Course Code: 2040314 Roll No: MLRS-R20

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
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II B.Tech II Sem Regular End Examination, July 2022

Kinematics of Machinery

(MECH)

Time: 3 Hours. **Max. Marks: 70**

Note: 1. Question paper consists: Part-A and Part-B.
2. In Part – A, answer all questions which carries 20 marks.
3. In Part – B, answer any one question from each unit.
Each question carries 10 marks and may have a, b as sub questions.

PART- A

(10*2 Marks = 20 Marks)

1.	a)	Differentiate lower and higher pairs.	2M	CO1	BL2
	b)	What is an inversion of a mechanism?	2M	CO1	BL1
	c)	What is an axode?	2M	CO2	BL1
	d)	What are the properties of instantaneous centre?	2M	CO2	BL1
	e)	Give an application of pantograph.	2M	CO3	BL1
	f)	What is the condition imposed for equal speeds of the driving and driven shafts?	2M	CO3	BL1
	g)	Why offset is provided to the cam follower mechanism?	2M	CO4	BL1
	h)	How the follower moves in a cam?	2M	CO4	BL1
	i)	What is the advantage of an epicyclic gear train?	2M	CO5	BL1
	j)	Which gear train is used in the clock mechanism to connect minute hand to hour hand?	2M	CO5	BL1

PART- B

(10*5 Marks = 50 Marks)

2	a)	What are the three types of constrained motions?	5M	CO1	BL1
	b)	What are the various categories of classification of kinematic pairs?	5M	CO1	BL1
		OR			
3		Discuss about the second inversion of the slider crank chain mechanism	10M	CO1	BL2
4		In a slider crank mechanism, the crank is 480 mm long and rotates at 20 rad/s in counter clockwise direction. The length of the connecting rod is 1.6 m. when the crank turns 60^0 from the inner dead centre, determine i) Velocity of the slider ii) Velocity of point E located at a distance 450 mm on the connecting rod extended. Angular velocity and rubbing velocity	10M	CO2	BL3

OR

5	Discuss the method of constructing acceleration diagrams considering Coriolis component	10M	CO2	BL2
6	Derive the conditions required for the correct steering mechanism for davis steering gear	10M	CO3	BL6
	OR			
7	Discuss the mechanics of Hart's mechanism	10M	CO3	BL2
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 a uniform velocity of 120 rpm and has a least radius of 30 mm. what will be the maximum velocity and acceleration of the follower during the lift and the return?	10M	CO4	BL3
	OR			
9	Analyze the circular arc convex cam with flat faced follower.	10M	CO4	BL4
10	Construct the gear profile and define the various terminologies used in the gear profile	10M	CO5	BL6
	OR			
11	Construct and analyze the mechanism of differential gear of an automobile	10M	CO5	BL6

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EXAMINATION BRANCH

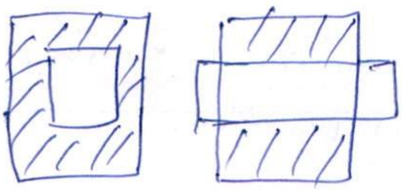
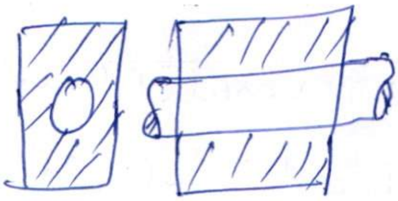
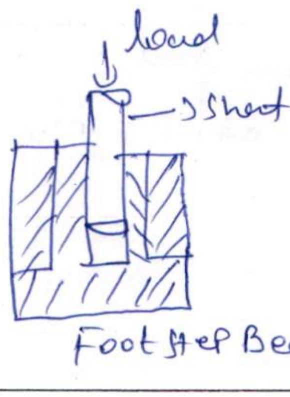
Academic Year	21-22
Year & Semester	II & II
Regulation	R-20
Branch	Mech
Course Code	2040314
Course Name	kom
Course Faculty's	S.P.Jani
Course Moderator	S.P.Jani
Date of Exam	8/7/22
Reporting Time & Sign	8.45Am & [signature]

