IX. Write brief notes on ***ANY FOUR*** of the following:

(i) State transition matrix
(ii) Settling time
(iii) Phase cross-over frequency
(iv) State equation of discrete data systems
(v) Integrating amplifiers
(vi) Off-set nulling of integrating amplifiers

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BTS 171 (B)

B.Tech. Degree V Semester (Supplementary) Examination in Computer Science and Engineering June 2002

CS 504 CONTROL SYSTEMS
(1995 Admissions)

Time: 3 Hours Maximum Marks: 100

(All questions carry ***EQUAL*** marks)

I. (a) Distinguish between linear and nonlinear control systems.

(b) Define transfer function of a dynamic system. How is it related to its impulse response?

(c) Derive the transfer function $\frac{X_2(s)}{F(s)}$ of the mechanical system shown in figure 1.

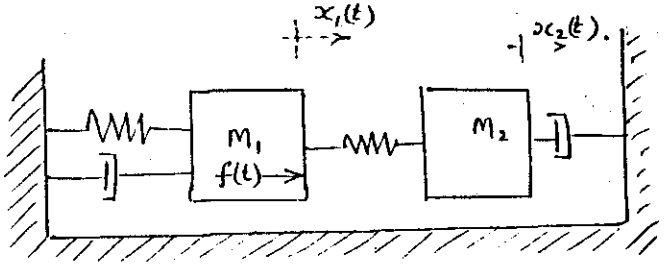

Fig. 1

OR

II. (a) For the sytem modelled by the third order differential equation

$$\frac{d^3c}{dt^3} + a_2\frac{d^2c}{dt^2} + a_1\frac{dc}{dt} + a_0c = b_0r(t),$$

derive the state variable representation.

(b) State and explain 'Final value theorem' and show how this is used to estimate the steady state error of a feed back system. What are the drawbacks of this method?

III. (a) Corresponding to the locations of the characteristic-equation-roots listed below, sketch the time domain responses.

(i) $s = \sigma\ [\sigma > 0]$

(ii) $s = j\omega,\ j\omega,\ -j\omega,\ -j\omega$

(iii) $s = -\sigma + j\omega,\ -\sigma - j\omega$

$$\begin{bmatrix} \sigma > 0 \\ |\sigma| << |\omega| \end{bmatrix}$$

(b) A feed back system has forward transfer function $G(s) = \dfrac{1}{s^3 + 4s^2 + 13s + 36}$ and feed back transfer function $H(s) = \dfrac{k}{s}$. Use Routh Harvitz' criterion to find the value of k that gives undamped oscillations in the response. What is the frequency of oscillations?

(c) Explain Liapunov's stability criterion applied to linear systems.

OR

IV. (a) Draw the Bode-plot of the system having loop-transfer-function $G(s)H(s) = \dfrac{K}{s(1+0.02s)(1+0.05s)}$ for $K = 80$. What value of K will make the system marginally stable?

(b) A certain control system has coefficient matrix A given by

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$$

Obtain the eigen values.

V (a) State and explain Shannon's sampling theorem.

Contd.....3.

V. (b) Find Z-transform of the sequences given below

(i) $f(k) = 1, 1, 1, \ldots\ldots$ for $k = 0, 1, 2, \ldots\ldots$

(ii) $f(k) = \begin{cases} 1 & \text{for } k = 0, 2, 4, 6\ldots\ldots \\ -1 & \text{for } k = 1, 3, 5, 7\ldots\ldots \end{cases}$

OR

VI. (a) Solve the difference equation given below using Z- transform:

$$x(k+2) - x(k+1) + 0.1x(k) = U_s(k)$$
$$x(0) = 0$$
$$x(1) = 0$$

where $U_s(k)$ denotes the sampled version of unit step.

(b) Using Jury's test find whether the system characterised by $z^3 + z^2 + 3z + 0.2 = 0$ is stable or not.

VII. (a) Explain how an OP-AMP is used as a finite gain amplifier.

(b) How is multiplication of a time function by a constant such as 3.52 carried out in a analog computer.

(c) Draw and explain the analog computer patch board diagram for generating the function

$$y(t) = 2\cos(2t + 60^\circ)$$

OR

VIII. (a) Citing examples explain the necessity of -

(i) time-scaling, and

(ii) amplitude scaling.

(b) Draw and explain the patch board diagram for simulating the transfer function,

$$G(s) = \frac{10}{s^2 + 7s + 10}$$

in the analog computer.

Contd.....4.