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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Second Semester, B.E. - Mechanical Engineering (MMDN)

Semester End Examination; May/June - 2018

Dynamics and Mechanism Design

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any, may be suitably assumed.

UNIT - I

1 a. Explain the following :

i) Holonomic and nonholonomic constraints 12

ii) Generalized force and generalized momentum

b. State and explain the principle of virtual work with suitable example. 8

2 a. The cube of mass *m* is resting in static equilibrium at a corner formed by two frictionless, mutually perpendicular planes as shown in Fig.Q2(a). Using principle of virtual work, determine the reaction forces R_1 and R_2. 10

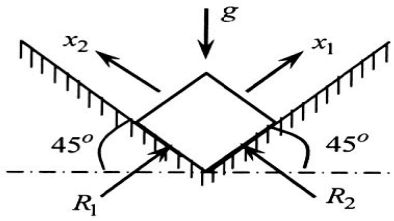


Fig. Q 2(a)

b. Three particles are connected by two rigid rods having a joint between them to form the system shown in Fig.Q2(b). The configuration of the system is given by the ordinary coordinates (x_1, x_2, x_3) or by the generalized coordinates (q_1, q_2, q_3), where

$$x_1 = q_1 + q_2 + \frac{1}{2}q_3; \quad x_2 = q_1 - q_3; \quad x_3 = q_1 - q_2 + \frac{1}{2}q_3;$$

Find the expression for the kinetic energy and the generalized moment. 10

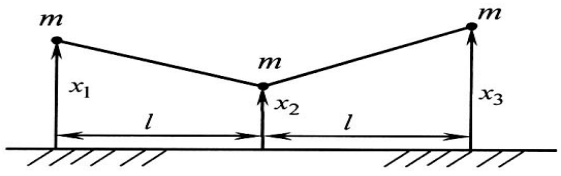


Fig. Q 2(b)

UNIT - II

3. A double pendulum consists of two particles suspended by mass less rods as shown in Fig.Q3. Find the differential equation of motion. Linearize these equations, assuming small motions. 20

Contd...2

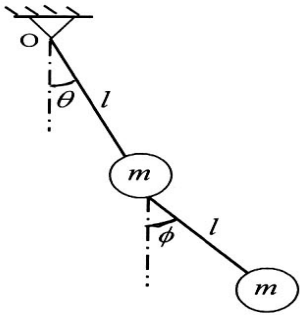


Fig. Q3

4 a. Derive Hamilton's equations from Lagrange's equation. 10

b. Derive Euler's equation of motion. 10

UNIT - III

5 a. Determine the number of roots in the right half of s-plane for the following polynomial $s^5+4s^4+12s^3+20s^2+30s+100 = 0$. 8

b. Explain the following controller : 12

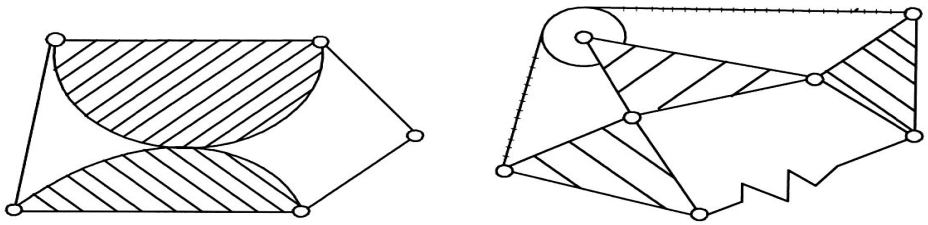
i) Proportional controller ii) Proportional plus derivative controller

6 a. Define the following : 8

i) Kinematic link and kinematic pair ii) Planar and spherical mechanisms

b. Derive Kutzbach criterion for the mobility of mechanisms. 6

c. Find the dof of the mechanisms shown in Fig.Q6(c) and draw equivalent kinematic chain with turning pairs. 6



(i) (ii)

Fig. Q 6(c)

UNIT - IV

7 a. Explain the following tasks of synthesis : 6

i) Function generation ii) Path generation iii) Motion generation

b. Obtain the Chebychev's spacing for the function $y = f(x)$ in the range $10 \leq x \leq 50$, where 3 precision points are prescribed. Use both analytical and graphical methods. 6

c. Using relative pole method, synthesize a 4-bar linkage in which 30° of crank rotation produces 60° of follower rotation. Both crank and follower rotates in clockwise direction. 8

8 a. Derive the expressions for the synthesis of crank-rocker mechanism for maximum transmission angle when time ratio is unity. 10

b. Explain Bloch's method for the synthesis of four-link mechanism. 10

Contd … 3

UNIT - V

9 a. Using inversion method, synthesis a four-link mechanism for three positions of its input and output links. The angular displacements of input and output links are : 8

$\theta_{12} = 30°$, $\theta_{23} = 30°$, and $\phi_{12} = 45°$, $\phi_{23} = 60°$

Input link moves counter clockwise and output links moves clockwise direction.

b. Using point position reduction, design a four-bar mechanism so that the input and output links have the following angular displacements : 12

$\theta_{12} = 20°$, $\theta_{23} = 30°$, $\theta_{34} = 20°$ and $\phi_{12} = 40°$, $\phi_{23} = 30°$, $\phi_{34} = 20°$.

10. Write a short notes on : 20

i) Overlay method of synthesis

ii) Cognate linkages

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