KEY PAPER

QNO	ANSWER	MARKS
	Part-A	
1, a,	Lower Pair When the two kinematic links are connected such that they have a surface contact b/w the two links it is called as lower pair.	1
	higher Pairs:- When the two kinematic links are connected such that they have a line or Point contact b/w the two links it is called as higher Pair.	1

QNO	ANSWER	MARKS
b,	Inversion of a mechanism:-	
	The method of obtaining differed mechanism by fixing differed links in a kinematic chain. is known as inversion of the mechanism.	2
c.	Axode:-	
	The locus of all such 'I' centres is known as centrode. A line drawn through an 'I' centre and $\perp^{lr}$ to the plane of motion is called 'I' axis. The locus of this axis is known as axode.	2
d,	Properties of 'I' centre:-	
	* A rigid link rotates instantaneously relative to another link at the 'I' centre for the configuration of the mechanism considered.	2
	* the two rigid links have no linear velocity relative to each other at the 'I' centre.	
e,	Application of Pantograph:-	
	* Reproduction of plane areas and figures such as maps, plans etc. on enlarged or reduced scales.	2

QNO	ANSWER	MARKS
f.	$\tan\theta = \pm\sqrt{\cos\alpha}$	2
g.	Offset of Cam: The center line of the follower does not pass through the center line of the cam shaft. The amount of offset is the distance b/w these two center lines. The offset cause a reduction of the side thrust present in the roller follower.	2
h.	CAM: A follower is a mechanical component concerning which the cam rotates in an oscillatory or circular motion.	2
i.	* Coaxial arrangement of input shaft and output shaft * Load distribution to several planetary gears. * High efficiency due to low rolling power. * Almost transmission ratio options due to combination of several planet stages.	2

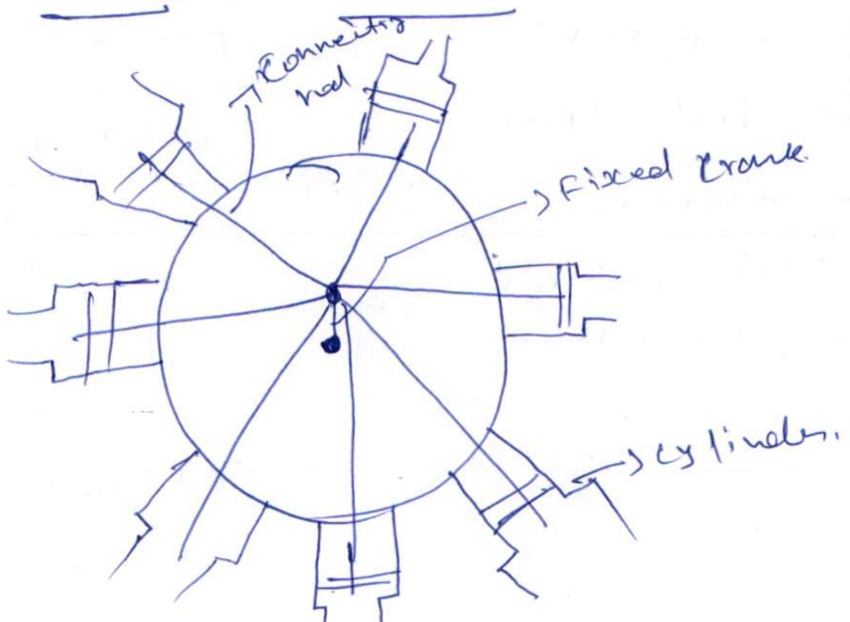
QNO	ANSWER	MARKS
J.	~~The reverted gear train.~~ ~~Epicyclic gear train.~~ The reverted gear train.	2
	Part-B	
2, a,	Contrained motions: (i) Completely constrained (ii) Un completely constrained (iii) Success fulley constrained	1
	(i) 	2
	(ii) 	1
	(iii)  Foot step Bearing	1

