

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-I Examination January 2010****Subject code: 711104****Subject Name: Modeling, Simulation and Computer Application.****Date: 29 / 01 / 2010****Time: 12.00 – 2.30 pm.****Total Marks: 60****Instructions:**

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

- Q.1 (a)** What is meant by system modeling? Describe the analysis and simulation of Linear and Nonlinear systems. **06**
- (b)** Classify different models. Explain the importance of each model keeping in view their characteristics **06**

- Q.2 (a)** For some of the following consequences which arise anytime during modeling and simulation, suggest suitable MATLAB functions with their general syntax : **06**

- (i) To visualize the effect of two parameters on the third one.
- (ii) To show multiple data in one window only and multiple data on different windows of the same figure.
- (iii) To convert transfer function to state-space and vice-versa.
- (iv) To control axis and setting up limits.
- (v) Use of step and conv.
- (vi) Use of ode45 functions.

- (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 make a MATLAB program for the same. **06**

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

OR

- (b)** Give a physical model of an automobile suspension system. Write only the system equations and give state-space representation. **06**

- Q.3 (a)** For modeling mechanical systems, describe idealized translational passive elements : Mass, spring and damper elements. **06**
- (b)** What is meant by random variables? Explain their significance. **06**

OR

- Q.3 (a)** Explain different models of random variables. **06**
- (b)** For an inverted pendulum mounted on a moving cart, make a model. The pendulum is constrained using a pivot in the vertical plane. Write state space representation only, based on the dynamic equations of the system. **06**

- Q.4 (a)** 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 θ and angular rotation of the driven pulley as θ_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 $J = (J_{\text{Motor}} + J_{\text{Pulley}})$, R as the field resistance, K_m as motor constant and b as the motor-pulley friction factor. **06**
- (b)** Classify system variables and write their importance. **06**
- OR**
- Q.4 (a)** 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**
- (b)** Make a list of simulation tools you know. Give the basic features that are required in any simulation tool. **06**
- Q.5 (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 ζ on the response by drawing plots. **06**
- (b)** Explain RC circuit and its importance. Write a program for showing the effect of a resistance and a capacitance. **06**
- OR**
- Q.5 (a)** Draw the RLC circuit and make a model to simulate a second order system. Mention important parameters and their effects on the response of the system. **06**
- (b)** Explain the method of modeling a DC motor. Write down system equations and get a transfer function of the system. **06**
