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(Pages : 2)

Name..

Reg. No.......................................

FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2010

IC/AI 04-502—CONTROL ENGINEERING

Time : Three Hours | Maximum : 100 Marks

Part A

Answer **all** *questions.*

1. (a) Draw a signal flow graph for a series RLC circuit.

(b) Draw force voltage analogy for system given below in Fig. 1.

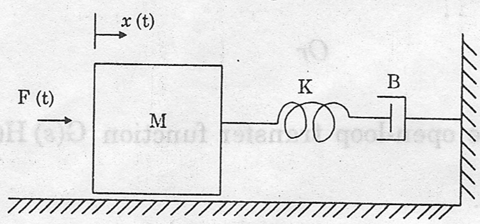

Fig 1

(c) Distinguish between Static error coefficients and Dynamic error coefficients.

(d) Check whether characteristic equation is stable or not using Routh Hurwitz criterion :

$$s^3 + 4.5s^2 + 3.5s + 1.5 = 0.$$

(e) Sketch shape of polar plot for the open-loop transfer function $G(s)H(s) = \dfrac{K}{s(1+s)}$.

(f) Define terms gain cross over frequency and phase cross over frequency.

(g) List out the properties of a state transition matrix.

(h) Write state space representation is phase variable for system whose closed loop transfer function is $\dfrac{C(s)}{R(s)} = \dfrac{24}{s^3 + 9s^2 + 26s + 24}$.

(8 × 5 = 40 marks)

Part B

Unit I

2. (a) Reduce block diagram given in Fig. 2 and verify using signal flow graph :

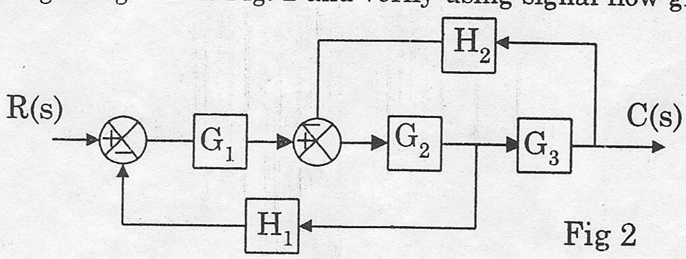

Fig 2

Or

Turn over

(b) Derive the transfer function of an armature controlled DC servo motor.

Unit II

3. (a) Derive the time response of a second order under damped system when subjected to unit step input.

Or

(b) Sketch root locus for the open-loop transfer function $G(s)H(s) = \frac{K}{s(s+3)\left(s^2+4s+9\right)}$. Comment on stability.

Unit III

4. (a) Derive expressions for resonant frequency, peak resonance, bandwidth and gain margin of a second order system.

Or

(b) Sketch nyquist plot for the open-loop transfer function $G(s)H(s) = \frac{1}{s^2(1+s)}$. Comment on closed-loop system stability.

Unit IV

5. (a) Obtain response of system described by state equation :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u.$$

where u is unit step input. Given initial conditions $x(0) = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$.

Or

(b) Obtain state space model for the transfer function $G(s) = \frac{s}{(s+2)(s+3)}$ using

(i) Parallel decomposition.

(ii) Cascade decomposition.

(iii) Direct decomposition.

(4 × 15 = 60 marks)