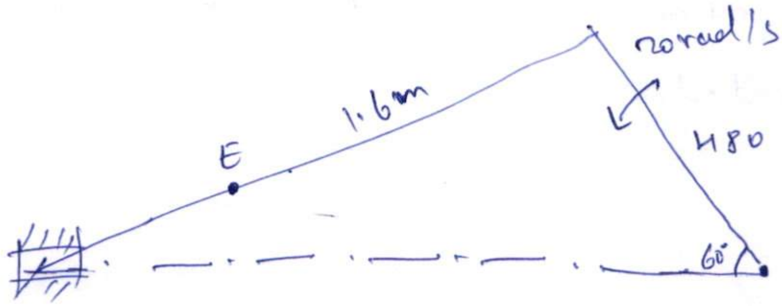
QNO	ANSWER	MARKS
b)	Chassification of kinematic Pairs:-	5

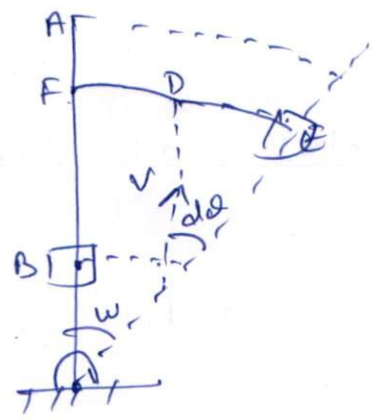
~~Type of relative motion~~

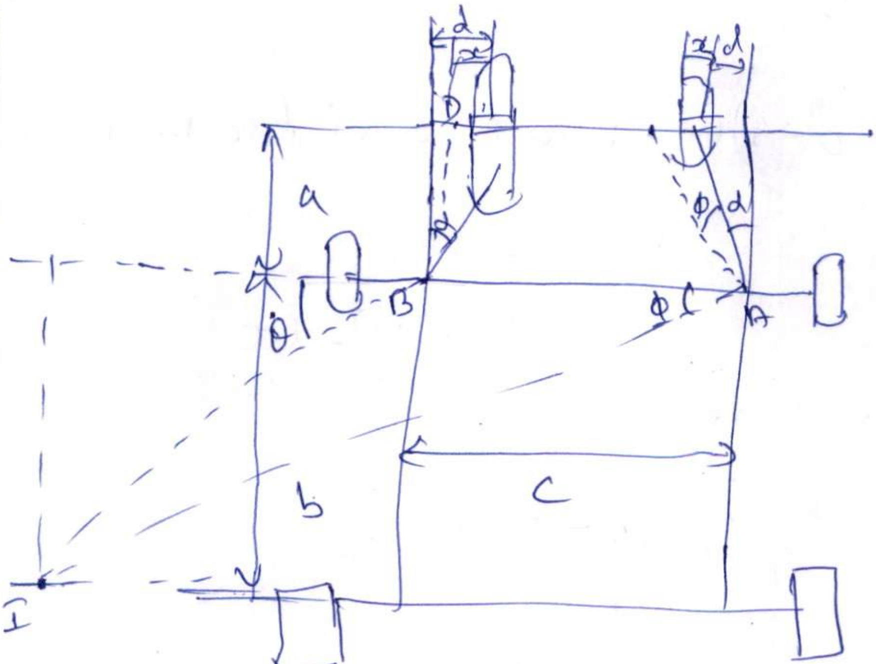
Kinematic Pairs

- relative motion transmission
  - Sliding Pair
  - Turning Pair
  - cylindrical Pair
  - rolling Pair
  - Spherical Pair
  - Screw Pair
- Contact ~~btw~~ b/w links
  - lower Pair
  - Higher Pair
- Form of closure of Two links.
  - Slef closed Pair
  - Force closed Pair

