ROLL NO. _____

Code: DE65 **Subject: CONTROL ENGINEERING**

DipIETE – ET (NEW SCHEME)

Time: 3 Hours **JUNE 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 main application of transfer function is in the study of

(A) Only steady state behaviour of systems
(B) Steady state as well as transient behaviour of systems.
(C) Only transient behaviour of system.
(D) None of these.

b. Two blocks having respective functions G_1 and G_2 are connected in series cascade. There resultant will be

(A) G_1 or G_2 whichever is higher. **(B)** G_1 or G_2 whichever is lower.
(C) $G_1 + G_2$ **(D)** $G_1\ G_2$.

c. With feedback system

(A) The transient response gets magnified.
(B) The transient response decays at a constant rate.
(C) The transient response decays slowly.
(D) The transient response decays more quickly.

d. The open loop transfer function of a control system is $G(s) = \frac{K}{s(s+5)}$, the number of asymptotes and the angle of asymptotes are

(A) Two, 90^o, 270° **(B)** Two, $\pm 60^o$
(C) Four, $\pm 90^o$, $\pm 270^\circ$ **(D)** None of these.

e. Type-0 system has

(A) All poles at origin. **(B)** No pole at origin.
(C) Simple pole at origin. **(D)** No zero at origin.

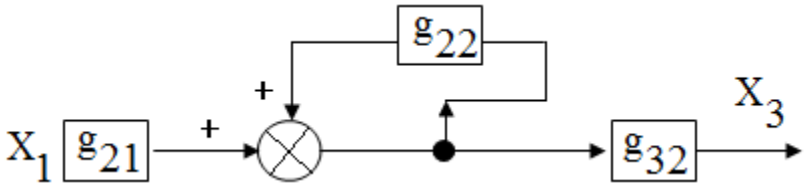
f. The value of K for which the system having characteristic equation $s^3 + 3s^2 + 3s + 1 + K = 0$ becomes stable, is

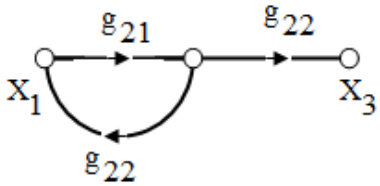
(A) K>8 **(B)** K=8
(C) K=7 **(D)** None of these

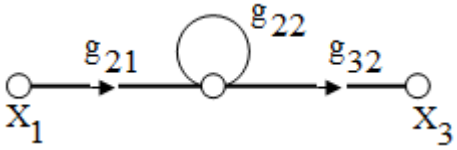
g. Which of the following is used for Nyquist plot?

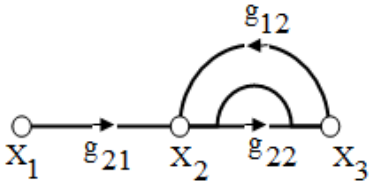
(A) Characteristic equation **(B)** Closed loop transfer function
(C) Open loop transfer function **(D)** None of these

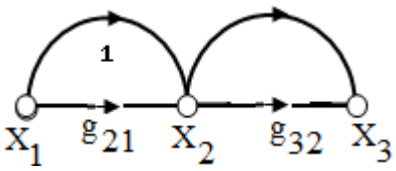
h. The signal flow graph for the control system shown in the figure below



(A)


(B)


(C)


(D)


i. $G(s) = \dfrac{1}{s(1+6s)}$, the system is

(A) Stable **(B)** Unstable
(C) Marginally stable **(D)** conditionally stable

j. The gain of a system is 10 at some frequency. In terms of dB, it is

(A) 0 dB **(B)** 1 dB
(C) 20 dB **(D)** 100 dB

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

Q.2 a. Draw the block diagram of feedback control system and discuss in brief the basic components of it. Also give the characteristics of the feedback control system. **(8)**

b. Define the terms servomechanism and regulators. Give simple example for each Also mention how a regulator differs from servomechanism. **(8)**

