BT3	Apply
9	The arm of an epicyclic gear train rotates at 100 rpm in the anticlock wise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm (clockwise).	(13)	BT3	Apply
10	In a reverted epicyclic train, the arm A carries two gear B and C and a compound gear D-E. Wheel B meshes with gear E and gear C meshes with gear D. The number of teeth on gear B, C and D are 75, 30, and 90. Find the speed and direction of gear C , when gear B is fixed and arm A makes 100 rpm clockwise.	(13)	BT3	Apply
11	A compound epicyclic gear is shown in Fig.1 The gears A, D and E are free to rotate on axis P. The compound gears B and C rotate together on the axis Q at the end of arm F. All the gears have equal pitch. The number of external teeth on gears, A B and C are	(13)	BT4	Analyze

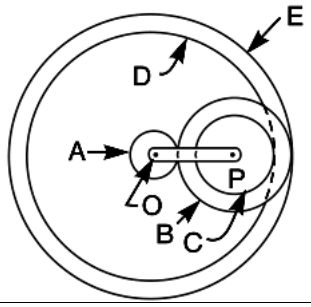
	18, 45 and 21 respectively. The gears D and E are annulus gears. The gear A rotates at 100 rpm in anticlockwise direction and the gear D rotates at 150 rpm clockwise. Find the speed and direction of the arm and the gear E.  Fig.1			
12	The sun planet gear of an epicyclic gear train, the annular D has 100 internal teeth, the sun gear A has 50 external teeth and planet gear B has 25 external teeth. The gear B meshes with gear D and gear A. The gear B is carried on arm E, which rotates about the centre of annular gear D. If the gear D is fixed and arm rotates at 20 rpm, then find the speeds of gear A and B.	(13)	BT4	Analyze
13	An epicyclic gear train for an electric motor, is shown in Fig.2 The wheel S has 15 teeth and is fixed to motor shaft rotating at 1450 rpm. The planet P has 45 teeth, gears with fixed annular A and rotates on a spindle carried by an arm which fixed to output shaft. The planet P also gears with the sun when S. Find the speed of output shaft. If motor is transmitting 2 KW find the torque required to fix the annular.  Fig.2	(13)	BT3	Apply
14	An epicyclic gear train as shown in fig.3 is composed of a fixed annular wheel A having 150 teeth. The wheel A is meshing with wheel B which drives wheel D through an idle wheel C, D being concentric with A. The wheels	(13)	BT4	Analyze

	B and C are carried on an arm which revolves clockwise at 100 rpm about the axis of A and D. If the wheels B and D have 25 and 40 teeth respectively, determine the number of teeth on C and speed and sense of rotation of wheel C.  Fig.3			
15	The number of teeth on each of the two spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6mm. If the arc of contact is 1.75 times the circular pitch. Find the addendum.	(13)	BT3	Apply
16	A single reduction gear of 120 kW with a pinion 250 mm pitch circle diameter and speed 650 r.p.m. is supported in bearings on either side. Calculate the total load due to the power transmitted, the pressure angle being 20°.	(13)	BT3	Apply
17	The speed ratio of the reverted gear train, as shown in Fig., 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.  	(13)	BT3	Apply
18	In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the number of teeth are : TC = 28; TD = 26; TE = TF = 18. 1. Sketch	(13)	BT3	Apply

	the arrangement ; 2. Find the number of teeth on A and B ; 3. If the arm G makes 100 r.p.m. clockwise and A is fixed, find the speed of B ; and 4. If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise ; find the speed of wheel B. 			

PART – C (15 MARKS)

SL. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	Two mating gears have 20 and 40 involute teeth of module 10 mm and 20 degree 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)	BT3	Apply
2	A pair of 20 degree full depth involutes spur gears having 25 and 45 teeth respectively of module 3mm are in mesh. The smaller gear rotates at 900 rpm. Determine sliding velocities at engagement and at disengagement of pair of a teeth and contact ratio.	(15)	BT4	Analyze
3	A pair of spur wheels with involute teeth is to give a gear ratio of 3 to 1.The arc of approach is not to be less than the circular pitch and the smaller wheel is the driver. The pressure angle is 20 degree. What is the least number of teeth that can be used on each wheel? What is the addendum of the wheel in terms of the circular pitch?	(15)	BT3	Apply
4	Two spur gears of 24 teeth and 36 teeth of 8 mm	(15)	BT4	Analyze

	module and 20 degree pressure angle are in mesh. Addendum of each gear is 7.5 mm. The teeth are of involute form. Determine the angle through which the pinion turns while any pair of teeth are in contact and the velocity of sliding between the teeth when the contact on the pinion is at a radius of 102 mm. The speed of the pinion is 450 rpm.			
5	Fig. shows diagrammatically a compound epicyclic gear train. Wheels A , D and E are free to rotate independently on spindle O, while B and C are compound and rotate together on spindle P, on the end of arm OP. All the teeth on different wheels have the same module. A has 12 teeth, B has 30 teeth and C has 14 teeth cut externally. Find the number of teeth on wheels D and E which are cut internally. If the wheel A is driven clockwise at 1 r.p.s. while D is driven counter clockwise at 5 r.p.s., determine the magnitude and direction of the angular velocities of arm OP and wheel E. 	(15)	BT4	Analyze