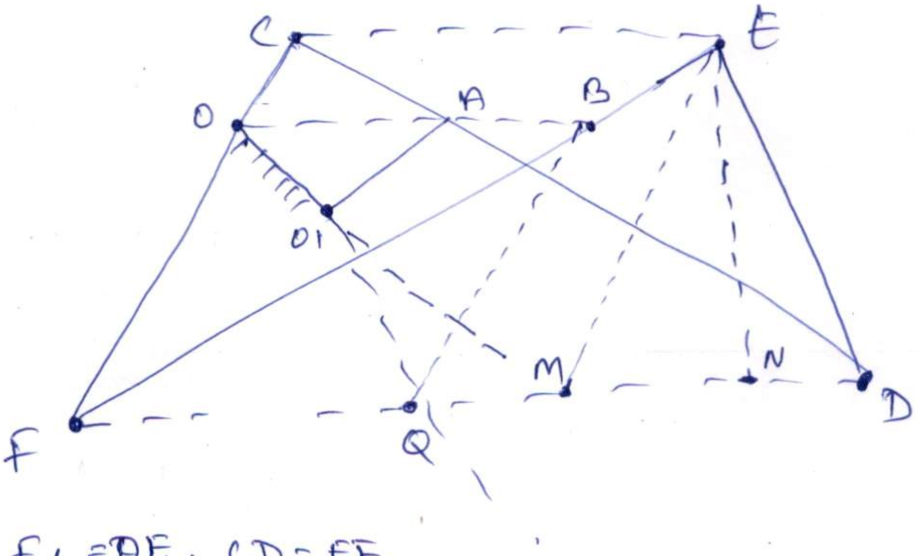
QNO	ANSWER	MARKS
3)	The Inversion is Obtained by fixing the Cylinder or link. ~~fut~~ In this case the crank rotates the connecting rod oscillates around a pin Pivoted to the fixed link i.e. the Cylinder and the Piston attached to the piston rod resiprocates.	3
	Rotary Internal Combustion Engine 	7
	Explain	

QNO	ANSWER	MARKS
4)		4
	Velocity of Slider	4
	Velocity of Point E	2

QNO	ANSWER	MARKS
5)	**Coriolis Component**	
	When a Point on one link is sliding along another rotating link, such as in quick return motion mechanism, then the Coriolis Component of the acceleration must be calculated.	2
		3
	$arc\,DE = arc\,FE - arc\,FD$ $= arc\,FE - arc\,BC$ $= (OF)(d\theta) - (OB)(d\theta)$ $= OF - OB(d\theta)$ $= FB\,(d\theta)$ $= CD(d\theta)$ $= (V\cdot dt)(w\cdot dt)$ $DE = V\cdot w\,(dt^2)$ $DE = \frac{1}{2}a\,(dt^2)$ $\frac{1}{2}a\,dt^2 = Vw\,(dt^2)$ $\boxed{a_{cr} = 2Vw}$ → slotted bar; ↳ slide	5

QNO	ANSWER	MARKS
6,	Davis Steering gear. 	3
	$\Delta AA'C'$ $\tan(\alpha+\phi) = \frac{A'C'}{AA'} = \frac{d+x}{a}$ $\Delta AA'C$ $\tan\alpha = \frac{A'C}{AA'} = d/a$ $\Delta BB'D'$ $\tan(\alpha-\theta) = \frac{B'D'}{BB'} = \frac{d-x}{a}$ $\tan(\alpha+\phi) = \frac{\tan\alpha+\tan\phi}{1-\tan\alpha\tan\phi}$ $\frac{d+x}{a} = \frac{d/a+\tan\phi}{1-d/a\times\tan\phi} = \frac{d+a\tan\phi}{a-d\tan\phi}$	3

QNO	ANSWER	MARKS
	$(d+x)(a-d\tan\phi) = a(d+a\tan\phi)$ $\tan\theta = \frac{ax}{a^2+d^2-d\cdot x}$ Correct steering $\cot\phi - \cot\theta = c/b$ (or) $\frac{1}{\tan\phi} - \frac{1}{\tan\theta} = c/b$ $\frac{a^2+d^2+dx}{ax} - \frac{a^2+d^2-dx}{ax} = c/b$ $2d/a = c/b$ $2\tan\alpha = c/b \quad \because d/a = \tan\alpha$ $\boxed{\tan\alpha = c/2b}$	3

QNO	ANSWER	MARKS
	a = Vertical distance b/w AB and CD b = wheel base d = Horizontal distance b/w AC and BD c = Distance b/w pivots A and B of from Axle x = AC to AC$'$ = CC$'$ = DD$'$ α = Angle of inclination of the links AC & BD.	1
7)	Hart's mechanism:- 	2
	FC = DE, CD = EF Q, A, B divide FC, CD, FE in same ratio.	1

