

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), November 2017

B. Tech. in Electrical Engineering, Semester V

Roll No.....

EE 503: 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)

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i. The value of A in $\dot{X} = AX$ for a system $\ddot{y} + 2\dot{y} + 3y = 0$ is

(a) $A = \begin{bmatrix} 0 & 0 \\ 2 & -1 \end{bmatrix}$ (b) $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$ (c) $A = \begin{bmatrix} 0 & 1 \\ -2 & 1 \end{bmatrix}$ (d) $A = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix}$

ii. The size of coefficient matrices A and B in the state space model are:

- (a) both square (b) A rectangular and B square
(c) A square and B rectangular (d) both rectangular

iii. A mass damper spring system is given by

$$\frac{d^2x(t)}{dt^2} + \frac{dx(t)}{dt} + 0.6x(t) = f(t)$$

, where $f(t)$ is the external force acting on the system and x is the displacement of mass. The steady state displacement corresponding to a force of 6 Newton is given by

- (a) 10 m (b) 0.36 m (c) 6 m (d) none of these

iv. The system equation for a mechanical system is $5 \frac{d\omega(t)}{dt} + \omega(t) = 5$, where ω is angular velocity. The solution for ω is given by

- (a) $5 \left(1 - e^{-\frac{t}{5}} \right)$ (b) $5e^{-\frac{t}{5}}$ (c) $5 \left(1 + e^{-\frac{t}{5}} \right)$ (d) $5 \left(1 - e^{\frac{t}{5}} \right)$

v. What is the z-transform of the signal $x(n) = (0.5)^n u(n)$?

- (a) $\frac{1}{1-0.5z^{-1}}$; ROC: $|z| > 0.5$ (b) $\frac{1}{1-0.5z^{-1}}$; ROC: $|z| < 0.5$
(c) $\frac{1}{1+0.5z^{-1}}$; ROC: $|z| > 0.5$ (d) $\frac{1}{1+0.5z^{-1}}$; ROC: $|z| < 0.5$

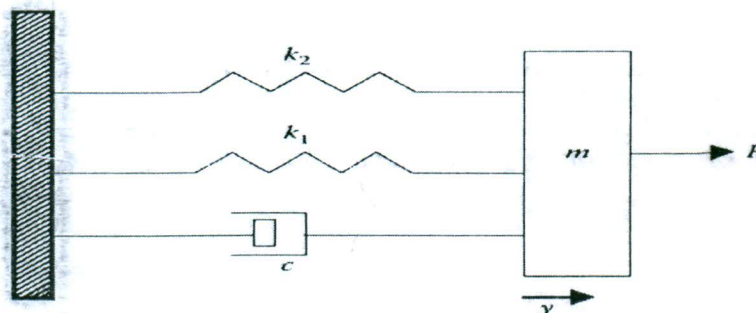
vi. Which of the following expressions generates an evenly spaced vector x containing values between 4 and 20?

- (a) $x = \text{linspace}(4, 15, 20)$ (b) $x = \text{linspace}(15, 4, 20)$
(c) $x = \text{linspace}(4, 20, 15)$ (d) $x = 4:15:20$

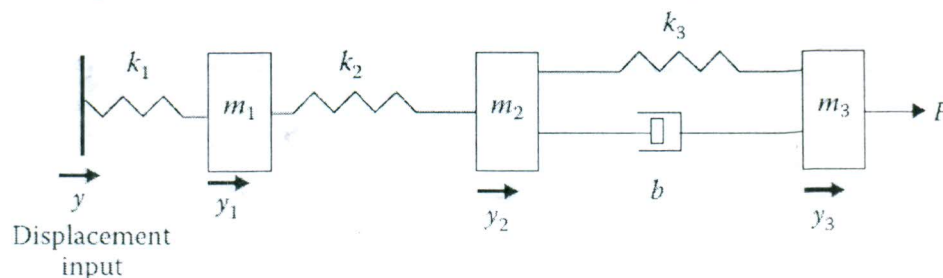
vii. If we are going to simulate an inventory problem, we must

- (a) run the simulation for many days
(b) run the simulation for many days many times, i.e., using multiple sets of random numbers