UNIT V - FRICTION IN MACHINE ELEMENTS			
Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes- Band and Block brakes-disc brakes.			
PART – A (2 MARKS)			
Sl.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	What is dry friction?	BT1	Remember
2.	State the laws of dry friction.	BT2	Understand
3.	State the laws of fluid friction.	BT2	Understand

4.	Define angle of repose.	BT6	Create
5.	What is limiting angle of friction?	BT6	Create
6.	Define Co-efficient of friction.	BT1	Remember
7.	Why self locking screws have lesser efficiency?	BT4	Analyze
8.	List the functions of clutches.	BT1	Remember
9.	What is the difference between cone clutch and centrifugal clutch?	BT2	Understand
10.	Why friction is called as necessary evil?	BT5	Evaluate
11.	What are the belt materials?	BT1	Remember
12.	Define velocity ratio.	BT5	Evaluate
13.	State the law of belting.	BT4	Analyze
14.	Compare slip and creep.	BT6	Create
15.	Why cross belt used instead of open belt?	BT4	Analyze
16.	Define wipping.	BT1	Remember
17.	Why lubrication reduces friction?	BT1	Remember
18.	What you meant by crowning in pulley?	BT4	Analyze
19.	List the purpose of disc brake.	BT5	Evaluate
20.	Define self energizing.	BT2	Understand
21.	What are the types of belt drives?	BT1	Remember
22.	Classify the types of belts.	BT1	Remember
23.	Mention few materials commonly used for belt.	BT1	Remember
24.	Is the frictional torque transmitted by a disc or plate clutch same as that of flat collar bearing.	BT1	Remember
25.	Write the equation for maximum efficiency of a screw jack.	BT1	Remember

PART – B (13 MARKS)

SL. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	A shaft rotates at a constant speed of 160 rpm is connected by belting to a parallel shaft 720 mm apart, which has to run at 60,80 and 100 rpm. The smallest pulley on the driving shaft is 40mm in radius. Determine the remaining radii of the two stepped pulleys for a crossed belt and an open belt. Neglect belt thickness and slip.	(13)	BT4	Analyze

2	A shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits 6 kw through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m.The smaller pulley is 0.5m in diameter. Calculate the stress in the belt, if it is an open belt drive and a cross belt drive. Take μ=0.3.	(13)	BT4	Analyze
3	The leather belt is required to transmit 6.5kW from a pulley 1.0m in diameter running at 300 rpm. The angle embraced is 155 degree and the co-efficient of friction between the belt and the pulley is 0.2.If the safe working stress for the leather belt is 1.3 MPa, density of leather 1.3 Mg/m^3 and thickness of the belt 13mm,determine the width of the belt taking centrifugal tension into account.	(13)	BT5	Evaluate
4	An open flat belt drive connects two parallel shafts 1.2 m apart. The driving and driven shafts rotates at 350 rpm and 140 rpm respectively and the driven pulley is 400 mm in diameter. The belt is 5 mm thick and 80 mm wide. The co-efficient of friction between the belt and pulley is 0.3 and the maximum permissible tension in the belting is 1.4 MN/m^2.Determine the diameter of the driving pulley, maximum power that may be transmitted by the belting and required initial belt tension.	(13)	BT5	Evaluate
5	a) For a flat belt, prove that $T1/T2=e^{\mu\theta}$ Where T1 and T2 = Tension in the tight and slack sides of the belt, θ = Angle of contact between the belt and pulley, and μ = Coefficient of friction between the belt and the pulley. b) An open belt running over two pulley of 1.5 m and 1.0 m diameters connects two parallel shafts 4.8 m apart. The initial ten in the belt is 3000 N. The smaller pulley is rotating at 600 rpm. The mass of belt is 0.6703 kg/m length. The coefficient of friction between the belt and pulleys is 0.3. Find (1) the exact length of	(7) (6)	BT5	Evaluate

	the belt required (2) the power transmitted taking centrifugal tension into account.			
6	A multi plate disc clutch transmits 55 kW of power at 1800 rpm. Coefficient of friction for the friction surfaces is 0.1. Axial intensity at pressure is not to exceed 160 kN/m^2. The internal radius is 80 mm and is 0.7 times the external radius. Find the number of plates needed to transmit the required torque.	(13)	BT5	Evaluate
7	The mean diameter of the screw jack having pitch of 10 mm is 50 mm. A load of 20 KN is lifted through a distance of 170 mm. Find the work done in lifting the load and efficiency of the screw jack when (i) the load rotates with the screw, and (ii)the load rests n the loose head which does not rotate with screw. The external and internal diameter of the bearing surface of the loose head is 60mm and 10mm respectively. The coefficient of friction for the screw as well as the bearing surface may be taken as 0.08	(13)	BT5	Evaluate
8	A leather belt is required to transmit 7.5 kW from a pulley 1.2 m in diameter, running at 250 rpm. The angle entranced is 165° and the coefficient of friction between the belt and the pulley is 0.3. If safe working stress for the leather belt is 1.5 MPa, density of leather is 1 kg/m^3 and thickness of belt is 10 mm. Determine the width of the belt taking Centrifugal tension into account.	(13)	BT5	Evaluate
9	a) Prove or disprove the following statement – "Angle of friction is equal to angle of repose" b) Briefly explain the following: 1) Slip of the belt 2) Creep of the belt.	(7) (6)	BT1	Rememberi ng
10	A conical pivot bearing supports a vertical shaft of 200mm diameter. It is subjected to a load of 30kN. The angle of cone is 120° and the co- efficient of	(13)	BT5	Evaluate

