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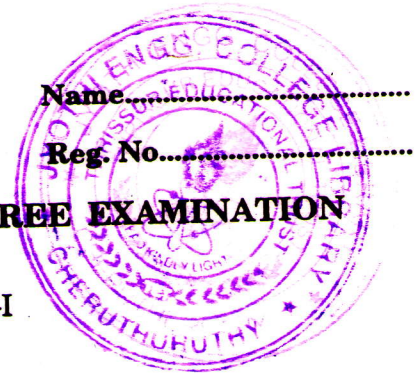
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Name.....

Reg. No.....

**SIXTH SEMESTER B.Tech. (ENGINEERING) DEGREE EXAMINATION
JUNE 2007**

**EE 04 603—CONTROL SYSTEMS—I
(2004 admissions)**



Time : Three Hours

Maximum : 100 Marks

- I. (a) Define the terms "State Variable" and "State space".
(b) What is meant by Zero Input Response of a system ?
(c) State Shanon's sampling theorem.
(d) Obtain the mapping of the s-plane to the Z-plane.
(e) Sketch the polar plot of the transfer function $G(s) = \frac{10}{(1-s)}$.
(f) What is meant by gain margin of a system ?
(g) What is meant by cascade compensation in control systems ?
(h) Discuss the effect of PD compensators in the transient response of a second order system.
(8 × 5 = 40 marks)
- II. (a) (i) Enumerate the advantages of State-space model over the Transfer Function model.
(ii) Derive the state variable representation of a field controlled d.c. servo motor driving a load with a moment of inertia J_L and friction constant B_L . Take the output position and its derivatives as the state variables.

Or

- (b) (i) A system is characterised the state equation :

$$\begin{aligned}\dot{X} &= Ax + Bu \text{ and} \\ y &= Cx + Du\end{aligned}$$

where u is the input and Y is the output and the elements of A , B , C and D matrices are constants.

- (ii) Obtain the unit step response of the system described by the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 0 \end{bmatrix} u(t).$$

$$y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

$$\text{given } x_1(0) = x_2(0) = 0.$$

(15 marks)

Turn over

III. (a) (i) Find the inverse Z-transform of :

$$F(z) = \frac{1}{(z+1)(z+2)}.$$

(ii) Obtain the solution of the difference equation :

$$c(k+2) + 3c(k+1) + 2c(k) = U(t).$$

with $c(0) = 1$ and $c(k) = 0$ for $k < 0$.

$U(t)$ is unit step function.

Or

(b) (i) Explain the Jury's test for stability.

(ii) Investigate the stability of a discrete time system having the characteristic equation

$$F(z) = z^4 - 1.368z^3 + 0.4z^2 + 0.8z + 0.002 = 0.$$

(15 marks)

IV. (a) A unity feedback control system has the forward path transfer function

$$G(s) = \frac{K(s+1)}{s(s+2)(s+3)}.$$

Sketch the root loci for the system and determine the value of K for a damping ratio of 0.866.

Or

(b) The forward path transfer function of a unity feedback control system is given by

$$G(s) = \frac{K}{s(s+1)(s+2)}.$$

Sketch the Nyquist plot and determine the maximum value of k beyond which the system becomes unstable.

(15 marks)

V. (a) The open loop transfer function of a unity feedback control system is given by,

$$G(s) = \frac{K}{s(s+1)(s+5)}.$$

Design a phase lead compensator to satisfy the specification (i) velocity error constant, $K_v \geq 50$; (ii) Phase Margin $\geq 20^\circ$.

Or

(b) Discuss the various design methods adopted for discrete data systems using frequency response methods.

(15 marks)

(4 × 15 = 60 marks)