ROLL NO. _____

Code: DE65 **Subject: CONTROL ENGINEERING**

DipIETE – ET

Time: 3 Hours **DECEMBER 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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 45 minutes 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 input-output relationship of a linear system is given by

(A) $y=a_0x^2+a_1x+a_0$ **(B)** $y=a_1x+a_0$
(C) $y=a_1x$ **(D)** $y= a_0$

b. The Laplace transform of $e^{\alpha t}$ is

(A) $\frac{1}{S-\alpha}$ **(B)** $\frac{1}{S+\alpha}$
(C) $\frac{1}{S}e^{\alpha t}$ **(D)** None of these

c. The transfer function of the network as shown in Fig. 1 is

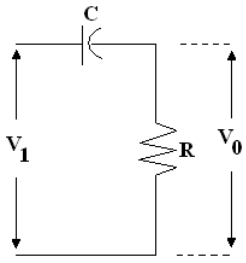

Fig. 1

(A) $\frac{1}{1+SRC}$ **(B)** $\frac{SRC}{1+SRC}$
(C) $\frac{RC}{1+SRC}$ **(D)** $\frac{1+SRC}{1-SRC}$

d. With negative feedback, the system gain and stability

(A) Decreases, increases respectively **(B)** Increases, decreases respectively
(C) Increases, increases respectively **(D)** Decreases, decreases respectively

e. For the given block diagram as shown in Fig. 2 the output is

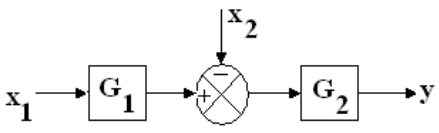

Fig. 2

(A) $(x_1+x_2)G_2$
(B) $(G_1x_1-x_2)G_2$
(C) x_1-x_2
(D) None of these

f. For the signal flow as shown in Fig. 3 the overall transfer function of the system will be

(A) $\frac{C}{R} = G$ **(B)** $\frac{C}{R} = \frac{G}{1+H_2}$

(C) $\frac{C}{R} = \frac{G}{(1+H_1)(1+H_2)}$ **(D)** $\frac{C}{R} = \frac{G}{1+H_1+H_2}$

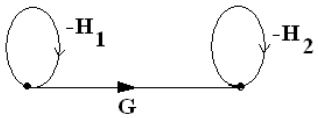

Fig. 3

g. For type 1 system the steady state error due to step input is

(A) Infinity **(B)** Zero
(C) One **(D)** None of these

h. The end point of a root locus is

(A) Open loop pole **(B)** Closed loop pole
(C) Closed loop zero **(D)** Open loop zero

i. An octave frequency ranges is specified by

(A) $\frac{\omega_2}{\omega_1} = 8$ **(B)** $\frac{\omega_2}{\omega_1} = 6$

(C) $\frac{\omega_2}{\omega_1} = 7$ **(D)** $\frac{\omega_2}{\omega_1} = 2$

j. The radius of constant N circle at centre $\left(-\frac{1}{2}, \frac{1}{2N}\right)$ for a given phase angle is

(A) $\frac{1}{N}$ **(B)** $\frac{\sqrt{N+1}}{2N}$

(C) $\frac{2N}{\sqrt{N+1}}$ **(D)** N

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

Q.2 a. Differentiate between the following systems:
(i) Linear and non linear control.
(ii) Analog and digital control systems. **(8)**

b. Along with the block diagram explain feedback control system with characteristics. **(8)**

Q.3 a. Explain the significance of Laplace transform in the solution of differential equation. **(5)**

b. Explain the different types of test signals used in control systems. **(5)**

c. Find f(t) if $F(S)= \dfrac{(S+3)}{(S+1)(S+2)(S+4)}$ **(6)**

Q.4 a. Find the stability of a system having characteristic equation
$S^6 + 2S^5 + 7S^4 + 10S^3 + 14S^2 + 8S + 8 = 0$. **(6)**

b. Calculate the transfer function of the electrical network as shown in Fig. 4. **(4)**

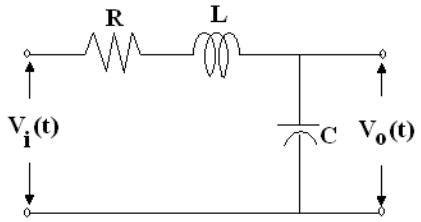

Fig. 4

c. Find the simplified block diagram of the Fig. 5. **(6)**

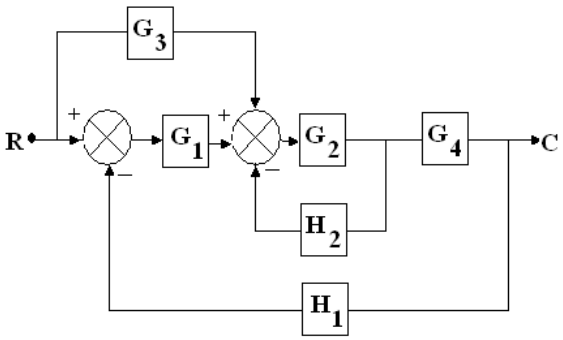

Fig. 5

Q.5 a. Obtain the block diagram for the signal flow graph as shown in Fig. 6. **(10)**

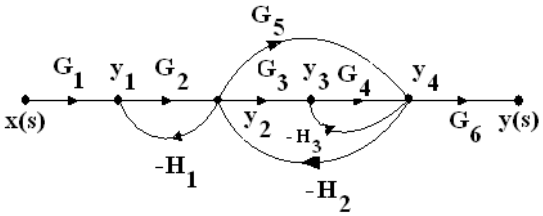

Fig. 6

b. Define the following with respect to a signal flow graph
(i) Sink node (ii) Source node
(iii) Dummy node (iv) Forward path
(v) Mason's gain formula. **(1+1+1+1+2)**

Q.6 a. Define the sensitivity of a control system. **(3)**

b. Find the sensitivity of the overall transfer function of the system shown in Fig.7 with respect to

(i) forward path transfer function
(ii) feedback path transfer function.
The value of ω is 1.2 rad/sec. **(7)**

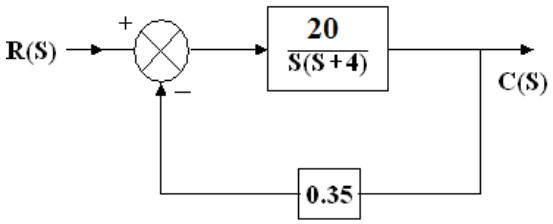

Fig.7

c. Briefly discuss different types of compensating network. **(6)**

Q.7 a. Explain the Nyquist stability criterion. **(2)**

b. Define the following with respect to a Nyquist plot
(i) Encircled (ii) Enclosed
(iii) Analytic function (iv) Single-valued function **(4)**

c. For G(S)H(S)=1/[S(S+2)], draw the Nyquist plot and decide stability. **(10)**

Q.8 a. For G(S)H(S)=K/[S(S+1)(S+3)], find the point of the root locus with the $j\omega$ axis. **(5)**

b. List the steps involved in plotting a root locus. **(4)**

c. Sketch the root locus for a system having

$$G(S)H(S) = \frac{K}{S(S+1)(S+2)(S+4)}, K > 0$$ **(7)**

Q.9 a. List the advantages of a Bode plot. **(5)**

b. A unity feedback control system has $G(S) = \frac{K}{S(S+4)(S+10)}$. Draw the Bode plot. Find K, when PM= 30° **(11)**