Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (IT)/SEM-4/EE-411/2011

2011
CONTROL SYSTEM

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) In terms of Bode plot, the system is stable if

      a) both gain margin & phase margin are positive

      b) both gain margin & phase margin are negative

      c) gain margin is positive & phase margin is negative

      d) gain margin is negative & phase margin is positive.

   ii) AC servo motor is a

      a) 3 phase induction motor

      b) 2 phase induction motor

      c) 1 phase induction motor

      d) 2 phase synchronous motor.

iii) If a second order system has poles at –1 + J & – 1 – J, then step response of the system will exhibit a peak value at

a) 4·5 s b) 3·5 s

c) 3·14 s d) 1 s.

iv) A series circuit containing R, L & C is excited by a step voltage input. The voltage across the capacitance exhibits oscillation. Damping co-efficient of this circuit is given by

a) $\frac{R}{2\sqrt{LC}}$ b) $\frac{R}{LC}$

c) $\frac{R}{2\sqrt{C/L}}$ d) $\frac{R}{2\sqrt{L/C}}$.

v) If the Nyquist plot cuts the negative real axis at a distance of 0·4, then the gain margin of the system is

a) 0·4 b) – 0·4

c) 4% d) 2.5.

vi) The root locus of a system line 4 separate root loci. The system can have

a) four poles & four zeros

b) four poles or four zeros

c) six poles & two zeros

d) two poles & two zeros.

vii) The value of A matrix in $\frac{dx}{dt}$ = Ax for the system described by the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 3y = 0$ *is*

a) $\begin{bmatrix} 1 & 0 \\ -2 & -1 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 0 \\ -1 & -2 \end{bmatrix}$

c) $\begin{bmatrix} 0 & 1 \\ -2 & -1 \end{bmatrix}$ d) $\begin{bmatrix} 1 & 0 \\ -3 & -2 \end{bmatrix}$.

viii) Addition of a pole to the closed loop transfer function

a) increases rise time b) decreases rise time

c) increases overshoot d) has no effect.

ix) With a derivative feedback control

a) a second order system is converted into a first order

b) a second order system is converted into a third order system

c) natural frequency of the oscillation changes

d) damping ratio is increased.

x) Type of a system depends on the

a) number of its poles

b) difference between the number of poles & zeros

c) number of its real poles only

d) number of poles it has at the origin.

xi) The impulse response of a system is given by $c(t) = \frac{1}{2} e^{-t/2}$

Which one of the following is its unit step response ?

a) $1 - e^{-t/2}$ b) $1 - e^{-t}$

c) $2e^{-t}$ d) $1 - e^{-2t}$.

xii) A transfer function of a two port passive network may have

a) poles in right half of *s* plane

b) both zeros & poles in right half of *s* plane

c) poles restricted solely to left hand half of *s* plane & nowhere else

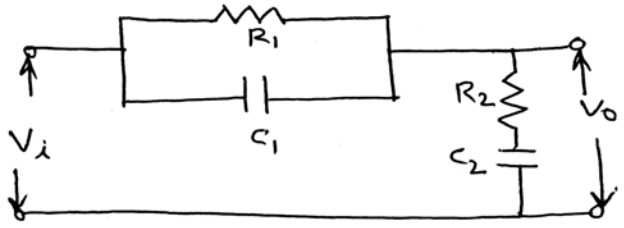
d) zeros in right hand half of *s* plane.

GROUP – B

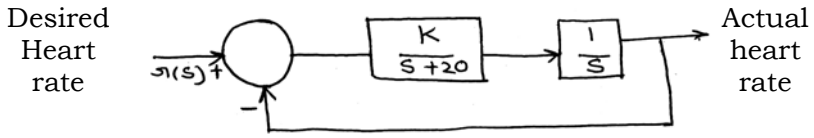
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Find the transfer function of the circuit given :



3. The block diagram of an electronic pacemaker is given in figure below, where K = 400.



i) Calculate the output c (t) for a unit step input

ii) Determine the steady state error for unit ramp input.

4. Find state variable model of the system governed by the differential equation $\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = 2\frac{du}{dt} + 6u$.

5. A second order system has 40% peak overshoot & settling time of 2 seconds for unit step input. Find resonant peak gain & resonant frequency.

6. Determine the stability of a closed loop control system whose characteristic equation is given by

$s^5 + s^4 + 2\ s^3 + 2\ s^2 + 11S + 10 = 0$ using Routh-Hurwitz criterion.

GROUP – C

(Long Answer Type Questions)

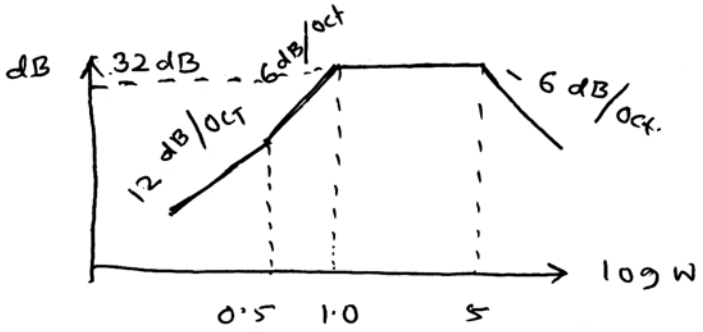
Answer any *three* of the following. $3 \times 15 = 45$

7. Draw the root locus of the unity feedback system whose open loop transfer function is $G(s) = \frac{k(s+4)}{s(s+5)(s^2+5s+25)}$. Show all relevant steps.

8. a) Sketch the Bode plots of the following function showing the magnitude in decibels & phase angle in degrees. Determine the gain crossover frequency.

$G(s) = \frac{20}{s(1 + 0 \cdot 5\ s)(1 + 0 \cdot 25s)}$.

b) From the plot shown determine the transfer function.



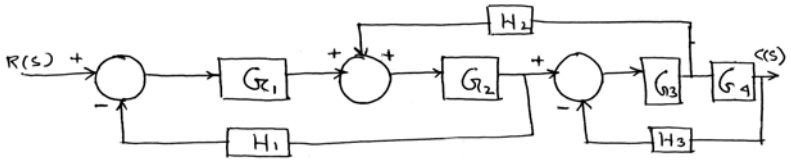
10 + 5

9. a) State & explain Nyquist stability criteria.

b) For the open loop transfer function of a unity feedback system

$G(s) = \frac{k}{(s + 2)(s + 5)}$, draw the Nyquist plot of the closed loop system and comment on the system stability. 5 + 10

10. a) Draw the signal flow graph & obtain the transfer function of the system shown :



b) Show that a unity feedback control system having open loop transfer function G (s) H (s) = $\frac{1}{(s-1)^2}$ can not be stabilized by using PI controller. 8 + 7

11. a) Find the Z-transform of ke^{-3k}.

b) Discuss what is meant by

i) Absoute & relative stability

ii) Sample & hold circuit. 5 + (5 + 5)