QNO	ANSWER	MARKS
	BOCE trapezium. OA and OB are respectively ∥ to FD and CE. Hence OAB is a straight line. It may be proved now that the product OA × OB is constant	1
	Δ CEF ∼ OFB $\frac{CE}{FC} = \frac{OB}{OF}$ (or) $OB = \frac{CE \times OF}{FC}$ Δ FCD ∼ OCA $\frac{FD}{FC} = \frac{OA}{OC}$ (or) $OA = \frac{FD \times OC}{FC}$ $OA \times OB = \frac{FD \times OC}{FC} \times \frac{CE \times OF}{FC}$ $OA \times OB = FD \times CE \times \text{constant}$ $FD \times CE = FD \times FM$ $= (FN + ND)(FN - MN)$ $= FN^2 - ND^2$ $= (FE^2 - NE^2) - (ED^2 - NE^2)$	6

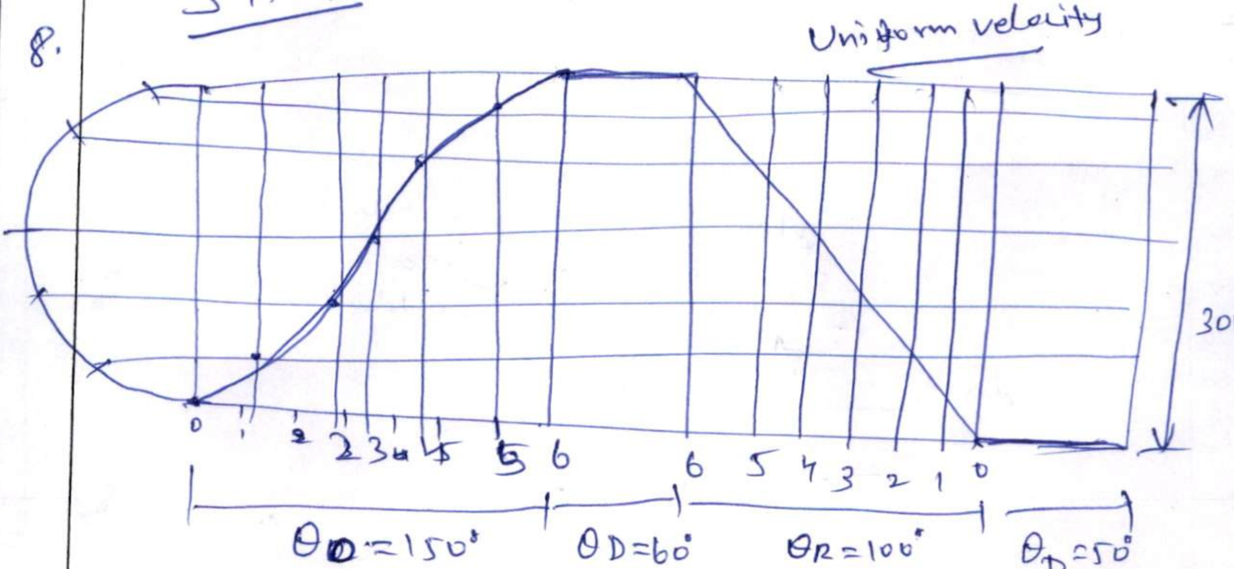
$= FE^2 - ED^2 = \text{constant}$

$\therefore OA \times OB = \text{constant}$

QNO	ANSWER	MARKS

S H M

8.



