Code: AE11 **Subject: CONTROL ENGINEERING**
Time: 3 Hours **Max. Marks: 100**

DECEMBER 2010

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 half an hour 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. State variable model is applicable if the system is

(A) Linear and time invariant
(B) Nonlinear and time invariant
(C) MIMO
(D) All of the above

b. If the transfer function of a system is given by $\frac{5}{s^2+4}$, then the system is called

(A) under damped **(B)** undamped
(C) over damped **(D)** critically damped

c. Addition of a zero and pole in the open loop transfer function such that-zero is closer to the origin than the pole then the compensator is called as

(A) Lag compensator **(B)** Lead compensator
(C) Lag lead compensator **(D)** Double lead compensator.

d. The system is characterised by $\frac{6s}{s^4+3s^3+2s^2}$ then the order and type of the system are

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

e. For type 2 system the velocity error coefficient is

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

f. Using Routh stability criterion it is possible to find

(A) System stability
(B) Number of roots on right-hand, left hand and on jw axis of S-plane
(C) Both **(A)** and **(B)**
(D) Exact location of the roots.

g. A point on the real axis lies on the Root locus if the number of OL poles and zeros on the real axis

(A) to the right of this point is odd
(B) to the left of this point is odd
(C) to the right of this point is even
(D) to the left of this point is even

h. In Nyquist stability criterion the system is said to be stable if

(A) P = 0 and N = 0   **(B)** P $\neq$ 0 and Z = 0
(C) Both **(A)** and **(B)**   **(D)** None

i. The pole factor 1/1+jwt has a slope of

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

j. The rise time of unit step response of second order system is given by

(A) $\pi / \omega_n \sqrt{1-\xi^2}$ **(B)** $3/\xi\omega_n$
(C) $\dfrac{\pi-\theta}{\omega_n\sqrt{1-\xi^2}}$ **(D)** $4/\xi\omega_n$

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

Q.2 a. With neat diagram explain input-output configuration of open and closed loop systems. **(8)**

b. For the circuit shown in Fig.1 obtain the transfer function $\dfrac{Vo(s)}{Vi(s)}$ **(8)**

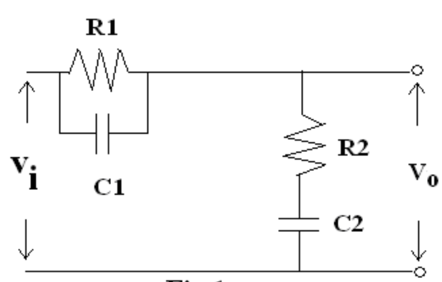

Fig.1

Q.3 a. Using block-diagram reduction rules, find $\dfrac{Y(s)}{R(s)}$ for the block diagram as shown in Fig.2. **(8)**

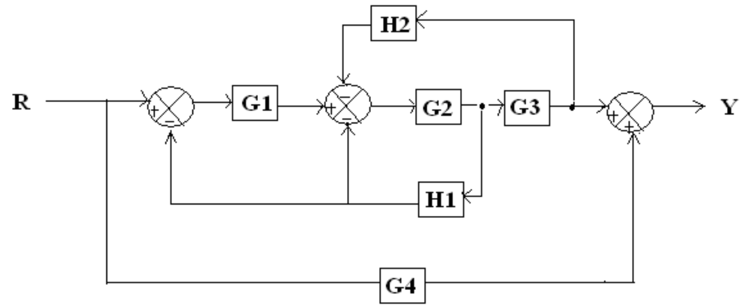

Fig.2

b. Explain **(8)**

Q.4 a. Explain different type of controller. **(9)**

b. Show that high loop gain feedback systems results in
(i) good steady-state tracking accuracy.
(ii) good disturbance signal rejection. **(7)**

Q.5 a. Determine the values of K>0 and a>0, so that the system as shown in Fig.3 oscillates at a frequency 2 rad/sec. **(8)**

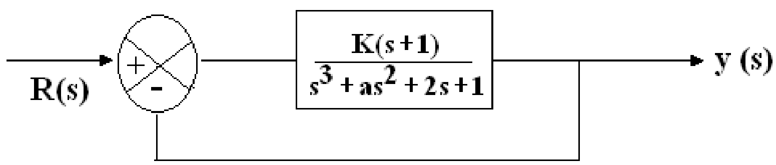

Fig.3

b. Showing neat unit step response of second order system explain following terms:-
(i) peak time
(ii) peak overshoot
(iii) settling time **(8)**

Q.6 a. The open loop transfer function of negative feedback system is given by

$$GH = \frac{K(s+1)}{s^2(s+9)}$$

Sketch the root locus for $0 < K < \infty$ indicating all the relevant points. What do you call such systems? **(12)**

b. Write a note on cascade lead compensation using root locus. **(4)**

Q.7 a. Ascertain the stability of the system with open loop transfer function

$$GH = \frac{250}{s(s+5)(s+10)}$$ using Nyquist stability criterion. **(10)**

b. For the Bode plot shown in Fig.4, obtain the transfer function. **(6)**

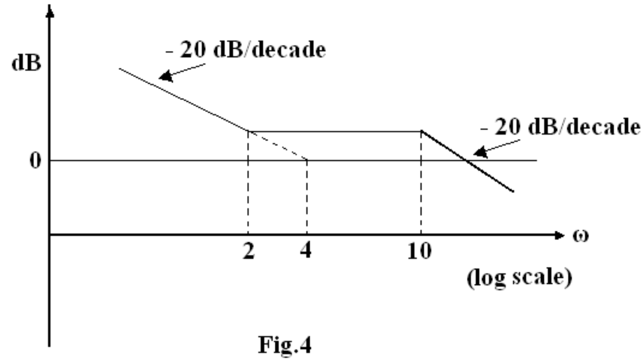

Fig.4

Q.8 The open loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{K}{s^2(0.2s+1)}$$

Compensate the system by Bode plot to meet the following specification

(i) Acceleration error constant, $K_a = 10$

(ii) phase margin $\geq 35^\circ$ **(16)**

Q.9 a. With neat diagram explain the RC-lag network. **(8)**

b. Design an Op-amp lead compensator circuit with transfer function

$$D(s) = \frac{16(s+1)}{(s+6)}$$ **(8)**