ROLL NO. _____

Code: DE65 **Subject: CONTROL ENGINEERING**

DipIETE – ET

Time: 3 Hours **JUNE 2013** **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. As compared to a closed loop system an open loop system is

(A) More stable as well as more accurate
(B) Less stable as well as less accurate
(C) More stable but less accurate
(D) Less stable but more accurate

b. Area under unit impulse function is

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

c. Laplace transform of integral of f(t) is

(A) F(s) **(B)** sF(s) –f(0)
(C) sF(s) **(D)** $s^2F(s)$

d. Feedback control systems are

(A) Insensitive to both forward and feedback -path parameter changes
(B) Less sensitive to feedback path parameter changes than to forward path parameter changes
(C) Less sensitive to forward path parameter changes than to feedback path parameter changes
(D) Equally sensitive to forward and feedback path parameter changes

e. The lag compensation in the control system is achieved by

(A) Adding zeros in the transfer function of the system
(B) Adding poles in the transfer function of the system
(C) Both **(A)** & **(B)**
(D) None of these

f. The Nyquist plot shown in the Fig.1 indicates

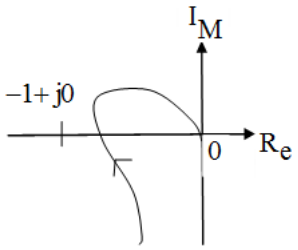

Fig.1

(A) Marginally stable system
(B) Unstable system
(C) Stable system
(D) None of these

g. The electrical resistance is analogous to

(A) Viscous damper **(B)** Spring
(C) Mass **(D)** None of these

h. The Bode plot is applicable to

(A) Minimum phase network **(B)** Maximum phase network
(C) All phase network **(D)** None of these

i. The impulse response of a system is $5e^{-10t}$. Its step response is equal to

(A) $0.5e^{-10t}$ **(B)** $0.5(1- e^{-10t})$
(C) $5\ (1 – e^{-10t})$ **(D)** $10\ (1 – e^{-10t})$

j. Which of the following is not an electromechanical system

(A) Stepper motor **(B)** Transformer
(C) Synchro **(D)** DC Motor

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

Q.2 a. Discuss the computer controlled systems with the help of its block diagram. **(4)**

b. Differentiate the following:
(i) Continuous & discrete control systems
(ii) Open loop & closed loop control system **(6)**

c. What do you understand by regulators? Explain with suitable example. **(6)**

Q.3 a. A closed loop servo system is represented by the differential equation.

$$\frac{d^2c}{dt^2} + 8\frac{dc}{dt} = 64e$$

Where c is the displacement of the output shaft, r is the displacement of the input shaft and e = r - c. Determine.
(i) Damping ratio
(ii) Damped natural frequency
(iii) % M_p for unit step input **(10)**

b. Derive the unit step response to a second order system. **(6)**

Q.4 a. Determine the transfer function of a control system shown in Fig.2: **(10)**

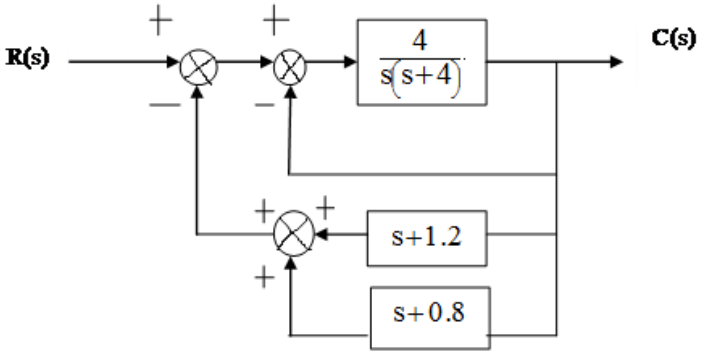

Fig.2

b. State and explain the rule for shifting the summing point ahead of a block. **(6)**

Q.5 a. Draw the signal flow graph for the block diagram in given Fig.3 and obtain the transfer function C(s)/R(s). **(10)**

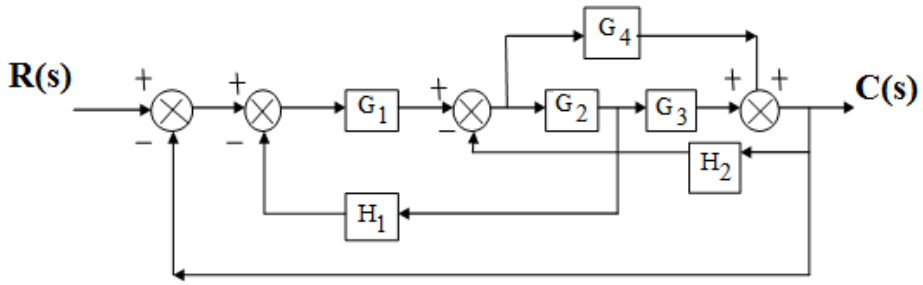

Fig.3

b. Write down Mason's gain formula and explain each term therein. **(6)**

Q.6 a. Explain various time domain specifications used for design of feedback control system. **(8)**

b. For the discrete system defined by
X(K+1) = aX (K) + u(K)
y(K) = cX (K)
Determine the sensitivity of the output y to the parameter a. **(8)**

Q.7 a. State & explain the Nyquist Stability Criterion. **(6)**

b. Sketch the Nyquist plot for:

$$G(s)H(s)=\frac{1}{s(1+2s)(1+s)}$$

Whether the closed loop system having above transfer function is stable or not. If not, how many closed loop poles lie in the right half of s-plane. **(10)**

Q.8 a. Draw the root locus plot for a unity feedback control system having open loop transfer function as $G(s)=\frac{k(s+2)}{s(s+1)(s+4)}$.

Determine:
(i) Centroid
(ii) Angles of a asymptotes
(iii) Breakaway point, if any **(12)**

b. Write the method for finding the angle of departure from a complex pole in a root locus plot. **(4)**

Q.9 a. Obtain Bode Plots for the system: **(10)**

$$G(s)=\frac{1000}{(0.1s+1)(0.001s+1)}$$

Also obtain GM and PM. Comment on stability.

b. Discuss the general procedure of determination of transfer function from bode plot. **(6)**