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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 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)

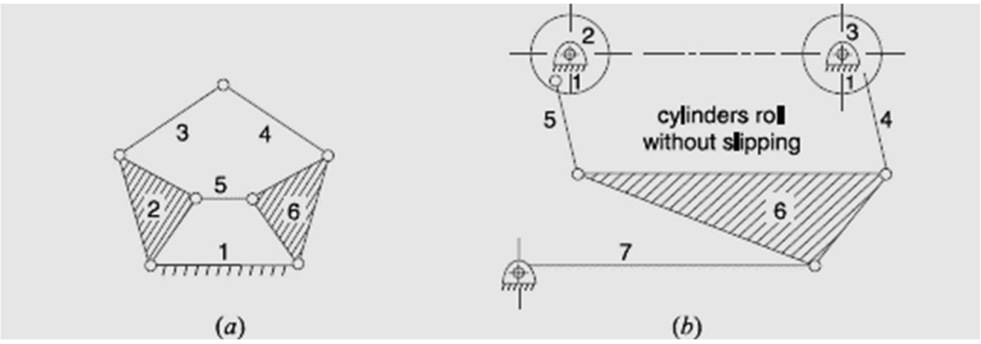
1. How are the Kinematic pairs classified? Explain with examples
2. Define degrees of freedom. Compare Greubler's and Kutzbach criteria.
3. What is Coriolis' component of acceleration?Write the equations for the same.
4. What is the instantaneous center? How is it used in velocity analysis?
5. Draw the free body diagrams of various linkages in a slider crank mechanism.
6. Explain about the principle of virtual work?
7. What is a rigid body? What are the types of motions of rigid bodies?
8. Explain about the Forward and Inverse Dynamics.
9. What is logarithmic decrement? How is it used to measure damping in vibrating systems?
10. What is an underdamped system? How does it behave differently from an overdamped or critically damped system?

PART B

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

MODULE I

11. a) Determine the mobility (degrees of freedom) of the mechanism shown in Fig (a) and (b) using Kutzbach mobility criterion and classify them. (6)



b) Explain the working of crank and slotted lever mechanism with neat figures. (8)

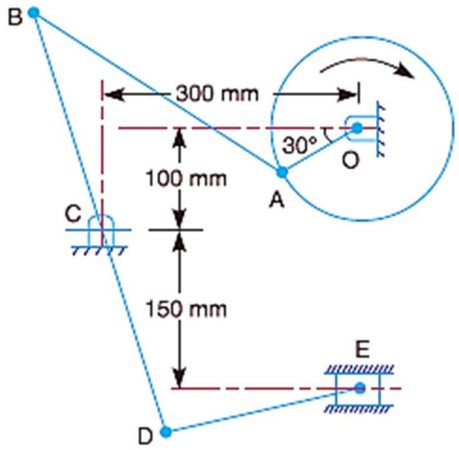
OR

12. a) Define transmission angle. Mention the extreme angles for the same. (3)

b) A crank-rocker mechanism has a 70mm fixed link, 20mm crank, 50mm coupler and 70mm rocker. Draw the mechanism and 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 (11)

MODULE II

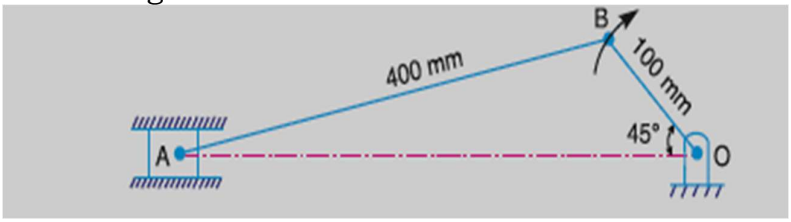
13. In a mechanism as shown in Fig. the crank OA is 100 mm long and rotates in a clockwise direction at a speed of 100 r.p.m. The straight rod BCD rocks on a fixed point at C. The links BC and CD are each 200 mm long and the link AB is 300 mm long. The slider E, which is driven by the rod DE is 250 mm long. Find the velocity and acceleration of E. (14)



OR

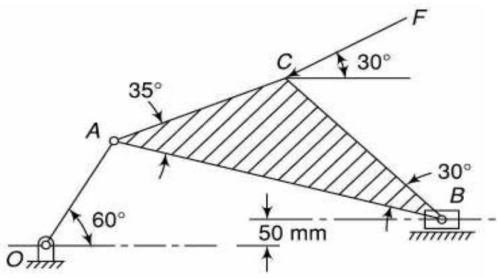
14. a) State and prove Kennedy's theorem. (3)

b) Locate all the instantaneous centers of the slider crank mechanism as shown in the below figure. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod AB. (11)



MODULE III

15. For the mechanism shown in the figure Find the required input torque for the static equilibrium. The length of OA and AB are 250mm and 650mm respectively and F=500N



(14)

OR

16. Explain the steps involved in dynamic force analysis of a slider crank mechanism using neat diagrams. (14)

MODULE IV

17. a) What is parallel axis theorem? Obtain an expression for the same. (7)
    b) Determine the expression for total kinetic energy of a rigid body (7)

OR

18. a) Derive an expression for Euler's equation of motion for a rigid body. (11)
    b) What do you mean by Lagrangian formulation for manipulator dynamics? (3)

MODULE V

19. A machine component having a mass of 3kg vibrates in a viscous medium. A harmonic exciting force of 30N acts on it and causes resonant amplitude of 15mm with a period of 0.24 second. Find the damping coefficient. (14)
    If the frequency of the exciting force is changed to 5Hz, determine the increase and also the % increase in the amplitude of the forced vibrations upon the removal of the damper.

OR

20. a) Explain briefly on Transmissibility? (3)
    b) In a single degree damped vibrating system, a suspended mass of 8kg makes 30 oscillations in 18 Seconds. The amplitude decreases to 0.25 of initial value after 5 oscillations.
    Determine the:
    (i) Stiffness of Spring
    (ii) logarithmic decrement
    (iii) Damping Factor
    (iv) Damping Coefficient (11)

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