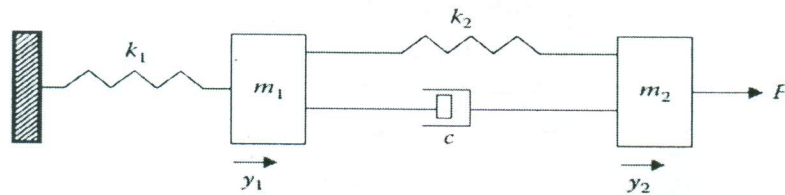
- (c) run the simulation many times, i.e., using multiple sets of random numbers.
 (d) run the simulation once, for a relative short period of time
- viii. In a one-to-many relationship, the entity that is on the one side of the relationship is called a(n) _____ entity
 (a) parent (b) child (c) instance (d) subtype
- ix. Transformer modeling is an example of :
 (a) Static physical model (b) Dynamic physical model
 (c) Static mathematical model (d) Dynamic mathematical model
- x. For analyzing a problem, decision-makers should study
 (a) Its qualitative aspects (b) Its quantitative aspects
 (c) Both a & b (d) Neither a nor b
- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- i. Mention the need of system modeling to mimic the behavior of systems under different operating conditions.
- ii. Draw pictorial representation of models classification.
- iii. What are model validation and model verification?
- iv. Explain the D'Alembert's principle for linear systems
- Q.3A Discuss basic elements of Entity Relationship Diagram (ERD) and explain an entity relationship data model with applications in real world. 05
- Q.3B Derive an expression for the mathematical model for the below mechanical system. 05



- Q.4A A mechanical system with three masses, two springs, and a dashpot as shown below. A force is applied to mass m_3 and a displacement is applied to spring k_1 . Drive an expression for the mathematical model of the system. 05

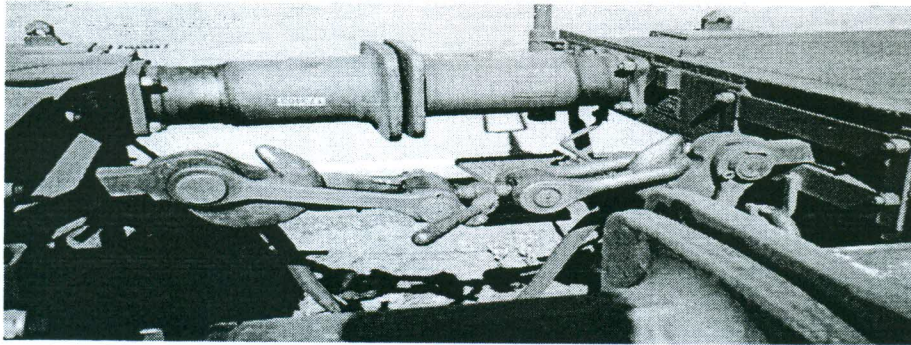


- Q.4B Design a graphical model to stability analysis of below system using simcape. 05



Q.5A Explain the terms for state space model development (a) Sensitivity, (b) Observability (c) Controllability 05

Q.5B The equivalent system of railway coupling is shown as below, which consists of two masses, a spring, a dashpot, and forces applied to each mass. Derive an expression for the mathematical model of the system. 05

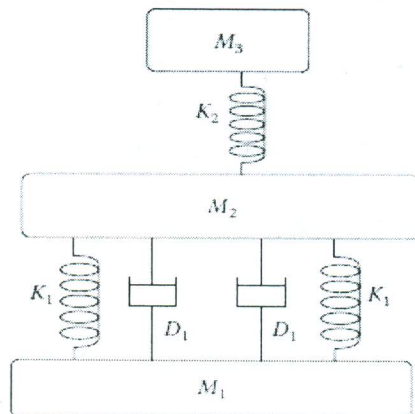


Q.6A Explain the terms: (a) Data Modeling (b) Logical Data Model (c) physical model (d) foreign key (d) attribute. 05

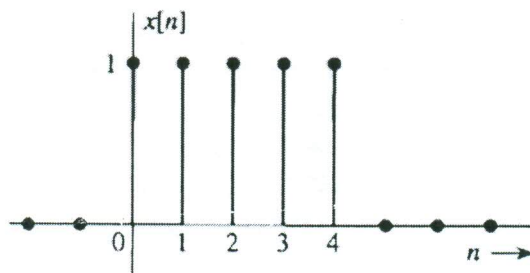
Q.6B Explain the term "interpretive structural Modeling and reachability matrix." 05

