G 1335

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B.TECH. DEGREE EXAMINATION, MAY 2016

Seventh Semester

Branch : Electrical and Electronics Engineering

EE 010 704—MODERN CONTROL THEORY (EE)

(New Scheme—2010 Admission onwards)

[Improvement/Supplementary]

Time : Three Hours

Maximum : 100 Marks

Part A

Answer all questions.

Each question carries 3 marks.

1. Explain the concept of controllability and observability in closed loop control system.

2. State and explain the different non-linearities present in practical control system.

3. Write a short note on different methods of Analyzing non-linear systems.

4. State and explain the "Sampling Theorem" what is anti-alias filter ?

5. What are different selection criteria of PLC ?

(5 × 3 = 15 marks)

Part B

Answer all questions.

Each question carries 5 marks.

6. Write a short note on pole placement design using state variable feedback.

7. Explain the Isocline method of plotting phase-plane trajectories.

8. Derive the describing function of dead-zone non-linearity.

9. Write down the advantages, limitations and applications of Z-transform.

10. Write down the rules for proper construction of ladder diagram.

(5 × 5 = 25 marks)

Turn over

Part C

Answer **all** *questions.*

Each full question carries 12 *marks.*

11. Design a full order observer for :

$$A = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix} ; B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} ; C = \begin{bmatrix} 0 & 1 \end{bmatrix}$$

Assume the desired eigenvalues of the observer

$$\mu_1 = -1.8 + 2.4\,j\,; \mu_2 = -1.8 - 2.4\,j.$$

Or

12. Judge the controllability of the system with below mentioned state equation :

$$\dot{x} = Ax + Bu = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u.$$

13. Explain the below mentioned terms with neat diagram with respect to phase portrait :

    (a) Centre *or* vortex point.   (b) Focus point.

    (c) Saddle point.   (d) Nodal point.

Or

14. Write a short note on Linearization and stability of equilibrium points with reference to the ph
    portrait.

15. Plot roughly the nature of phase portrait for standard second order system with :

    (a) $\zeta = 1$.   (b) $\zeta > 1$.

    (c) $\zeta < 1$.   (d) $\zeta = 0$.

Or

16. Derive the describing function of saturation non-linearity.

17. Given a z.o.h. in cascade with $G_1(s) = (s + 2)/(s + 1)$ or

$$G(s) = \frac{1 - e^{-Ts}}{s} \frac{(s + 2)}{(s + 1)}$$

Find the sampled-data transfer function, G(z), if the sampling time T, is 0.5 second.

Or

18. Derive the convolution theorem using Z-transform i.e.,

   If $x_1(n) \xleftrightarrow{Z} X_1(Z)$ and $x_2(n) \xleftrightarrow{Z} X_2(Z)$

   Then $x_1(n) * x_2(n) \xleftrightarrow{Z} X_1(Z), X_2(Z)$

   and ROC is at least the intersection of ROC of $X_1(Z)$ and $X_2(Z)$.

19. Draw the ladder diagram for the following function table :

   Inputs—I_1, I_2 *Output*—Q_1, Q_2, Q_3, Q_4

I_1	I_2	Q_1	Q_2	Q_3	Q_4
0	0	1	1	1	1
0	1	0	0	0	0
1	0	0	0	0	0
1	1	1	1	1	1

   Or

20. Explain speed control of DC motor using PLC.

                                                    (5 × 12 = 60 marks)