Register No.: ……………………………… Name: ……………………………………………………………..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), JULY 2022

MACHINE DESIGN

(2021 Scheme)

Course Code: **21MD203**

Course Name: **Advanced Theory of Mechanisms**

Max. Marks: **60** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

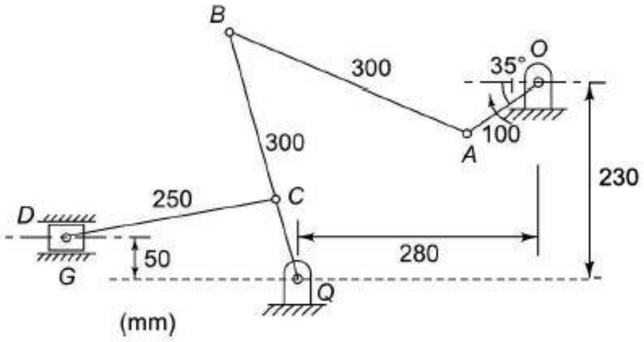
1. Define the terms: (i) Mechanism, (ii) Degrees of freedom, (iii) inversion
2. What is inflection circle? Mention its significance
3. Define Robert's law. What are cognate mechanisms?
4. Write the expressions for displacement, velocity and acceleration of a follower executing cycloidal motion. Also draw the diagrams for each
5. Define static equilibrium? What are the conditions?
6. Compare static force analysis and dynamic force analysis.
7. Write Euler's equations of motion.
8. What is dynamically equivalent system? Mention the conditions for the same.

PART B

(Answer one full question from each module, each question carries 6 marks)

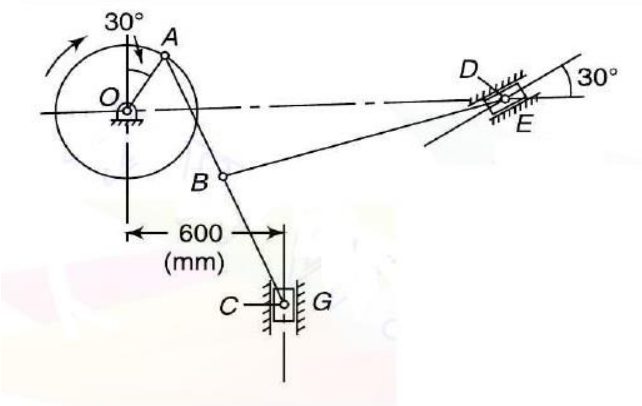
MODULE I

9. For the mechanism shown in figure, OA=QC=100mm, AB=QB=300mm and CD=250mm. The crank OA rotates at 150rpm in the clockwise direction. Determine the (i) velocity of the slider at D
(ii) angular velocities of links QB and AB (6)



OR

10. For the mechanism shown in figure, OA=300mm, AB=600mm, AC=BD=1.2m. OD is horizontal for the given configuration. If OA rotates at 200rpm in the clockwise direction, find,
   (i) linear velocities of C and D
   (ii) angular velocities of links AC and BD
   (iii) acceleration of C and D



(6)

MODULE II

11.	a)	Derive Euler-Savary equation with the aid of neat figures.	(5)
	b)	What is polode curvature?	(1)

OR

12.	a)	Find the centre of curvature of the path of a coupler point 'C' in a mechanism with the following dimensions. O_2A=2cm, O_4B=4cm, AB=6cm, AC=4cm, θ_2= 60°, O_2O_4 = 8cm.	(5)
	b)	What is Hartman's construction?	(1)

MODULE III

13.	a)	A crank rocker mechanism has a 70mm fixed link, a 20mm crank, a 50 mm coupler and a 70mm rocker. Draw the mechanism and determine the maximum and minimum values of the transmission angle. Locate the two toggle positions and find the corresponding crank angles and the transmission angles.	(5)
	b)	Define the terms: (i) mechanical advantage, (ii) transmission angle	(1)

