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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTERB.TECH DEGREE EXAMINATION (S), SEPT 2022

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. With the help of examples, distinguish between lower and higher pair.
2. Define Grashof's law. Mention its significance.
3. Explain the terms: (i.) Centripetal acceleration and (ii.) Corioli's acceleration.
4. With help of sketch, derive the expressions for tangential and radial accelerations of a point on a rotating link.
5. With the help of an example, explain the principle of virtual work.
6. Explain the conditions of static equilibrium of two and three force members.
7. What is a rigid body? Mention the types of motion of an arbitrary rigid body.
8. Compare forward and inverse dynamics.
9. What is meant by principal moments of inertia?
10. Distinguish between under damped, critically damped and over damped systems in terms of damping coefficient.

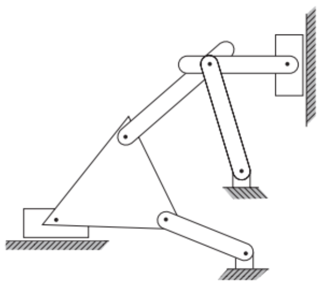
PART B

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

MODULE I

11. a) Explain the term kinematic link. Give the classification of kinematic links with examples. (6)

b) Define degrees of freedom. Determine the degrees of freedom of the mechanism shown below. Number the links and label the lower pairs and the higher pairs. (8)



OR

12. a) What is a machine? With help of examples, differentiate between a machine and a mechanism. (5)

    b) What are manipulators? With the help of an example, explain 2D (planar) manipulators. (9)

MODULE II

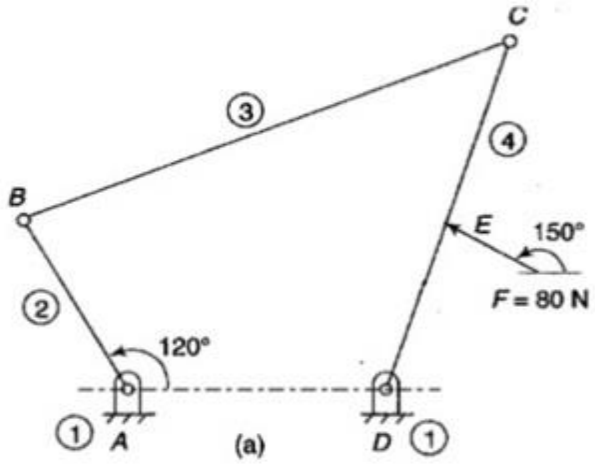
13. In a slider crank mechanism, the length of crank OB and connecting rod AB are 125 mm and 500 mm respectively. The centre of gravity G of the connecting rod is 275 mm from the slider A. The crank speed is 600 rpm. clockwise. When the crank has turned 45° from the inner dead centre position, determine: i) velocity of the slider A, ii) velocity of the point G, and iii) angular velocity of the connecting rod AB. (14)

OR

14. In a four-bar chain ABCD, link AD is fixed and the crank A B rotates at 10 radians per second clockwise. Lengths of the links are A B = 60 mm ; BC = CD = 70 mm ; DA = 120 mm. When angle DAB = 60° and both B and C lie on the same side of AD, find the angular velocities (magnitude and direction) of BC and CD. (14)

MODULE III

15. A four-link mechanism shown below with the following dimensions is acted upon by a force 80 N at an angle 150° on link DC. AD = 50 mm, AB = 40 mm, BC = 100 mm, DC = 75 mm, DE = 35 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration. (14)



OR

16. Explain parallel axis theorem and obtain an expression to transfer the moment of inertia to the axis at the end of a mallet hammer. (14)

MODULE IV

17. a) Deduce the Lagrangian formulation for manipulator dynamics. (7)

    b) Derive the expression for kinetic energy of a rigid body. (7)

OR

18. With the help of sketch, derive the expressions for kinetic and potential energy for a two-point mass robot. (14)

MODULE V

19. Derive the Euler's equation of motion for a rigid body from Newton's law with the help of a neat figure. (14)

OR

20. The following data relates to a vibratory system with viscous damping: Mass = 2.5 kg; spring constant = 3 N/mm and the amplitude decreases to 0.25 of the initial value after five consecutive cycles.
Determine the (14)
    (i) stiffness of the spring
    (ii) logarithmic decrement
    (iii) damping factor
    (iv) damping coefficient

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