ROLL NO. _____

Code: DE65 **Subject: CONTROL ENGINEERING**

DipIETE – ET (Current Scheme)

Time: 3 Hours **December 2016** **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. A Phase –lag Compensation will
(A) Improve relative Stability **(B)** Increase the speed of response
(C) Increase bandwidth **(D)** Increase overshoot

b. The bode diagram approach is the most commonly used method for the analysis and synthesis of
(A) Nonlinear feedback control systems only
(B) Linear feedback control systems only
(C) Open loop system
(D) All of these

c. 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.

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 the system has not repeated poles on the jω-axis, the system is
(A) stable **(B)** unstable
(C) marginally stable **(D)** conditionally stable

f. Considering the unity feedback system of Fig.1, the settling time of the resulting second order system for 2% tolerance band will be _____.

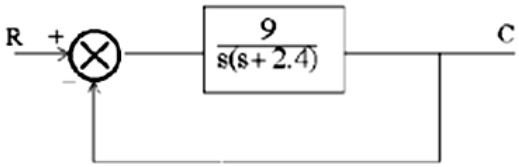

Fig.1

(A) 3.33 sec **(B)** 4.5 sec
(C) 2.25 sec **(D)** 2.84 sec

g. Which one of the following response-excitation relationship represents a linear control system?

(A) $y = k_1x^2$ **(B)** $y = 7x + 15$

(C) $y = 5x$ **(D)** $y = k_4$

h. The root- loci of a closed loop control system is shown in Fig.**2**, then the system is

(A) stable for $k \leq 9$
(B) unstable for all values of k
(C) stable for all values of k
(D) unstable for $k \geq 9$

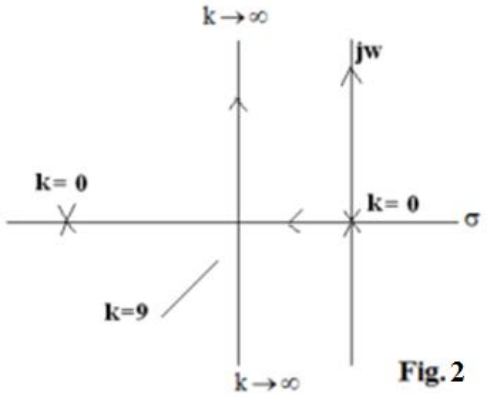

Fig. 2

i. Type of a control system is determined for
(A) open loop control system
(B) closed loop control system
(C) Both for open & closed loop system
(D) None of these

j. In root locus at breakaway point which one of the condition is satisfied
(A) Two or more branches of the root locus depart or arrive at the real axis.
(B) Asymptotes are meeting at that point.
(C) Point at which root locus intersect with jω axis.
(D) None of these

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

Q.2 a. In reference to control system engineering define the following terms:
(i) plant (ii) reference input
(iii) actuating signal (iv) forward path **(2x4)**

b. What do you understand by regulators? Explain with suitable example. **(8)**

Q.3 a. Derive the Laplace Transform of the following function. **(8)**
(i) e^{at} (ii) Sinωt

b. Define the transfer function of a linear time-invariant system in terms of its differential equations model. What is the characteristic equation of the system? **(8)**

Q.4 a. Determine the location of roots of following equation using continued fraction stability criterion. **(8)**

$Q(s) = s^3 + 6s^2 + 12s + 8 = 0$

b. What are the steps involved in evaluating the performance of multiple inputs to a control system? What are the conditions for this evaluation? Explain with a typical example. **(8)**

Q.5 a. Explain transfer function computation of cascaded components using suitable example. **(8)**

b. Obtain the transfer function C(s)/R(s) of the following signal flow graph as shown in fig.3 **(8)**

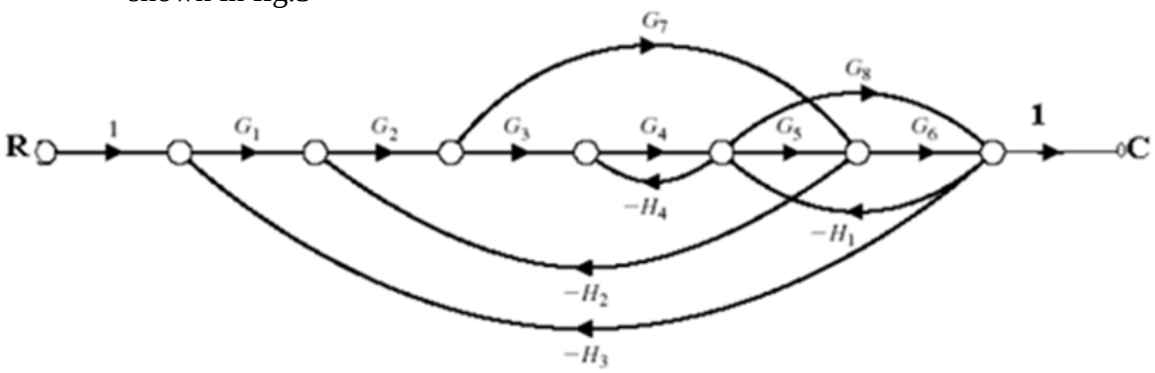

Fig.3

Q.6 a. Determine the resonance peak M_P and the resonant frequency ω_P for the system whose transfer function is $\frac{C(s)}{R(s)} = \frac{5}{s^2 + 2s + 5}$. **(6)**

b. Enumerate the design methods for analysis and design of control system. **(10)**

Q.7 Construct root locus and comment on the stability of a unity-feedback control system having the open-loop transfer function $G(s) = \frac{10}{s(s-1)(2s+3)}$. **(16)**

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 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. Discuss M and N circles. **(8)**

b. Discuss Nyquist stability criterion **(8)**