Menoufiya University Faculty of Engineering Shebin El- Kom Second (June) Term Examination Academic Year: 2014-2015 Date: 13/6/2015	Minufiya University	Dept.: Production Engineering Year : Master Subject: Dynamic of Multi-bodies systems Code : PRE 619 Time Allowed: 3 hours Total Marks : 100 Marks
Allowed Tables and Charts: None *Examiners: Dr/ Mohamed Hesham Belal*		

Answer All the Following Questions:

Question No.(1): [25 Mark]

(a)- For the shown 2-DOF vibrating system in Fig.(1), all data are given. Determine the equations of motion using Lagrange's equation.

(b)- For the shown framed structures in Fig.(2), assuming the axial deformation of all members are neglected and all data are given. The force acting on the joints A and B are given respectively F_1, F_2, M_3, F_4, F_5, M_6 as shown.

(1)- Derive the form of the holonomic scleronomic constraints subjected to the frame,

(2)- Derive the expression of the generalized forces.

Question No.(2): [25 Mark]

(a)- The forces of multi-body systems can be classified mainly into three types. Discuss this statement.

(b)- A sphere of radius R rolls without sliding on the horizontal surface as shown in Fig.(3). Write down the equation of scleronomic constraints and non- scleronomic constraints.

(c)- Derive the Hamilton's canonical equations of the shown system in Fig.(4). All data are given.

Question No.(3): [25 Mark]

(a)- There are three approaches of condensation process for reducing the number of generalized coordinates describing the kinematic configuration of large multi-body systems. Write down in brief the process for each approach.

(b)- A trailer is modeled by 3-DOF system as shown in Fig.(5). All data are given.

(1)- Determine the equations of motion using Lagrange's equation,

(2)- Use condensation technique to derive the equation of vertical motion of the trailer.

Question No.(4): [25 Mark]

(a)- From the first principle, Derive the expressions of the mass and stiffness matrices for the single element in terms of the global reference system.

(b)- Fig.(6) shows the single flexible link manipulator of uniform cross-section diameter D, length L, mass per unit volume ρ and Young's Modulus E. The manipulator having flexible joint O_1 of stiffness coefficient (k_F) and payload of mass (m_P) welded at the tip of the link.

(1)- Write the local mass and stiffness matrices,

(2)- Derive the global mass and stiffness matrices,

(3)- Write-down the equation of motion of the manipulator in detail, and

(4)- Calculate the equivalent joint torque acting at the shoulder joint.

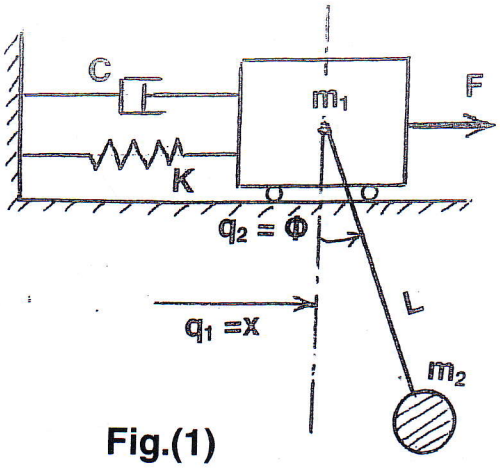

Fig.(1)

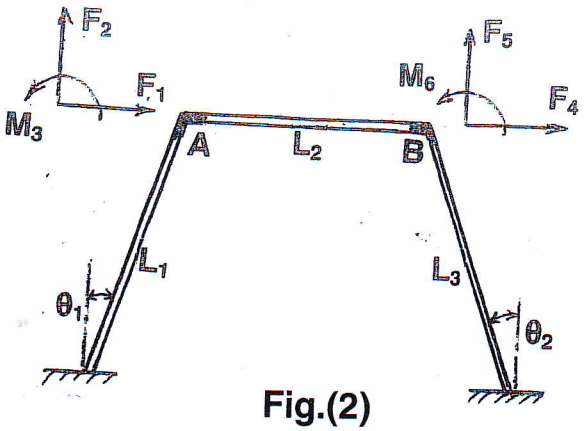

Fig.(2)

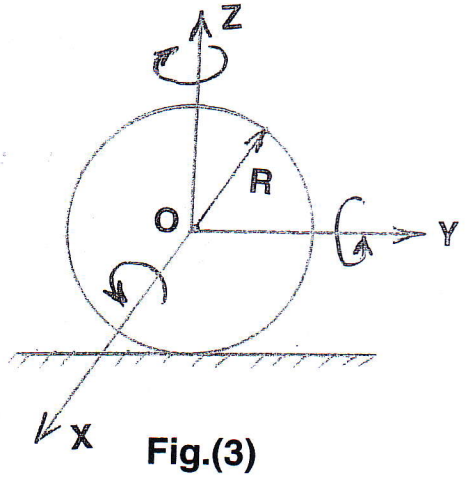

Fig.(3)

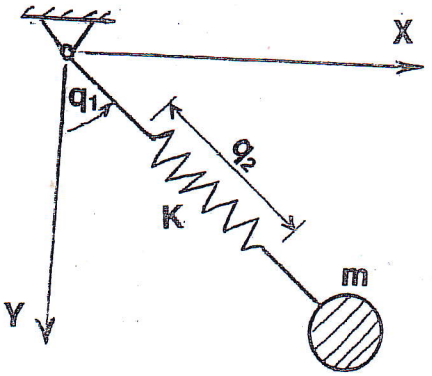

Fig.(4)

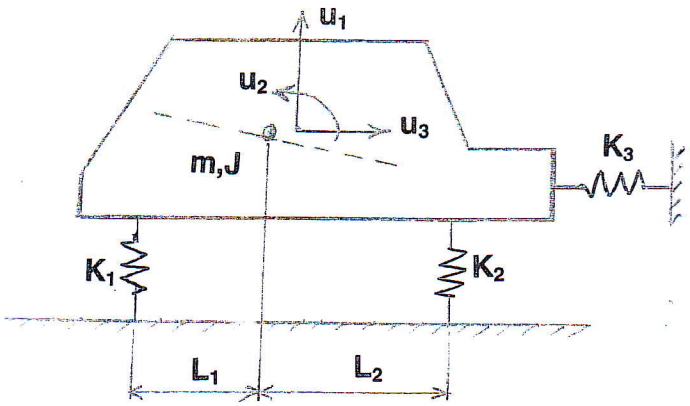

Fig.(5)

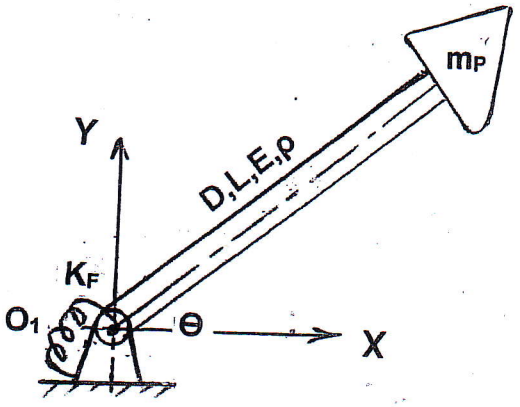

Fig.(6)

With my best wishes

This exam measure the following ILOs												
Question No.	Q2-a	Q3-a	Q4-a		Q1-b	Q2-b	Q3-b	Q4-b	Q1-b	Q2-c	Q3-b	Q4-b
Skills	a-1	a-3	a-6		b-1	b-6	b-1	b-6	c-4	c-3	c-3	c-4
	Knowledge & Understand				Intellectual				Professional			