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

Question Paper Code : 21688

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Seventh Semester

Instrumentation and Control Engineering

IC 2401/IC 71/10133 IC 701 – DIGITAL CONTROL SYSTEM

(Common to Eighth Semester Electronics and Instrumentation Engineering)

(Also common to IC 71 Digital Control System for Electronics and Instrumentation Engineering)

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the functional block diagram of digital control system.

2. Differentiate discrete time signal and digital signal.

3. State Shanon's sampling theorem.

4. What is the transfer function of zero order hold?

5. Find the Z transform of exponential function $f(t) = e^{-at}$.

6. Define Bounded Input and Bounded Output Stability.

7. What is the characteristic equation of a system represented in state space form? With $A = \begin{bmatrix} -1 & 1 \\ -0.5 & 0.2 \end{bmatrix}$; $B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$; $D = \begin{bmatrix} 1 & 0 \end{bmatrix}$;

8. Define observability of a system.

9. What is the effect of PI controller in a system?

10. Draw the dead beat response of a discrete-data system to a unit-step input.

PART B — ($5 \times 16 = 80$ marks)

11. (a) Explain briefly about configurations of digital control system and sampled data system variables.

Or

(b) State and explain the advantages of digital control system with an example.

12. (a) (i) Explain the operation of ideal sampler with input and output signals. (8)

(ii) Describe reconstruction of sampled signal with first order hold. (8)

Or

(b) Briefly explain about Frequency Prewarping with an example.

13. (a) (i) Relate s and z domain. (4)

(ii) Find the z transform of the function $f(k) = (0.1)^k u_s(k) + 0.5k(0.1)^k u_s(k)$. (12)

Or

(b) (i) Determine the values of K for the system with characteristic equation $z^4 + 0.2z^3 - 0.25z^2 - 0.05z + K = 0$, to be asymptotically stable. (8)

(ii) Briefly discuss about steady state error for step input and ramp input applied to Type 0, Type 1 and higher type systems. (8)

14. (a) (i) Convert the transfer function $\frac{1.65(z + 0.1)}{z^3 + 0.7z^2 + 0.11z + 0.005}$ into state space representation. (8)

(ii) Find the state transition equation of the systems with initial states at $x(0)$ has $A = \begin{bmatrix} 0 & 1 \\ 0.5 & 0.3 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$; (8)

Or

(b) (i) Illustrate Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$. (8)

(ii) Find the state controllability of a discrete data control system described by state equation (8)

$$x(k + 1) = Ax(k) + Bu(k); \quad A = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0.5 & 0 \\ 0 & 0 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}.$$

15. (a) Transfer function of controlled process is $G(z) = \frac{1.338(z + 0.7531)}{z^2 - 0.9398z + 0.4347}$, design a PID controller such that zeros of PID controller cancel the poles of G(z) and the ramp error constant Kv = 1.

Or

(b) (i) Briefly explain about state observers. (6)

(ii) Find the state feedback matrix G such that the eigen values of A–BG are at 0 and 0.3. $A = \begin{bmatrix} 0 & 1 \\ -1 & 2 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$; (10)