*Seat No.: _____* *Enrolment No._____*

# GUJARAT TECHNOLOGICAL UNIVERSITY

**M.E Sem-I Regular Examination January / February 2011**

## Subject code: 711104N

## Subject Name: Modeling, Simulation and Computer Application

**Date: 04 /02 /2011** **Time: 02.30 pm – 05.00 pm**

**Total Marks: 70**

## Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Explain modern concept of system modeling and simulation. Give any three examples to strengthen your answer. **07**

**(b)** Classify system variables and write their significance. **07**

**Q.2** **(a)** For the system shown in figure 1, write state-space representation. Excitation, F is given to the mass $M_1$. **07**

**(b)** Model a printer belt drive system with an objective of determining the effect of the belt spring constant "k". Assume the radius of both the pulleys as r, the angular rotation of the motor shaft as $\theta$ and angular rotation of the driven pulley as $\theta_p$. The mass of the printing device as m and its position as y(t). A light sensor is used to measure y and the output of the sensor is voltage $V_1 = k_1 * y$; where $k_1$ is sensor constant. The controller provides an output voltage $V_2 = - k_1 * k_2 (dy/dt)$. Take $J=(J_{Motor} + J_{Pulley})$, R as the field resistance, $K_m$ as motor constant and b as the motor-pulley friction factor. **07**

**OR**

**(b)** Model a disk drive read system by considering an input as a force at motor mass $M_1$. Write a state space model for this two mass system and write a MATLAB program for the same. **07**
Show the effect of the flexure, which is made up of spring steel material, in order to have rapid movement of a light weight arm. Take the following system parameters.

(i) Motor mass : $M_1$
(ii) Head mass : $M_2$
(iii) Flexure spring stiffness : k
(iv) Friction constant at $M_1$ & $M_2$ : $b_1$ and $b_2$ respectively.
(v) Motor constant : $K_m$

**Q.3** **(a)** Give transfer function form of a second order differential equation representing a damped system. **07**

**(b)** Give state diagram showing the relationship of different elements of matrices which you obtained in Question No.3 above. **07**

**OR**

**Q.3** **(a)** Give a physical model of (i) an automobile and (ii) its suspension system. Write only system equations for the suspension system. **07**

**(b)** Draw RLC circuit and make a model to simulate a second order system. Mention important parameters and their effects on the response of the system. **07**

**Q.4** **(a)** Derive an expression for the unforced dynamic response of the spring-mass-damper mechanical system. Write a MATLAB program for observing the effects of damping ratio $\zeta$ on the response by drawing plots. **06**

**(b)** For the system shown in figure 2, write matrix form showing the motion equations in terms of velocities. $v_1$ and $v_2$ are velocities of masses $M_1$ and $M_2$. **06**

**OR**

**Q.4** **(a)** For modeling mechanical systems, describe idealized translational and rotational passive elements. Mention only governing equations clearly with appropriate sketches. **06**

**(b)** Model and simulate a mechanical accelerometer which is mounted on a jet engine test sled. Show clearly the characteristics of the accelerometer and mention how can we reduce the response time. **06**

**Q.5** Answer **Any Four** of the following: **16**

1. Give classification of systems. Explain in brief.
2. Explain random variables and their significance.
3. Classify different models. Explain the importance of each model keeping in view their characteristics.
4. Explain the method of modeling a DC motor. Write down system equations and get a transfer function of the system.
5. Explain Monte Carlo simulation technique.
6. Enlist MATLAB functions you have used for the simulation of problems on hands with the syntax thereof and examples.

**Figures for Q. 2(a) and Q. 4(b).**

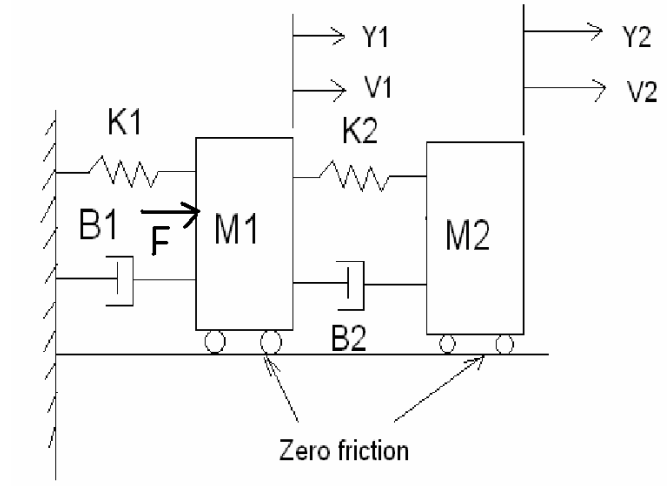


Figure 1 [Question No.2(a) ].

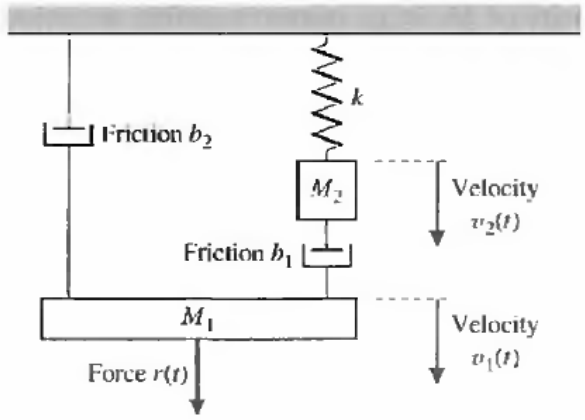


Figure 2 [Question No. 4(b) ]

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