ROLL NO. _____

Code: AE61 Subject: CONTROL ENGINEERING

AMIETE – ET (NEW SCHEME)

Time: 3 Hours **DECEMBER 2011** **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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 linear function has to obey the property of

(A) Additive **(B)** Homogeneity
(C) Commutative **(D)** Superposition

b. Which of the following statements are true for the block diagram as shown in Fig. 1?

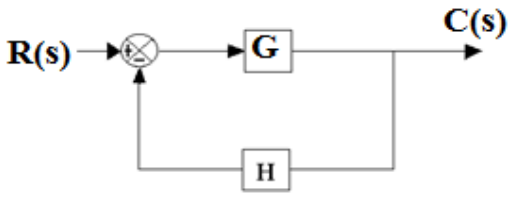

Fig. 1

(A) Gain is reduced by a factor $\frac{1}{[1+G(s)H(s)]}$
(B) Parameter variation is reduced by a factor [1+G(s)H(s)]
(C) There is improvement in sensitivity
(D) All the above are true

c. A system has an impulse response of e^{-3t}. Then its transfer function is

(A) $\frac{1}{s+3}$ **(B)** (s+3)

(C) $\frac{s}{s+3}$ **(D)** $\frac{3}{s+1}$

d. The number of turns of wire needed to provide a potentiometer with a resolution of 0.05%

(A) 100 **(B)** 1000
(C) 2000 **(D)** 200

e. If the gain K of the system increases, the steady state error of the system

(A) Decreases **(B)** Increases
(C) May increase **(D)** Remain unaltered

f. Overall gain of the block diagram shown in Fig.2 is

(A) $\frac{G_1G_2}{1+G_1(H_1+H_2)}$

(B) $\frac{(H_1+H_2)}{G_1+G_2}$

(C) $\frac{G_1G_2}{(H_1H_2)}$

(D) None of the above

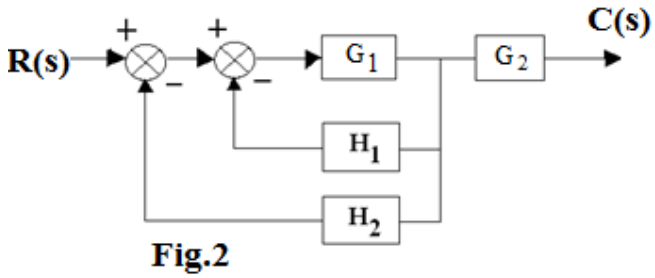

Fig.2

g. The system with $G(s)=\frac{5}{s}$ and $H(s)=\frac{1}{s}$ is of the type

(A) 0 **(B)** 1
(C) 2 **(D)** 3

h. A system has an open loop transfer function $G(s)=\frac{K}{s+T}$ and unity feedback. It's closed loop pole is located at

(A) s= –(K+T) **(B)** s=(K+T)
(C) s=1 **(D)** s=0

i. A system is characterised by the equation $s^3+5s^2+10s+3=0$. The number of roots in the right half of the s plane are

(A) 0 **(B)** 1
(C) 2 **(D)** 3

j. The root locus of a unity feedback system is shown in Fig.3.

The open loop transfer function is

(A) $G(s)=\frac{K}{s+1}$

(B) $\frac{K^2}{s+1}$

(C) $\frac{K}{s^2+1}$

(D) $\frac{s+1}{K}$

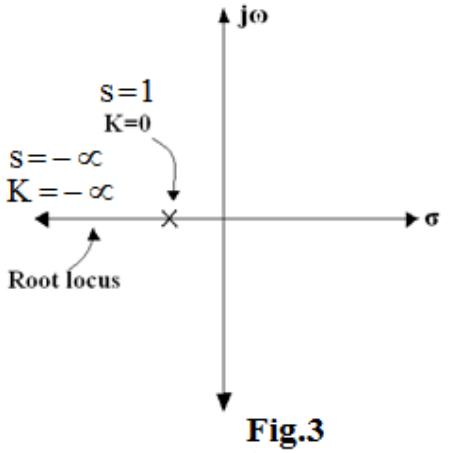

Fig.3

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

Q.2 a. Define the following with respect to a control system:

(i) Linear (ii) Continuous
(iii) Deterministic (iv) Stochastic. **(8)**

b. Derive the transfer function $V_o(s)/V_i(s)$ for the network as shown in Fig.4, below **(8)**

