ROLL NO. _____

Code: AE11 **Subject: CONTROL ENGINEERING**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **OCTOBER 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. Area under the unit Impulse function is

(A) Infinity **(B)** Unity
(C) Zero **(D)** None of the above

b. One of the following method is used to determine the relative stability of a control system

(A) Routh stability criterion **(B)** Root locus method
(C) Bode plot **(D)** None of these

c. The transfer function of a system is

T.F= $\dfrac{1000}{(1+0.1s)(1+0.01s)}$ the corner frequencies are

(A) 0.1 and 0.01 **(B)** –0.1 and –0.01
(C) 10 and 100 **(D)** –10 and –100

d. Number of Asymptotes in root locus for the system having open loop poles and zeros indicated in Fig. 1, below are

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

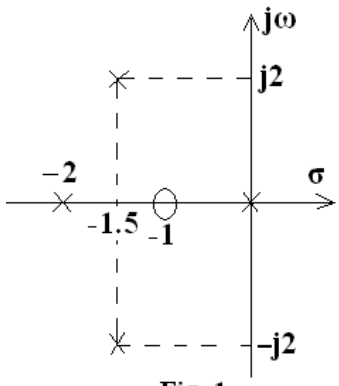

Fig. 1

e. Nyquist plot represented in Fig. 2 has

(A) Stable system
(B) Unstable system
(C) Marginally stable system
(D) None of the above

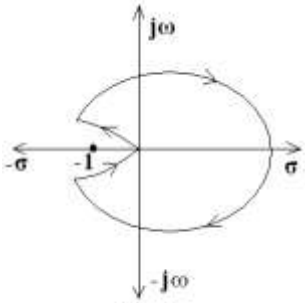

Fig. 2

f. Time constant for second order control system corresponding to unit step input is

(A) $\xi\omega n$ **(B)** $\frac{1}{\xi\omega n}$

(C) $2\xi\omega n$ **(D)** $\frac{1}{\xi^2\omega^2 n}$

g. Pneumatic controllers are mostly used for

(A) Flexible operation **(B)** High torque operation
(C) High speed operation **(D)** Fire proof operation

h. Using phase lead network

(A) Phase margin decreases **(B)** Bandwidth decreases
(C) Velocity constant increases **(D)** Response is slower

i. Using PI controller

(A) Rise time decreases **(B)** Bandwidth increases
(C) Steady state accuracy decreases **(D)** Response is oscillatory

j. Transfer function of op-amp circuit as shown in Fig.3 is

(A) $-R_2$
(B) $-R_2/R_1$
(C) $1+R_2/R_1$
(D) $1-R_2/R_1$

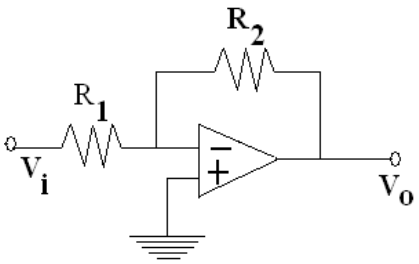

Fig. 3

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

Q.2 a. Draw block diagram of closed loop system and write its advantages and disadvantages. **(6)**

b. Draw the analogous electrical circuit of the system shown in Fig. 4, using F-V analogy. **(4)**

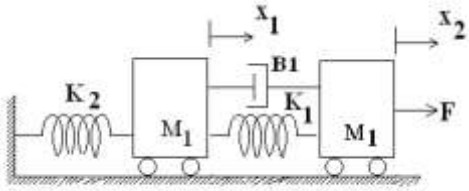

Fig. 4

c. Draw Transient response for second order system corresponding to unit step input and mark various time response specification on it. **(6)**

Q.3 a. Draw block diagram for electrical circuit shown in Fig. 5 and determine transfer function using Mason's gain formula. **(8)**

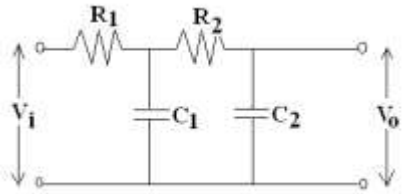

Fig. 5

b. Discuss working of the following:
(i) Synchro transmitter
(ii) Synchro control transformer. **(8)**

Q.4 a. Explain action of PID controller. Write its transfer function and draw time response curve. **(8)**

b. Write effect of feedback on
(i) Overall gain of system
(ii) Stability of system. **(8)**

Q.5 a. Sketch Bode plot for the transfer function $G(s) = \dfrac{1000}{(1+0.1s)(1+0.001s)}$.

Determine
(i) Phase margin
(ii) Gain margin
(iii) Stability of system. **(10)**

b. Draw frequency response curve for second order system and define:
(i) Resonant peak
(ii) Bandwidth
(iii) Cut-off frequency. **(6)**

Q.6 Draw root locus for unity feedback system of open loop transfer function $G(s) = \dfrac{K}{s(s+4)(s+5)}$ and design a lag compensator for

$K_v \geq 5$

$\xi = 0.707$ **(16)**

and $\omega_n = 2$ rad/sec

Q.7 Consider open loop transfer function of a unity feedback system. $G(s) = \frac{K}{s(1+0.2s)}$. Design the compensation network as per given requirements

(i) Velocity error constant is at least 20 and

(ii) Phase margin should be 44°. **(16)**

Q.8 a. For unity feedback control system the forward path transfer function is $G(s) = \frac{20}{s(s+2)(s^2+2s+20)}$. Determine the steady state error of the system when input is (i) 5u(t) (ii) 5r(t) **(8)**

b. A unity feedback system has open loop transfer function $G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$. Using Routh criterion, calculate the range of K for the system to be stable. **(8)**

Q.9 Find transfer function of the circuits as shown in Fig 6 and Fig. 7. **(8+8)**

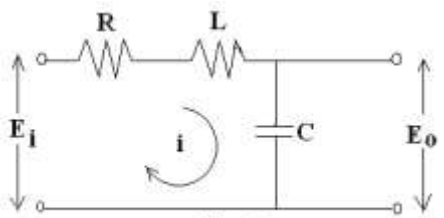

Fig. 6

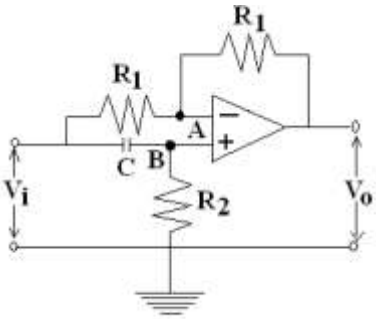

Fig. 7