Subject: CONTROL ENGINEERING

Time: 3 Hours **Max. Marks: 100**

DECEMBER 2010

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. The impulse response of a linear system is the output when the input x(t) is

(A) $r(t)$ **(B)** $\delta(t)$
(C) $u(t)$ **(D)** None of the above

b. The initial value of the function f(t) whose Laplace transform is $F(s) = \dfrac{4s}{s^3 + 2s^2 + 9s + 6}$

(A) 0 **(B)** 4
(C) 0.33 **(D)** 0.166

c. System is said to be stable if

(A) Bounded input, the output is unbounded.
(B) Bounded input, the output is bounded.
(C) Unbounded input, the output is bounded.
(D) Unbounded input, the output is unbounded.

d. If $G = \dfrac{4}{s(s+3)}$ and $H = \dfrac{1}{s}$ then the system is

(A) Type 0 **(B)** Type 1
(C) Type 2 **(D)** Type -1

e. Let $Y(s) = \dfrac{s^2 + s - 1}{s^3 + 7s^2 + 14s + 8}$ the poles are at

(A) $s = -1, -3, 2$ **(B)** $s = -2, 3, -4$
(C) $s = -3, 4, 8$ **(D)** $s = -1, -2, -4$

f. The acceleration error is finite in case

(A) Type 3 **(B)** Type 2
(C) Type 1 **(D)** Type 0

g. In root locus at breakaway point which one of the condition is satisfied

(A) Two are more branches of the root locus depart or arrive.
(B) Asymptotes are meeting at that point.
(C) Point at which rootlocus intersect with jω axis.
(D) None of the above.

h. The root locus of a certain control system shown in Fig.1. The open loop transfer function of the system is

(A) $\frac{K(s+j2)(s-j2)}{(s+1)(s-1)}$

(B) $\frac{K(s+1)(s+2)}{(s+j1)(+j2)}$

(C) $\frac{K(s+2)}{(s+1-j2)(s+1+j2)}$

(D) $\frac{K(s+2)}{(s+1+j2)(s-1-j2)}$

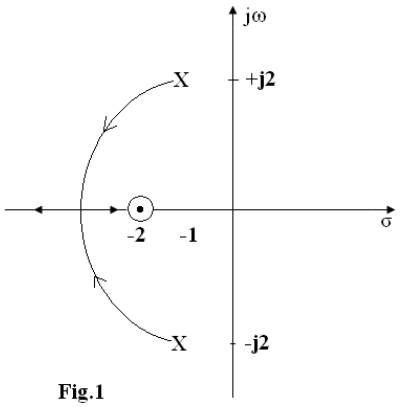

Fig.1

i. Bode plot is plot of

(A) Magnitude plot
(B) Phase plot
(C) Both the magnitude and phase plot
(D) Neither magnitude nor phase plot

j. In Nyquist stability criterion if N = 1 and P =0 then the closed system is

(A) stable. **(B)** unstable.
(C) critically stable. **(D)** None of the above.

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Define control system. Write the characteristics of feedback control system. **(6)**

b. Draw the general block diagram of a feedback control system and explain. **(6)**

c. Give an example to both open loop and closed loop control system. **(4)**

Q.3 a. Find the free response of $\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+6y=0$ with the initial conditions $y(0)=-1, \left.\frac{dy}{dt}\right|_{t=0} = \left.\frac{d^2y}{dt^2}\right|_{t=0} = 0$. **(8)**

b. Find the partial fraction expansion of the function $F(s)=\frac{10}{(s+4)(s+2)^2}$ and hence find the inverse Laplace transform. **(8)**

Q.4 a. The characteristic equation of a system is $s^4+s^3+2s^2+9s+5=0$. Determine the number of roots in the right half S-plane use RH – criterion. **(8)**

b. Explain the following block-diagram transformation theorems with proper diagrams. **(8)**
(i) Moving a summing point behind a block.
(ii) Moving a take off point ahead of a block.

Q.5 a. Explain Mason's gain formula. **(5)**

b. For the block diagram shown in Fig.2, draw the signal flow graph. Also find the transfer function. **(11)**

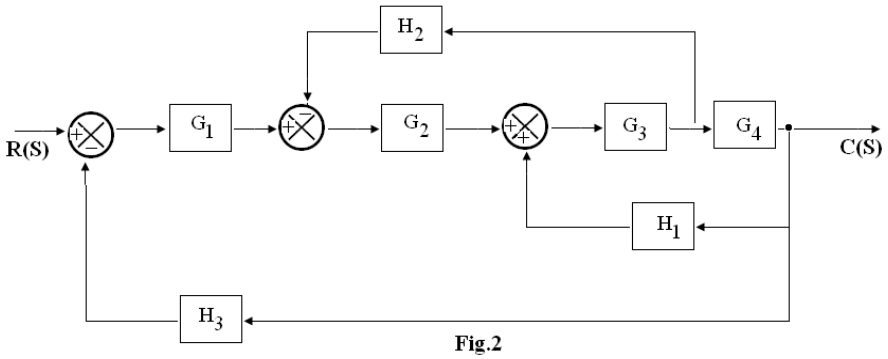

Fig.2

Q.6 a. Find the error constants and steady state error for the unity feedback system when the input is ramp if $G(s)=\frac{100}{s^2(s+2)(s+5)}$. **(8)**

b. Explain gain margin and phase margin? **(8)**

Q.7 a. Explain Nyquist stability criterion. **(6)**

b. Given $GH=\frac{12}{s(s+1)(s+2)}$. Draw the polar plot and hence determine if system is stable. Calculate gain margin. **(10)**

Q.8 a. Explain the angle and magnitude conditions of root loci. **(4)**

b. Construct the root locus for $GH = \frac{K}{s(s+1)(s+2)}$ **(12)**

Q.9 Draw the Bode diagrams for the both magnitude and phase with open loop transfer function as $GH(s) = \frac{20(0.2s+1)}{s(0.5s+1)}$. Also find gain margin and phase margin. **(16)**