ROLL NO. _____

Code: DE65 **Subject: CONTROL ENGINEERING**

DipIETE – ET (Current Scheme)

Time: 3 Hours **JUNE 2015** **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. Driving of a car by a man is

(A) an open-loop control system
(B) a closed-loop feedback system
(C) not a control system
(D) may be closed-loop or open-loop system, depending on the type of car in use.

b. In control system engineering the term servo-mechanism is used for system where the output is

(A) position **(B)** velocity
(C) acceleration **(D)** any of these

c. The general solution of differential equation $\frac{dy}{dx} = \frac{x^2}{y^2}$ is of the form

(A) $x^3 - y^3 = c$ **(B)** $x^2 + y^2 = c$
(C) $x^3 + y^3 = c$ **(D)** $x^2 - y^2 = c$

d. Which of the following function is not Laplace Transformable

(A) e^{at} **(B)** e^{-at}
(C) e^{t^2} **(D)** None of these

e. If a linear time-invariant control system is subjected to a bounded input and the response has some oscillations which neither damp out nor increases with respect to time, then the system is said to be

(A) stable **(B)** unstable
(C) relatively stable **(D)** marginally stable

f. The signal flow graph representation for a control system is

(A) pictorial representation **(B)** graphical representation
(C) both **(A)** and **(B)** **(D)** none of these

g. The steady-state error due to a unit-step input to a type 2 system is

(A) $\frac{1}{k_p}$ **(B)** $\frac{1}{1+k_p}$
(C) ∞ **(D)** 0

h. The independent parameter is Nyquist plot is/are

(A) Magnitude of G(jw) **(B)** phase of G(jw)
(C) both **(A)** and **(B)** **(D)** frequency (w)

i. The initial slope of the Bode plot for a transfer function having double zero at origin is

(A) 20 dB/decade **(B)** 40 dB/decade
(C) -20 dB/decade **(D)** -40 dB/decade

j. The open-loop transfer function of a closed-loop control system is given as follows $G(s)H(s) = \frac{k(s+1)^2}{(s+2)^2}$ determine the number of branches of its root-loci

(A) 1 **(B)** 2
(C) 3 **(D)** 4

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

Q.2 a. Discuss the important characteristics of feedback in reference to control systems. **(8)**

b. Draw the block diagram for the system represented by the following equation.

$x_3 = \frac{d^2x_2}{dt^2} + \frac{dx_1}{dt} - x_1$ **(8)**

Q.3 a. Name the various test functions used in control system analysis. Explain each one clearly bringing out their relative merits and limitations. **(8)**

b. Determine the Inverse Laplace transform of the following function

$f(s) = \frac{2s+6}{s^2+3s+2}$ **(8)**

Q.4 a. With the help of example explain Routh stability criterion used to determine the stability of a control system. **(8)**

b. Determine the location of roots of following equation using continued fraction stability criterion. **(8)**
$Q(s) = s^3 + 6s^2 + 12s + 8 = 0$

Q.5 a. Give the important characteristics of signal flow graphs in reference to control system representation. **(8)**

b. Obtain C/R ratio for a system whose signal flow graph is represented by the following figure: **(8)**

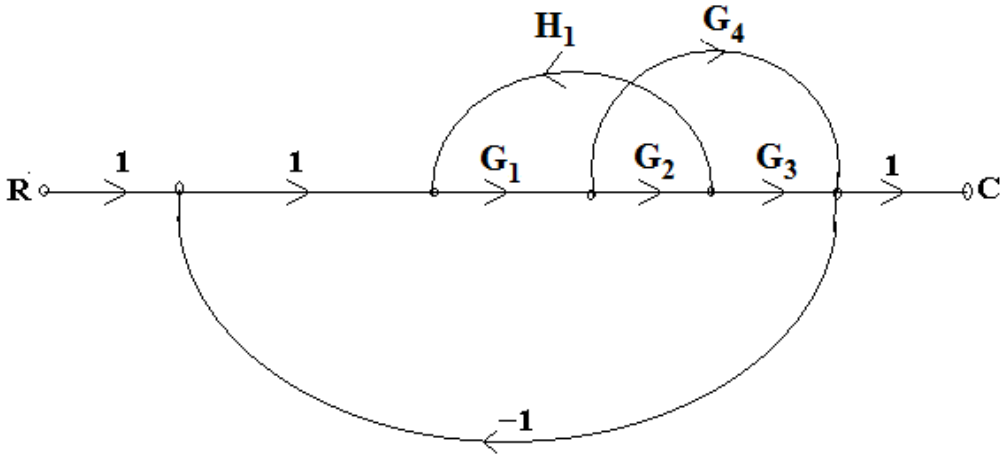

Fig.1

Q.6 a. Define parabolic-error constant for a general control system. Derive the values of parabolic error constants and steady-state error due to parabolic-input for type 0, 1 and 2 systems. **(8)**

b. Define and illustrate with the help of examples the following terms in reference to the control system design.
(i) Gain margin (ii) Phase margin **(8)**

Q.7 Write notes on any **TWO** of the following: **(2X8)**
(i) System compensation
(ii) Polar plots
(iii) Nyquist stability criterion

Q.8 Give a step wise procedure for drawing the root- locus in reference to control systems. Illustrates the procedure with the help of an example. **(16)**

Q.9 Explain how the Bode plots for a continues time system can be constructed. Illustrate with the help of an example. **(16)**