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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (S), AUGUST 2023
ROBOTICS AND AUTOMATION
(2020 SCHEME)

Course Code: **20RBT202**

Course Name: **Kinematics and Dynamics of Mechanisms**

Max. Marks: **100** **Duration: 3 Hours**

Part A

(Answer all questions. Each question carries 3 marks)

1. Define the terms Kinematic Link, Kinematic chain, Mechanism.
2. Explain Mechanical Advantage.
3. Explain Instantaneous centre with neat sketch.
4. Explain Corioli's component of acceleration. How its magnitude and direction calculated?
5. State and explain D' Alembert's principle.
6. Show the free body diagrams of various linkages in a Four Bar mechanism.
7. Explain and compare Forward and Inverse Dynamics.
8. What is a rigid body? What are the types of motions of rigid bodies?
9. Explain under damped, critically damped, and over damped systems.
10. Explain vibration isolation and transmissibility.

PART B

(Answer one full question from each module, each question carries 14marks)

MODULE I

11. a) State and explain Grashof's law. (4)
    b) Sketch and explain slider crank chain. Explain with sketch any two-inversion mechanism obtained from it. (10)

OR

12. a) Define transmission angle. (2)
    b) A crank-rocker mechanism ABCD has the dimensions AB = 20mm, BC = 50mm, CD = 70mm and AD (fixed link) = 70mm. Determine the maximum and the minimum values of the transmission angle. Locate the toggle positions and indicate the corresponding crank angles and the transmission angles. (12)

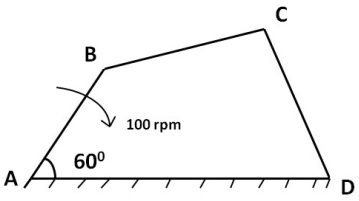
MODULE II

13. PQRS is a four-bar chain with link PS fixed. The lengths of the links are PQ = 50 mm; QR = 66 mm; RS = 56 mm; and PS = 100 mm. The crank PQ rotates at 10.5 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 link QR. (14)

OR

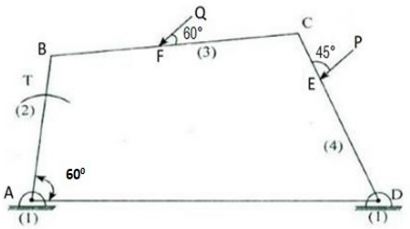
14. a) State and prove Arnold Kennedy's theorem. (4)

b) In a pin jointed 4 bar mechanism, AB = 300mm, BC=CD=360mm, AD=600mm, ∠BAD =60^0. The crank AB rotates uniformly at 100rpm. Locate all instantaneous centres and find angular velocity of link BC. (10)



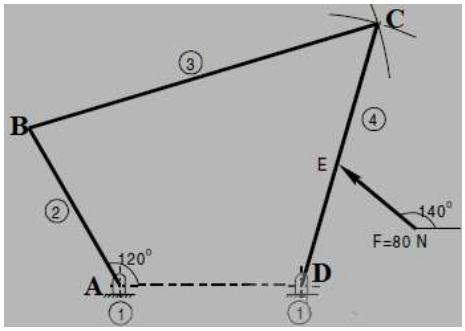
MODULE III

15. A four bar mechanism under the action of two external forces is shown below. The dimensions of the links are AB = 45 mm, BC = 60 mm, CD = 50 mm, CE = 20 mm, CF = 30 mm, AD=90 mm, angle BAD = 60°, P = 500N and Q = 400N. Determine the torque to be applied on the link AB for static equilibrium. (14)



OR

16. a. A four-link mechanism with the following dimensions is acted upon by a force 80 N at ∠140^0 on the link DC. AD =250mm AB = 250mm, BC=500mm, DC =375mm, DE=175mm. Determine input torque T on the link AB for the static equilibrium of the mechanism for the given configuration. (10)



b. Explain the effect of friction in mechanisms. Compare pin-joint friction and sliding friction with neat figures. (4)

MODULE IV

17. Derive the expression for inverse dynamic analysis of simple link under pure rotation (14)

OR

18. a) What is parallel axis theorem? Obtain an expression for the same (7)

b) What do you mean by principal axis and principal moments of inertia? (7)

MODULE V

19. a) Differentiate between Free undamped and damped vibration. (4)

b) A machine part of 3kg mass vibrates in a viscous medium. Determine the damping coefficient when harmonic force of 25N results in resonant amplitude of 13 mm with a period of 0.15s. If the system is excited by a harmonic force of 4Hz frequency, what will be the percentage increase in amplitude of vibration when the damper is removed as compared to that with damper? (10)

OR

20. a) Define logarithmic decrement and write the expression of logarithmic decrement in terms of damping ratio. (4)

b) A damped spring mass system has mass 2 kg, stiffness 100 N/m and damping coefficient 2 Ns/m. Determine the following:
i. Natural Frequency
ii. Damping ratio
iii. Damped natural frequency
iv. Logarithmic decrement
v. Ratio of two successive amplitudes (10)

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