

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov.-Dec. 2016

B. Tech in Electrical Engineering, Semester V

Roll No.....

COURSE CODE: EE503 MODELING AND SIMULATION Time: 3 hours Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. Laplace transform of differentiation of $f(t)$ is
(a) $\frac{F(s)}{s}$ (b) $sF(s) - f(0)$ (c) $sF(s)$ (d) $s^2F(s)$
- ii. The important step required for simulation approach in solving a problem is to
(a) Test & validate the model (b) Design the experiment
(c) Conduct the experiment (d) All of the above
- iii. A mathematical model is linear if the differential equation describing it has coefficient which are
(a) zero (b) constant
(c) function only the independent variable (d) b and c
- iv. A system is represented by $\ddot{y}(t) + 10\dot{y}(t) + 5y = 2\dot{x}(t) + 4x$ the transfer of the system will be
(a) $\frac{2s+4}{s^2+10s+5}$ (b) $\frac{s+4}{s^2+10s+5}$
(c) $\frac{1}{s^2+10s+5}$ (d) $\frac{s}{s^2+10s+5}$
- v. A simulation model uses the mathematical expressions and logical relationships of the
(a) real system. (b) computer model.
(c) performance measures (d) estimated inferences.
- vi. The state transition matrix " $\Phi(t)$ " is
(a) $[sI] - [A]^{-1}$ (b) $[[sI] - [A]]^{-1}$
(c) $L^{-1}[[sI] - [A]]$ (d) $L^{-1}[[sI] - [A]]^{-1}$
- vii. In order to verify a simulation model
(a) compare results from several simulation languages.
(b) be sure that the procedures for calculations are logically correct.

- (c) confirm that the model accurately represents the real system.
 (d) run the model long enough to overcome initial start-up results.
- viii. 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
- ix. The important step required for simulation approach in solving a problem is to
- (a) Test & validate the model (b) Design the experiment
 (b) Conduct the experiment (d) All of the above
- x. If $A = \begin{bmatrix} -0.5 & 1 \\ 0 & -2 \end{bmatrix}$, $B = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ and $C = \begin{bmatrix} 2 \\ 4 \end{bmatrix}$, then
- (a) system is observable (b) system is observable
 (c) system is undefined (d) none

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- Explain when simulation is appropriate tool and when it is not appropriate.
- Explain the properties of state transition matrix.
- Derive expression for similarity transformation prove transformed system can be represented by the vector matrix equation.
- Explain the concept of sampling process.

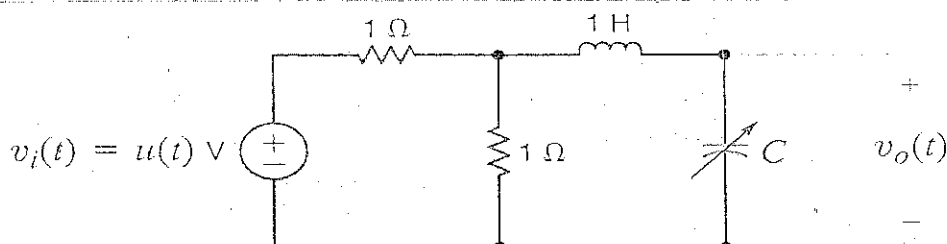
Q.3A What is mechanistic model? Explain distinguish role of differential equation in developing mechanistic model.

Q.3B Why simulation software is use for electrical system analysis? Write the advantage and disadvantages of simulation software. 05

Q.4A What is a model of a system? Explain different type of models. 05

Q.4B Determine the transfer function by transform the circuit to Laplace transform 05

$$H(s) = \frac{V_o(s)}{V_i(s)}$$



When: All initial condition set to be zero.

- Q.5A Write the important properties of eigenvalues of a matrix. Find the eigen values and eigen vectors of given A matrix 05

$$A = \begin{bmatrix} 1 & 2 & 5 \\ 2 & 4 & 2 \\ 3 & 5 & 1 \end{bmatrix}$$

- Q.5B What is Simulation? Write the advantages and disadvantages of simulation. 05

- Q.6A For unit step input to R in series with LC parallel circuit write the state variable formulation and draw its simulation diagram. 05

- Q.6B In series RL circuit the input is given by $V_s = 10t$. Determine the response of the circuit i.e., $i(t)$ when $R = 20$ ohm and $L = 10$ H. 05

OR

- Q.6B Obtain the z transform of the cosine function. 05

$$x(t) = \begin{cases} e^{-at} \sin \omega t, & 0 \leq t \\ 0 & t < 0 \end{cases}$$

- Q.7A Why the z-transform is preferred? Explain the properties of z-transform. 05

- Q.7B Write the steps for model validation using cross validation concept with suitable example. 05

OR

- Q.7B Find the observability of the system. 05

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = [1 \ 0 \ 0]x(t)$$

- Q.8A A system is described by the following equation 10

$$\dot{x}(t) = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 2 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$$

Find the transfer function of the system and draw signal flow graph.

- Q.9A Determine the characteristic equation, the eigen values and the state transition matrix of the system represented by the vector matrix A. 10

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

- Q.9B Find the diagonal state equation for a system with transfer function 10

$$\frac{Y(s)}{x(s)} = \frac{s^3 + 18s^2 + 50s + 50}{(s+3)(s+4)(s+5)}$$

OR

- Q.9B Determine the transfer function $v_o(t)$ for $t > 0$ 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.

