

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/ Backlog), Nov.-Dec. 2015

B. Tech/ M. Tech (*as applicable*) in Electrical Engineering, Semester V

Roll No.....

COURSE CODE: EE503 MODELING AND SIMULATION

Time: 3 hours Max. Marks: 100

Instructions to students:

- (a) Do not write anything other than your roll number on question paper.
 - (b) Assume suitable data wherever required and mention it clearly.
 - (c) Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
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Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. In a continuous data system:
 - (a) Data may be a continuous function of time at all points in the system.
 - (b) Data is necessarily a continuous function of time at all points in the system.
 - (c) Data is continuous at the input and output parts of the system but not necessarily during intermediate processing of the data.
 - (d) Only the reference signal is a continuous function of time.
- ii. If all the roots of the characteristic equation are found in the left of an s-plane, the response due to the initial condition will:
 - (a) Increase to infinity as time approaches infinity
 - (b) Decrease to zero as time approaches infinity
 - (c) Remain constant for all time
 - (d) Be oscillating
- iii. Select the valid reasons for using simulation.
 - (a) Relationship between the variables is nonlinear
 - (b) Optimized solutions are obtained
 - (c) Conduct experiments without disrupting the real system
 - (d) Answers 1 and 3
- iv. Which is considered to be a numerical computation technique used in conjunction with dynamic mathematical models?
 - (a) analysis
 - (b) system and simulation
 - (c) dynamic computation
 - (d) none of the above
- v. Area under a unit impulse function is
 - (a) infinity
 - (b) unity

- (c) zero (d) none of these

vi. Laplace transform of any time function $f(t)$ is given by

- (a) $F(s) = \int_{-\infty}^{\infty} f(t)e^{-st} dt$ (b) $F(s) = \int_0^{\infty} f(t)e^{-st} dt$
 (c) $F(s) = \int_{-\infty}^{\infty} f(t)e^{st} dt$ (d) none

vii. The electrical capacitance is analogous to

- (a) mass. (b) force
 (c) damping coefficient (d) none

viii.

A single-input, single-output system has the state variable representation

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -5 & -10 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = [0 \ 10] x$$

The transfer function of the system $T(s) = Y(s)/U(s)$ is:

- (a) $T(s) = \frac{-50}{s^2 + 10s + 5}$ (b) $T(s) = \frac{-50}{s^2 + 5s + 5}$
 (c) $T(s) = \frac{-5}{s + 5}$ (d) $T(s) = \frac{-50}{s^3 + 5s^2 + 50s}$

ix. The variable are used in state space modeling are

- (a) Phase variable and output variable.
 (b) The input variable, output variable and state variable.
 (c) Output variable and state variable.
 (d) Phase variable and input variable.

x. Non-minimum phase-transfer function is defined as the transfer function, which has:

- (a) Zeros in the right-hand s-plane (b) Zeros only in the right-half s-plane
 (c) Poles in the right-half s-plane (d) Poles in the left-half s-plane

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- Describe the process of building and verifying the models.
- What is meant by diagonalization explain with an example.
- Write the properties of z-transform.
- Differentiate between continuous and discrete system with suitable example.

Q.3A Classify the differential equation and describe it's distinguish role of in 05
 developing the mechanistic model.

Q.3B What is system and system environment? List the components of the system with examples. 05

Q.4A Construct a state model for a system characterized by the differential equation. 05

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 10y = 8u(t)$$

Draw the block diagram representation of the state model.

Q.4B Explain the transient behavior of elements inductance and capacitance. 05

Q.5A Obtain the solution of differential equation given below 05

$$\frac{d^2x(t)}{dt^2} + 2\frac{dx(t)}{dt} + 10x(t) = e^{-t}$$

When $x(0) = 0$ and $\dot{x}(0) = 0$

Q.5B Find the observability of the system. 05

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} u(t)$$

$$y(t) = [1 \ 0 \ 0]x(t)$$

Q.6A Define term state, state variable, state vector and state space. Draw the block diagram representation of the state variable formulation for multi variable systems. 05

Q.6B What is simulation? Develop the mathematical model of DC motor and draw its simulation diagram. 05

OR

Q.6B Obtain the x-transform of function: 05

$$X(s) = \frac{1}{s(s+1)}$$

Q.7A Explain the parametric modeling using least square technique with suitable example. 05

Q.7B Describe the stochastic and statistical properties of process for data base modeling. 05

OR

Q.7B For RLC series circuit write the state variable formulation and draw its simulation diagram. 05

Q.8A Draw a direct form realization of a block diagram, and write the state equations in phase variable form, for a system with the differential equation 10

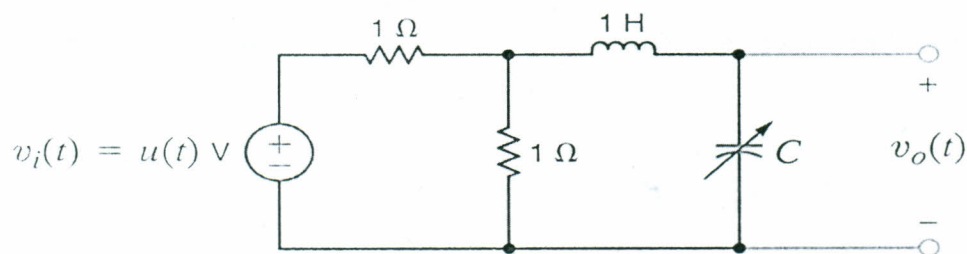
$$\frac{d^3 y}{dt^3} + 7 \frac{d^2 y}{dt^2} + 19 \frac{dy}{dt} + 13 y = 13 \frac{du}{dt} + 26 u$$

Q.9A Obtain the state transition matrix of A-matrix. 10

$$A = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -2 & 1 \\ 0 & 0 & -2 \end{bmatrix}$$

Q.9B Determine the transfer function $H(s) = \frac{V_o(s)}{V_i(s)}$ by transform the circuit to Laplace transform when: 10

- (i) All initial condition set to be zero.
- (ii) All initial condition not set to be zero.



OR

Q.9B Consider the fourth order system with a transfer function given by 10

$$G(z) = \frac{z^3 - 2z^2 + 2z - 1}{z^4 + z^3 - 3z^2 + 4z - 2}$$

Determine

- (a) An equivalent state space form (both state and output equation) for this system.
- (b) Draw the simulation diagram.