CBCS SCHEME

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18MDE14

First Semester M.Tech. Degree Examination, Dec.2019/Jan.2020
Dynamics and Mechanism Design

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Name various kinematic joints and the degree of freedom associated with each joint. Degree of freedom of joints varies from 1 to 5. **(10 Marks)**

b. Classify a 4-bar kinematic chain using Garshoff's criterion. Mention the criterion and driving link for the resulting mechanisms. **(10 Marks)**

OR

2 a. Find the mobility of the mechanism shown in Fig. Q2 (a). **(10 Marks)**

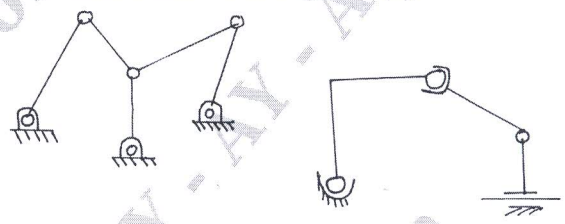

Fig. Q2 (a)

b. What is an equivalent linkage? Give one example. **(05 Marks)**

c. For the mechanism shown in Fig. Q2 (c). Using Hall-Ault auxiliary point method illustrate the procedure to find the velocities. **(05 Marks)**

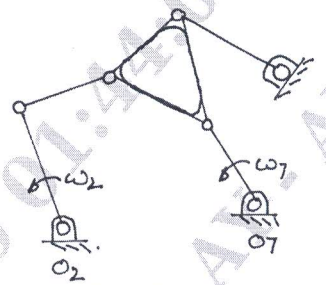

Fig. Q2 (c)

Module-2

3 a. Derive the relation between angular velocity and moment of momentum of a rigid body. **(10 Marks)**

b. Consider three particles connected by the rigid rods, as shown in Fig. Q3 (b) and subjected to force and a moment in CCW direction. Find the generalized forces. **(10 Marks)**

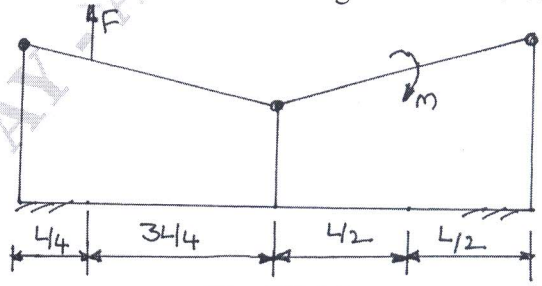

Fig. Q3 (b)

OR

4 a. Obtain the equation of motion of the system shown in Fig. Q4 (a) using Lagrange's equation. **(10 Marks)**

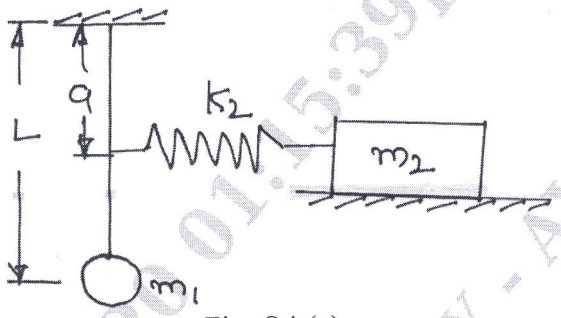

Fig. Q4 (a)

b. Obtain the equation of motion of the system shown in Fig. Q4 (b) using Hamilton equation. **(10 Marks)**

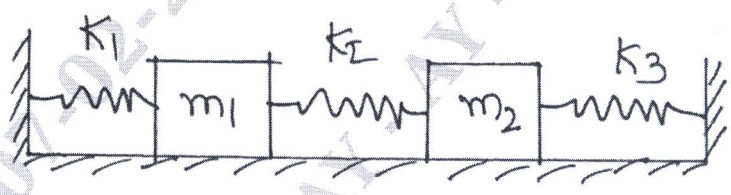

Fig. Q4 (b)

Module-3

5 a. Enumerate the combination of 8 link single degree of freedom kinematic chains. Among them sketch the unique chains containing
(i) Two quartinary chains.
(ii) One quartinary chain. **(15 Marks)**

b. What is Dimensional Synthesis? What are the types of dimensional synthesis problems? Explain. **(05 Marks)**

OR

6 a. Synthesize crank rocker mechanism for specified output swing ϕ and input Crank turns through ψ and $\psi > 180^\circ$. Explain the steps in synthesis. **(15 Marks)**

b. Given $y = x^{0.8}$. Generate three precession position in the range $1 \le x \le 3$. **(05 Marks)**

Module-4

7 a. Synthesize a 4 bar mechanism to guide coupler AB through $A_1(2,6)$, $A_2(7,9)$, $A_3(12,6)$ and $B_1(8,6)$, $B_2(10,8)$ and $B_3(14,5)$. **(10 Marks)**

b. Synthesize a 4-bar mechanism to satisfy the following conditions:
$\omega_2 = 2$ rad/s, $\omega_3 = 3.5$ rad/s. $\omega_4 = 5$ rad/s
$\alpha_2 = 0$ rad/s, $\alpha_3 = 2$ rad/s, $\alpha_4 = 4$ rad/s **(10 Marks)**

OR

8 a. Explain the synthesis of a slider crank mechanism with eccentricity 'C' for two positions of input link θ_{12} and output displacement δ_{12} of the slider. The slider should move away from the fixed center while input link moves in clock wise direction. **(10 Marks)**

b. Determine the dimensions of a 4-bar linkage if input angle θ_2 in three positions are 0° 30° 60° and corresponding output angles are 30° 50° and 80° respectively. **(10 Marks)**

Module-5

9 a. A turbine rotor of ship weighs 196 kN and has radius of gyration of 75 cm. Its speed is 200 rpm. The ship pitches 10° about and below horizontal axis. A complete oscillation takes place in 20 sec and motion is SHM. Determine

(i) Maximum couple tending to shear holding down bolts of turbine.

(ii) The direction in which bow will tend to turn while rising, if the rotation of rotor is clockwise when looking from aft.

(iii) Maximum acceleration of ship during pitching. **(10 Marks)**

b. Obtain $R_{xyz}(\gamma\beta\alpha)$ fixed axis rotation matrix. Illustrate the rotation by a sketch. **(10 Marks)**

OR

10 a. Obtain the phase plane response of single dof spring mass system with K = 100 kN/m and mass 50 kg subjected to a ramp input 0 – 100 N in 0.1 sec and step input of 100 N from time t = 0.1 sec to time 2.5 sec. Approximate ramp as two equal step functions. **(10 Marks)**

b. Choosing a 4 bar spatial mechanism, carry out the position analysis. **(10 Marks)**

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