4

Cam Profi

4

Maximum velocity durig lift

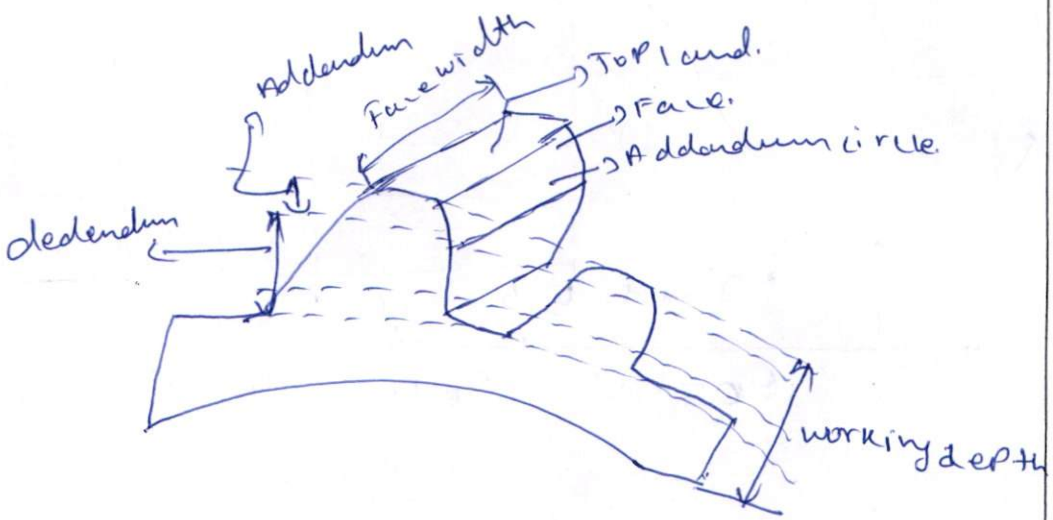
$S = 30mm$

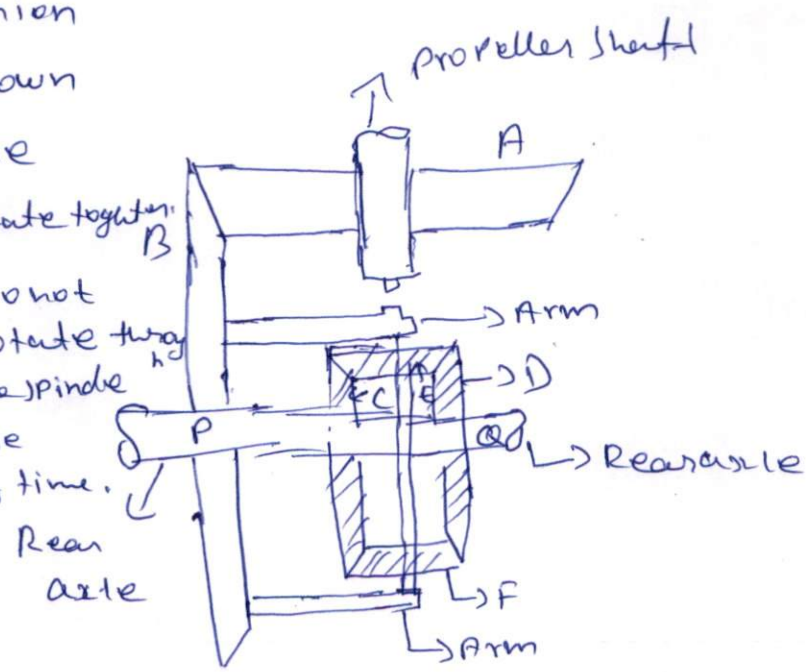
$$\omega = 2\pi N/60 = \frac{2\times\pi\times 120}{60} = 4\times\pi = 12.56 \text{ rad/s}$$

$$V_O = \frac{\pi \omega S}{2\theta_O}$$

2

$$a_O = \frac{\pi^2 \omega^2 S}{2(\theta_O)^2}$$

QNO	ANSWER	MARKS
10.	Gear Profile  	5
	Terminologies Explain	5

QNO	ANSWER	MARKS
11)	Differential gear of an Automobile	diagram 4
	A -> Pinion B -> Crown P -> axle C, D -> rotate together F, E -> do not rotate through the spindle ↓ It will use to turning time.	gear explain 3
		
	The differential gear used in the rear drive of an automobile shown in fig. * To transmit motion from the engine shaft to the rear driving wheels. * To rotate the rear wheels at different speeds while the automobile is ~~taking~~ taking a turn.	3

QNO	ANSWER	MARKS

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