OR

14.	a)	Explain the concept of vector loop closure.	(1.5)
	b)	What is analytical synthesis technique? Derive an expression for the same.	(4.5)

MODULE IV

15.	a)	Define the terms: (i) base circle, (ii) pitch circle, (iii) prime circle	(1)
	b)	Draw the profile of the cam with a knife edged follower subjected to the following motion. • To raise the follower through 30mm with uniform acceleration and deceleration during 120° rotation of the cam	(5)

- Dwell for next 30° of the cam rotation
- To lower the follower with simple harmonic motion during the next 90° rotation of the cam
- Dwell for the rest of cam rotation

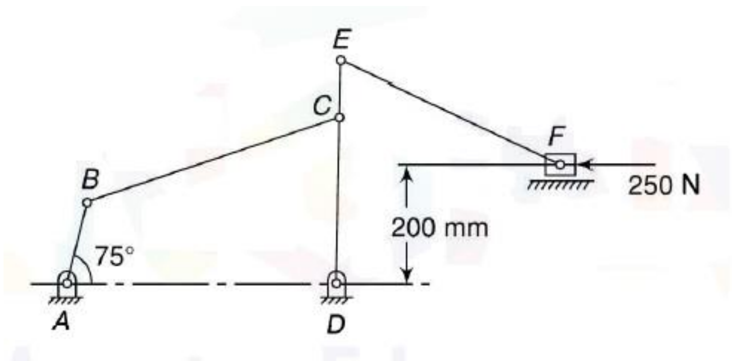
The cam has a minimum radius of 30mm and rotates counter-clockwise at a uniform speed of 800rpm. The line of stroke of follower is 20mm from the axis of cam shaft. Also, draw the displacement, velocity and acceleration diagrams for the motion of follower, for one complete revolution of the cam indicating main values.

OR

16. a) Define the terms: (i) position error, (ii) jump, (iii) cross over shock (1.5)
    b) Explain the dynamics of high speed cam system (4.5)

MODULE V

17. For the static equilibrium of given mechanism, find the required input torque at link AB. The dimensions are AB=150mm, BC=AD=500mm, DC=300mm, CE=100mm and EF=450mm. (6)

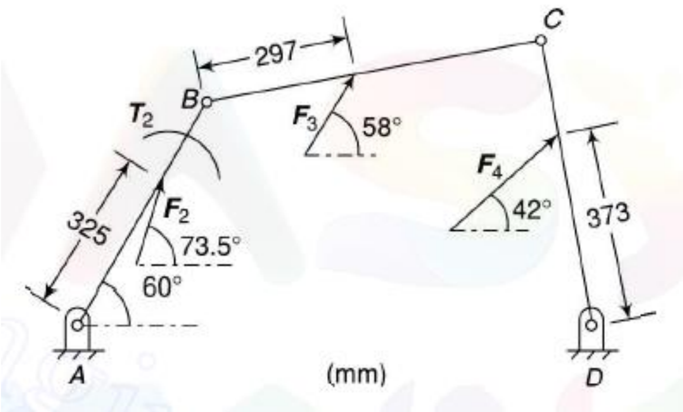


OR

18. a) Determine the required input torque on the crank of a slider crank mechanism for the static equilibrium when the applied piston load is 1500N. The lengths of the crank and connecting rod are 40mm and 100mm respectively and the crank has turned through 45° from the inner dead centre. (5)
    b) Define superposition principle. (1)

MODULE VI

19. Explain the steps involved in dynamic force analysis of a four bar mechanism subjected to three forces as shown in figure with the aid of relevant equations and diagrams. (6)



OR

20. a) The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60mm and 270mm respectively. The diameter of the piston is 100mm and the mass of the reciprocating parts is 1.2kg. During the expansion stroke when the crank has turned 20° from the top dead centre, the gas pressure is 650kN/m^2.

Determine the (4)

(i) net force on the piston

(ii) net load on the gudgeon pin

(iii) thrust on the cylinder walls

(iv) speed at which the gudgeon pin load is reversed in direction

b) What is meant by moments and products of inertia? (2)

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