U.S.N

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Second Semester, M.Tech. - Mechanical Engineering (MMDN)

Semester End Examination; May / June - 2019

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 Holonomic and Non-Holonomic constraints with example. 8

b. Write a note on : 12

i) Coordinate transformation ii) Generalized force iii) Generalized momentum

2 a. Two frictionless blocks of equal mass *m* are connected by a mass less rigid rod as shown in Fig. Q2(a). Obtain the force F_2 if the system is in static equilibrium. 6

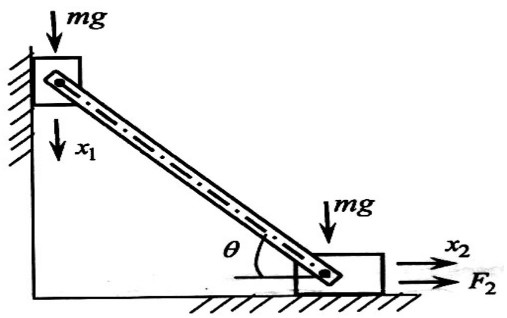

Fig. Q 2(a)

b. Prove that the work done on a particle depends upon its initial and final position. 8

c. A ball of mass *m* is sliding along a rigid rod as shown in Fig. Q2(c). If the position of mass is given by the spherical coordinates(r, θ, ϕ), obtain the expression for the kinetic energy and the generalized momenta. 6

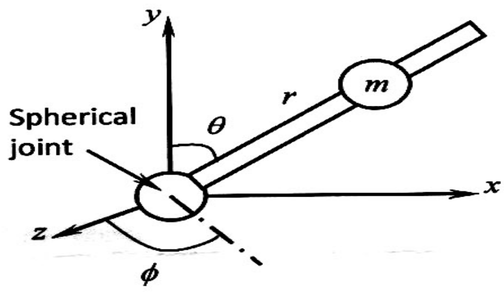

Fig. Q 2(c)

UNIT - II

3 a. A simple pendulum of length *L* and weight *mg* is pivoted to the mass *M* which slides without friction on a horizontal plane as shown in Fig. Q3(a). Use LaGrange's equation to determine the equations of motion of the system and hence approximate the equations for small oscillations. 12

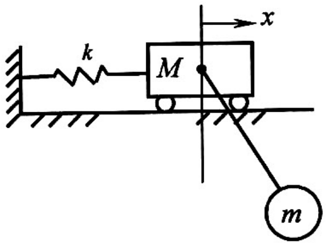

Fig. Q 3(a)

b. A particle of mass *m* can slide without friction on the inside of a small tube which is bent in the form of a circle of radius *r*. The tube rotates about a vertical diameter with a constant angular velocity as shown in Fig. Q3(b). Obtain the differential equation of motion. 8

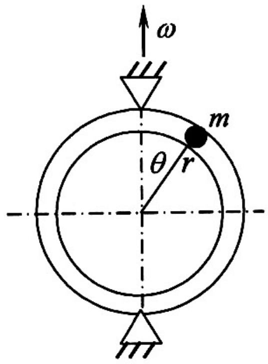

Fig. Q3(b)

4 a. Derive Hamilton's equation from LaGrange's equation. 12

b. Derive Euler's equation of motion. 8

UNIT - III

5 a. The characterstics of eqation of a system is given by, $s^4 + 12s^3 + 10s^2 + 2s + K = 0$. Determine the value of *K* for the system to be stable. 8

b. Explain the following controller: 12

i) Proportional controller   ii) Proportional plus derivative controller

6 a. State Grashof's law and specify the conditions with necessary sketches, for obtaining different kinematic inversion of a quadratic chain. 10

b. Determine the mobility of mechanisms shown in Fig. Q6(b) using Kutzbzch criterion. 4

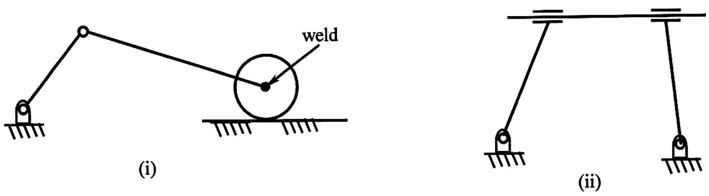

Fig. Q 6(b)

c. For the mechanism shown in Fig. Q6(c), draw equivalent kinematic chain with turning pairs. 6

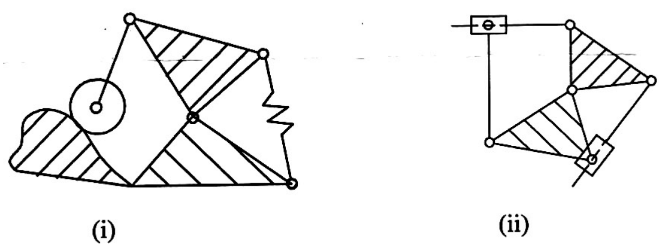

Fig. Q 6(c)

UNIT - IV

7 a. A crank-rocker mechanism is having a time ratio of one, output rocker angle of 60° and minimum transmission angle of 40°. If the length of fixed link is 50 mm, design the mechanism for its maximum transmission angle. 10

b. Using relative pole method synthesize a slider crank mechanism with eccentricity e =15 mm for the two positions of input link θ_{12} = 30° and output displacement S_{12} = 45 mm of slider. The slider should move away from the fixed center while input crank moves in clockwise direction. 10

8 a. Explain Bloch's method for the synthesis of four-link mechanism. 8

b. Using Freudenstein's equations, synthesis a 4-link mechanism to coordinate three positions of the input and output links as follows: 12

θ_1 = 20°, θ_2 = 35°, θ_3 = 50° and ϕ_1 = 35°, ϕ_2 = 45°, ϕ_3 = 60°.

UNIT - V

9 a. Synthesis a four-link mechanism to coordinate three positions of the input and output links for the following angular displacement by inversion method : 8

θ_{12} = 35°, θ_{13} = 80°, and ϕ_{12} = 50°, ϕ_{13} = 80°.

Input and output links rotate counter clock wise direction

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

θ_{12} = 20°, θ_{23} = 30°, θ_{34} = 40° and ϕ_{12} = 40°, ϕ_{23} = 30°, ϕ_{34} = 20°.

10. Write a short notes on : 20

a) Overlay method

b) Coupler curve synthesis

c) Congnate linkages

d) Caley's diagram

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