Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 50769

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Sixth Semester

Instrumentation and Control Engineering

IC 8651 – ADVANCED CONTROL SYSTEM

(Common to : Electrical and Electronics Engineering)

(Regulations – 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. When is a linear continuous time system controllable?
2. When is a system both controllable and observable?
3. State full state feedback control.
4. Define observer gain.
5. Write the relation between discrete time signal and sampled data signal.
6. List the processes by which a digital signal is derived in practice.
7. List the methods to construct a phase plane trajectories for linear and non-linear systems.
8. List the properties of phase plane analysis.
9. What is linear quadratic regulator (LQR) optimal control?
10. Write the purpose of optimal steady state regulator design for a class of non-linear system with arbitrary relative degree.

PART B — (5 × 13 = 65 marks)

11. (a) Explain the time varying case of continuous time linear state space model.

Or

(b) Write the mathematical substantiation for observability of discrete system.

12. (a) Explain how stability is improved by state feedback.

Or

(b) Prove that if the system is not completely controllable then there are eigen values that can't be controlled by state feedback.

13. (a) What is pulse transfer function? Explain the difference between stability analysis of linear and non-linear system.

Or

(b) State and prove the properties of Z transform.

14. (a) Explain the describing function for saturation of non-linearity.

Or

(b) (i) Derive the describing function of saturation with Dead Zone. (6)

(ii) Test the stability of the system using Lyapunov stability theorem

$$\dot{x}_1 = -x_1 + 2x_1^2 x_2$$
$$\dot{x}_2 = -x_2$$ (7)

15. (a) Explain the general formulation for discrete time optimal control problems.

Or

(b) Explain how an optimal controller problem can be thought as a generalization of a problem of calculation of variation.

PART C — (1 × 15 = 15 marks)

16. (a) Write the mathematical substantiation for observability of continuous system.

Or

(b) Explain the formulation of the optimal control problem for the minimum time problem.

———————