(3 Hours) [Total Marks: 80]

N. B.: (1) Question No. 1 is compulsory.
      (2) Attempt any three questions from remaining five questions.
      (3) Assume suitable data if necessary.
      (4) Figures to the right indicate full marks.

1. Attempt **any four** questions   **20**
      (a) Compare continuous and discrete time systems.
      (b) What do you understand by a generic model?
      (c) Explain the concept of transfer function model.
      (d) What is meant by difference equation and how it may be used for obtaining the discrete time transfer function?
      (e) Explain the process of model building.

2. (a) A circuit is excited by a voltage source v(t) and has a parallel combination of a resistance, an inductor and an SCR. Answer the following questions:
      i) Can this system be called a linear or nonlinear system? Explain.
      ii) Assuming R = 1 ohm and L = 2 Henry, derive the model and comment on the solvability of the model. Assume negligible on-state drop across the SCR.   **10**

  (b) Derive the transfer function and state-space models for a series RLC circuit excited by a voltage source. Assume suitable output.
Derive the expression for open-loop poles of the system and comment on the stability.   **10**

3. (a) A diffusion process is represented by the following PDE:
$$\frac{\partial \phi(x,t)}{\partial t} = D \frac{\partial^2 \phi(x,t)}{\partial x^2}$$
where $\phi(x, t)$ is the concentration, D is the diffusion. Use the separation of variables method to solve this PDE. Obtain the solution is terms of infinite series. Assume standard non-zero initial and boundary conditions.   **10**

[TURN OVER]

(b) Explain what you understand by an infinite-dimensional system. Is it possible to model such a system using lumped-parameter model? Justify your answer. **10**

4. (a) Explain the importance of simulation in model building and how it helps in the improvement of analysis and decision making. **10**

(b) Explain in detail the different types of errors during simulation with numerical methods. List the measures required to reduce these errors. **10**

5. (a) What are the reasons to apply system identification techniques for modelling? Explain the steps carried out to fix the model structure for a system. **10**

(b) Explain in detail various optimization techniques used for simulation and model validation. **10**

6. Write short notes on **(any three)** **20**
   (a) Classification of systems.
   (b) Controllability and observability.
   (c) Frequency domain method of system identification.
   (d) Examples of distributed parameter system.

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