ROLL NO. _____

Code: AE61/AE109 **Subject: CONTROL ENGINEERING**

AMIETE – ET (Current & New Scheme)

DECEMBER 2015

Time: 3 Hours **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. Type 2 system has

(A) One pole at origin **(B)** One zero at origin
(C) Two zeros at origin **(D)** Two poles at origin

b. Number of forward paths in the signal flow graph shown in fig.1 are

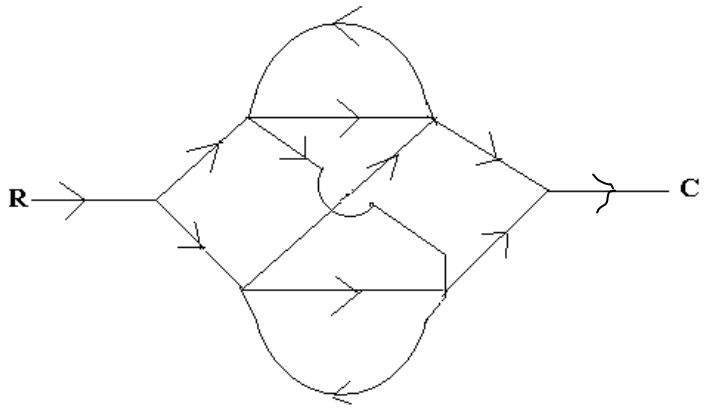

Fig.1

(A) 2 **(B)** 4
(C) 6 **(D)** 8

c. In Force-Voltage analogy, spring constant (K) is analogus to:

(A) R **(B)** L
(C) 1/C **(D)** 1/R

d. In negative feedback system with loop gain T, the noise generated within the basic amplifier

(A) Decrease by factor (1-T) **(B)** Increase by factor (1-T)
(C) Independent of factor T **(D)** Decrease by factor T

e. A system with differential equation $2\frac{d^2y}{dt}+4\frac{dy}{dt}+8y=8x$ has damping ratio:

(A) 1 **(B)** Zero
(C) 0.2 **(D)** 0.5

f. The centroid for a system having transfer function $G(s)H(s)=\frac{K}{s(s+1)(s+2)}$ is

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

g. The phase cross over frequency for $G(s) = \dfrac{1}{s(s+1)(s+0.5)}$ is

(A) 0 **(B)** 0.5
(C) 0.707 **(D)** 1

h. In lag- lead network, the frequency at which phase is zero is given by

(A) $\dfrac{1}{T1\,T2}$ **(B)** $\dfrac{1}{\sqrt{T1\,T2}}$

(C) $\dfrac{1}{T1\sqrt{T2}}$ **(D)** $\dfrac{\sqrt{T1}}{\sqrt{T2}}$

i. The concept of controllability and observability was given by
(A) Routh **(B)** Bode
(C) Evan **(D)** Kalman

j. If gain of system is doubled. The gain margin becomes
(A) Double **(B)** No change
(C) Half **(D)** Four times

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

Q.2 a. Explain servomechanism (Position control system). **(8)**

b. Write differential equation for mechanical translational system shown in fig.2. Also draw analogous system for this using force-voltage analogy. **(8)**

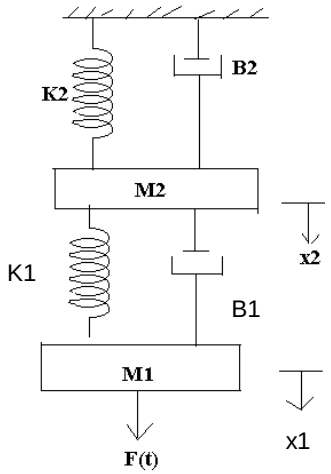

Fig.2

Q.3 a. Find transfer function $\dfrac{C(s)}{R(s)}$ of the system shown in fig.3 by block diagram reduction method. **(8)**

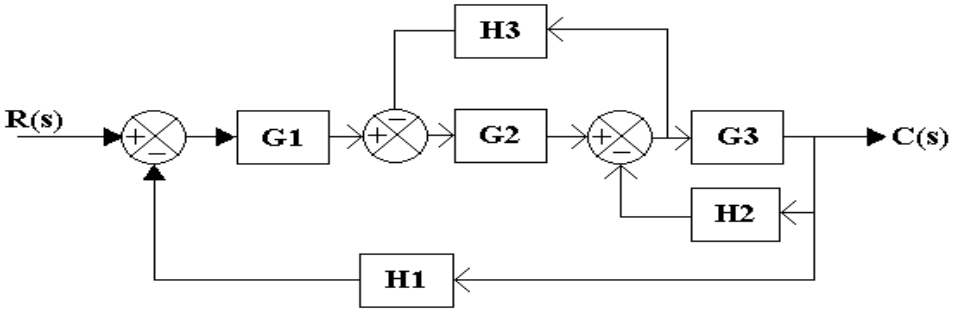

Fig.3

b. Find transfer function $\frac{C(s)}{R(s)}$ of the system given in part (a) using Mason's gain formula. **(8)**

Q.4 a. Discuss effect of parameter variation in:
(i) Open loop system
(ii) Closed loop system **(8)**

b. Explain effect of feedback on disturbances in forward path of control system **(8)**

Q.5 a. Determine error constants & corresponding steady state error for a system with $G(s) = \frac{100}{s(1+2s)(1+0.01s)}$ & $H(s) = 1$ **(8)**

b. A unity feedback system is shown in Fig.4 **(8)**

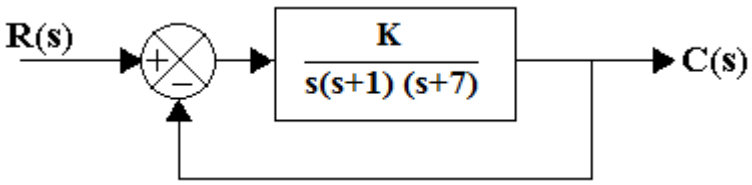

Fig.4

(i) Determine range of K for stable system
(ii) Value of K when roots of system lie on jw axis
(iii) Frequency of sustained oscillations

Q.6 Draw root locus as k varied from 0 to ∞ for unity feedback system has an open-loop transfer function $G(s)H(s) = \frac{K}{s(s+3)(s^2+2s+2)}$ **(16)**

Q.7 a. For a unity feedback system $G(s) = \frac{800(s+2)}{s^2(s+10)(s+40)}$ **(8)**

Draw the Bode plot. Find out W_{gc}, W_{pc}, GM and PM. Comment on stability.

b. Discuss the stability of system using nyquist plot for $G(s)H(s) = \frac{20}{s(s+4)(s-2)}$ **(8)**

Q.8 A system has open loop transfer function $G(s) = \frac{4}{s(2s+1)}$. It is desired to have the phase margin as 40°. Design a lead compensator to meet desired specifications using Bode plot. **(16)**

Q.9 a. Explain direct method of Liapunov for linear system. **(8)**

b. Obtain state space model of electric network shown in Fig.5. **(8)**

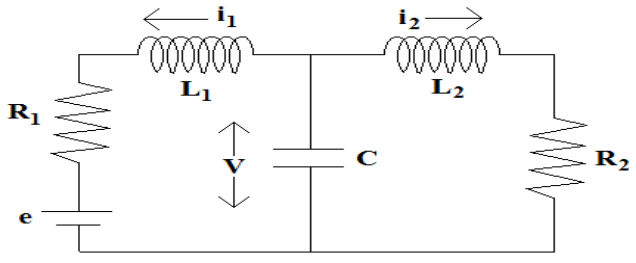

Fig.5

Assume Voltage & Current in R_2 as Output Variables.