OR

Q.6B Draw force voltage analogy of mechanical system as shown below. 05



Q.7A Find the Z Transform of the signal $x[n]$ depicted as below 05

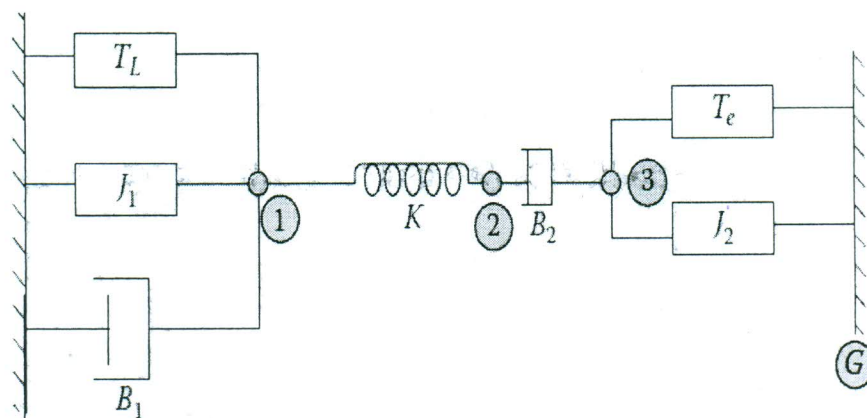


- Q.7B Determine the maximum path length for a directed graph, whose self-interaction matrix (SIM) is shown as shown below. 05

$$A_i = \begin{matrix} & \begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{matrix} & \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{matrix}$$

OR

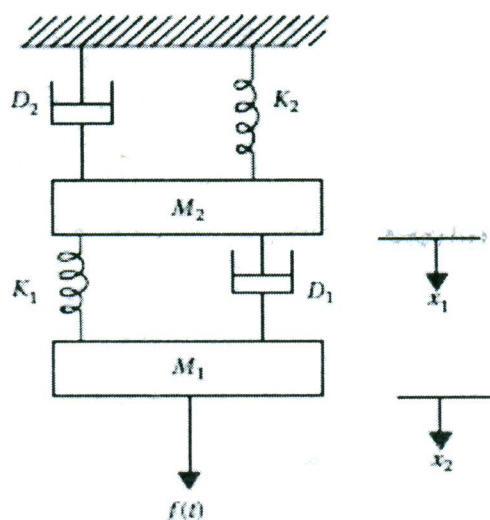
- Q.7B Draw force voltage analogy of lumped model of log chipping machine as shown below. 05



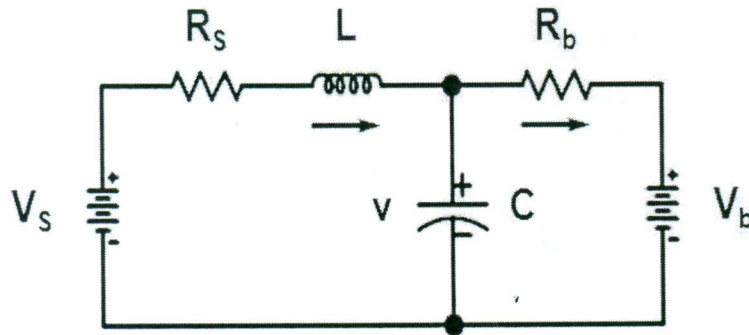
- Q.8 Write a MATLAB code to optimize below function 03

$$y(x) = 2x^2 + 20x - 22$$

- Draw its force current analogy of system as shown below 07

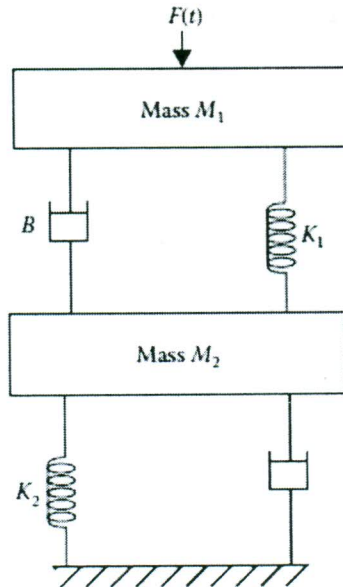


- Q.9A Derive state space for the following circuit diagram 10



Q.9B Obtain a state-space model for below mentioned system.

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OR

Q.9B As shown below, a dc motor circuit with a load connected to the motor shaft. Assume that the shaft is rigid, has negligible mass, and has no torsional spring effect or rotational damping associated with it. Obtain a state-space model for below mentioned for the mathematical model for the system.

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