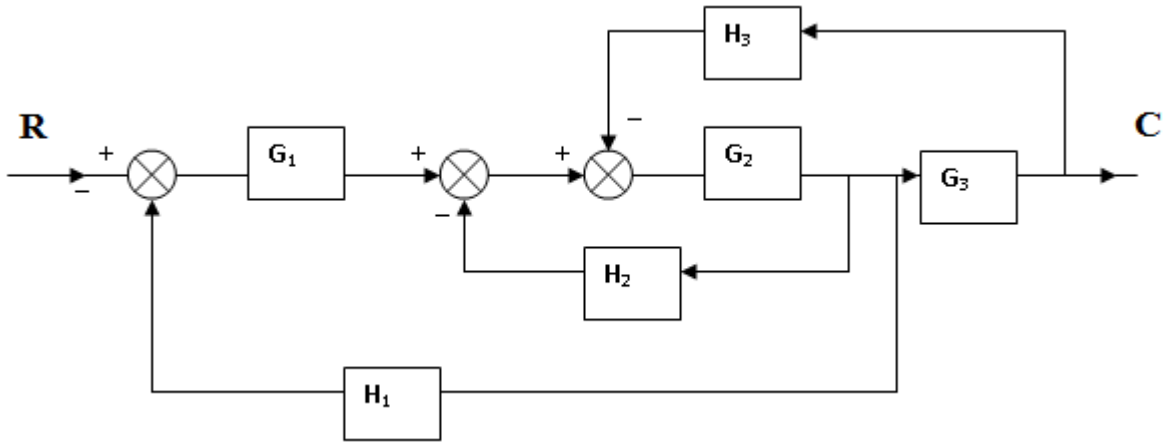
Q.3 a. Discuss the followings in brief: **(10)**

(i) Steady state and transient response
(ii) Time variability and Time invariance
(iii) Linearity and superposition
(iv) Causality & physical realizable system

b. Obtain the inverse Laplace transform of $F(s) = \dfrac{1}{(s+1)^2(s+2)}$ **(6)**

Q.4 a. Define stability. Use continued fraction stability criterion and determine stability of the characteristic equation: $s^4 + 4s^3 + 8s^2 + 16s + 32 = 0$. **(8)**

b. Reduce the block diagram of the figure shown below into canonical form by mentioning the steps used. **(8)**

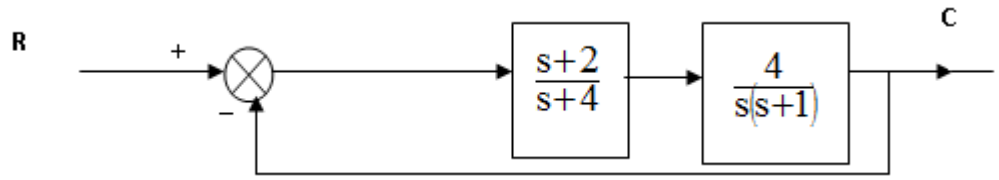


Q.5 a. What is a signal flow graph? Discuss its terminology. Give advantages of it over block diagram method for system representation **(6)**

b. Construct the signal flow graph for the following set of algebraic equations. **(10)**

$$x_2 = A_{21}x_1 + A_{23}x_3$$
$$x_3 = A_{31}x_1 + A_{32}x_2 + A_{33}x_3$$
$$x_4 = A_{42}x_2 + A_{43}x_3$$

Q.6 a. What do you understand by error constants? Find value of these constants for the system whose block diagram is given below. **(8)**



b. Discuss the need to analyze a control system. Give various methods for analysis and designing of control system **(8)**

Q.7 Construct root locus for the transfer function $GH(s) = \frac{K}{(s+1)(s^2+4s+5)}$.

Clearly mention the rules used for construction. **(16)**

Q.8 a. What is Nyquist path? Why Nyquist path does not contain LHS of the s-plane Explain mapping theorem. **(6)**

b. Sketch the Nyquist plot for control system having open loop transfer function as $GH(s) = \frac{1}{s(s+2)(s+10)}$. Comment on the stability of system. **(10)**

Q.9 Draw the Bode Plots and determine

(i) gain crossover and phase crossover frequencies and
(ii) the gain margin and phase margin for the system with open loop transfer function $GH(j\omega) = \frac{4}{(1+j\omega)(1+j\omega/3)^2}$. **(16)**