	friction is 0.025. Find the power lost in friction when the speed is 140 rpm assuming i) Uniform pressure and ii) Uniform wear.			
11	A single plate clutch is required to transmit 8 kW at 1000 rpm. The axis pressure is limited to 70 kN/m^2. The mean radius of the plate is 4.5 times the radial width of the friction surface. If both the sides of the plate are effective and the coefficient of friction is 0.25. Find a) the inner and the outer radius of the plate and the mean radius, b) the width of the friction lining.	(13)	BT5	Evaluate
12	A shaft has a number of collars integral with it. The external diameter of the collars is 400mm and the shaft diameter is 250 mm. If the uniform intensity of pressure is $0.35N/mm^2$ and its coefficient of friction is 0.05, estimate i) power absorbed in overcoming friction when the shaft runs at 105 rpm and carries a load of 150KN and ii) number of collars required.	(13)	BT5	Evaluate
13	a) Derive an expression for braking torque on the drum of simple band brake. b) Explain the working principle of disc brake.	(7) (6)	BT1	Rememberi ng
14	Two shaft whose centers are 1m apart are connected by a V belt drive. The driving pulley is supplied with 100 kW and has an effective diameter of 300 mm. It runs at 375 rpm. The angle of groove on the pulley is 400 The permissible tension in 400 mm^2 cross sectional area of the belt is 2.1 MPa. The density of the belt is 1100 kg/ mm^3 coefficient of friction is 0.28. Estimate number of belts required.	(13)	BT5	Evaluate
15	A rope drive is required to transmit 230 kW from a pulley of 1m diameter running at 450 rpm. The safe pull in each rope is 800 N and the mass of the rope is 0.4 kg per meter length. The angle of lap and groove angle 1600 and 450 respectively. If coefficient of friction is 0.3, find the number of ropes required.	(13)	BTL3	Apply
16	Two pulley one 450 mm diameter and other 200	(13)	BTL3	Apply

	mm diameter are on parallel shaft 2.1 m apart and are connected by a cross belt. The larger pulley rotates at 225 rpm. The maximum permissible tension in the belt is 1 kN and the coefficient of friction between the belt and the pulley is 0.25. Find the length of the belt required and the power can be transmitted.			
17	A plate clutch has three discs on the driving shaft and two discs on the driven shaft, providing four pairs of contact surfaces. The outside diameter of the contact surfaces is 240 mm and inside diameter 120 mm. Assuming uniform pressure and $\mu = 0.3$; find the total spring load pressing the plates together to transmit 25 kW at 1575 r.p.m. If there are 6 springs each of stiffness 13 kN/m and each of the contact surfaces has worn away by 1.25 mm, find the maximum power that can be transmitted, assuming uniform wear.	(13)	BTL3	Apply
18	An effort of 1500 N is required to just move a certain body up an inclined plane of angle 12^o, force acting parallel to the plane. If the angle of inclination is increased to 15^o, then the effort required is 1720 N. Find the weight of the body and the coefficient of friction.	(13)	BTL3	Apply

PART – C (15 MARKS)

SL. NO	QUESTIONS	MARKS	LEVEL	COMPETENCE
1	An open belt running over two pulleys 240mm and 600mm diameter connects two parallel shafts 3 metres apart and transmits 4kW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is 10kN per mm width. Determine minimum width of the belt, initial belt tension and the length of the belt required.	(15)	BT3	Apply
2	A belt drive consists of two V belts in parallel on	(15)	BT4	Analyze

	grooved pulleys of the same size. The angle of the groove is 30°. The cross sectional area of each belt is 750mm^2 and μ= 0.12.The density of the belt material is 1.2 Mg/m^3 and the maximum safe stress in the material is 7 MPa. Calculate the power that can be transmitted between the pulleys 300 mm diameter rotating at 1500 rpm. Find also the shaft speed in rpm at which the power transmitted would be maximum.			
3	A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at a speed of 90 rpm. The angle of the lap is 160° and the angle of the groove is 45°, the co-efficient of friction is 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.	(15)	BT3	Apply
4	A pulley used to transmit power by means of ropes has a diameter of 3.6m and has 15 grooves of 45° angle. The angle of contact is 170° and the co-efficient of friction between the ropes and the grooves sides is 0.28.The maximum possible tension in the ropes is 960N and the mass of the rope is 1.5kg per metre length. What is the speed of pulley in rpm and the power transmitted if the condition of maximum power prevails?	(15)	BT4	Analyze
5	An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at the screw threads is 0.1. Estimate power of the motor.	(15)	BT4	Analyze