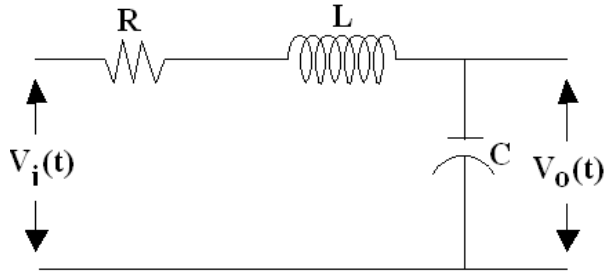

Fig.4

Q.3 a. Find the transfer function of the Signal Flow graph as shown in Fig.5. **(8)**

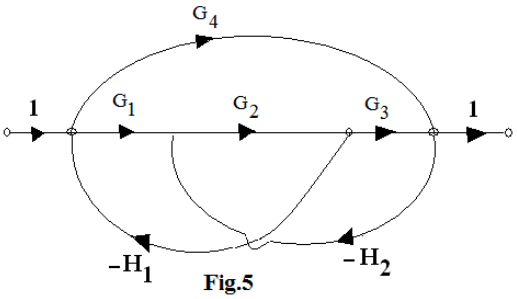

Fig.5

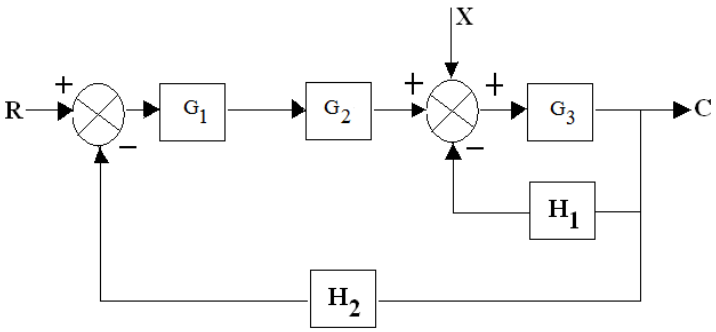

Fig.6

b. Find the output of the system as shown in Fig.6. **(8)**

Q.4 a. Determine the system equations for the system as shown in Fig.7. **(8)**

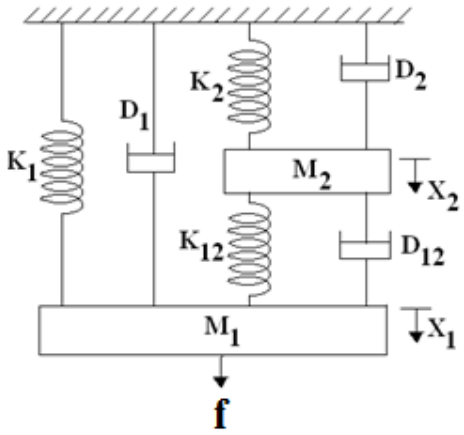

Fig.7

b. Briefly explain the principles of PD and PI controllers. **(8)**

Q.5 a. For a system having forward path transfer function $G(s) = \frac{25}{s(s+10)}$ and unity feedback, find

(i) ω_n (ii) ξ
(iii) ω_d (iv) T_P
(v) M_P **(8)**

b. With a neat sketch of a system response, define the following:

(i) Delay time (ii) Rise time
(iii) Settling time (iv) Peak time
(v) Overshoot and (vi) Steady state error. **(8)**

Q.6 Sketch the root locus for a system with

$$G(s)H(s) = \frac{K}{s(s+1+j)(s+1-j)}, (K > 0)$$ **(16)**

Q.7 a. List six advantages of a Bode plot. **(6)**

b. A unity feedback control system has $G(s) = \frac{40}{s(s+2)(s+5)}$, find GM and PM **(10)**

Q.8 a. Discuss the different types of compensation used in control engineering. **(10)**

b. What are the advantages and disadvantages of lead and lag compensation. **(6)**

Q.9 a. Obtain the time response of the following system

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

where u(t) is a unit step occurring at t = 0 and $x^T(0) = [1 \quad 0]$. **(10)**

b. Obtain the state model of the network as shown in Fig.8. **(6)**

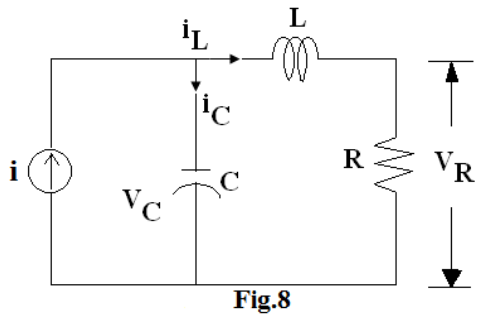

Fig.8