ROLL NO. _____

Code: AE11 Subject: CONTROL ENGINEERING

AMIETE – ET (OLD 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. What is the transfer function of a system having a gain factor of g and pole-zero plot as shown in Fig. 1

(A) $\frac{g(s+1)(s+2)(s+3)}{s}$

(B) $\frac{g(s-1)(s-2)(s-3)}{s}$

(C) $\frac{gs(s+1)}{(s+2)(s+3)}$

(D) $\frac{gs}{(s+1)(s+2)(s+3)}$

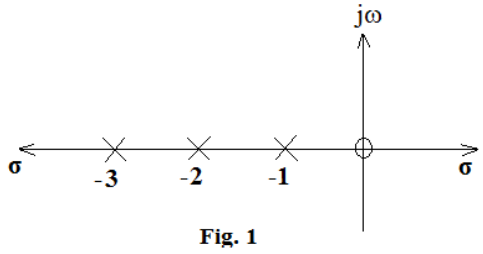

Fig. 1

b. What is the type of system represented by block diagram as shown in Fig. 2

(A) Type '1'
(B) Type '2'
(C) Type '3'
(D) Type '0'

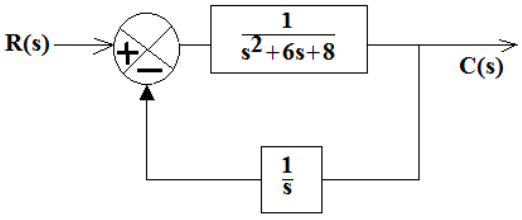

Fig. 2

c. By the use of P-D control to second order system the rise time

(A) Increases **(B)** Decreases
(C) Remains same **(D)** None of the above.

d. The first column of Routh table contains 2, 4, -5, 3. The given system is unstable and number of roots of characteristic equation in right half of s-plane are

(A) One **(B)** Two
(C) Three **(D)** Four

e. The effect of phase lead network (i) velocity constant increases (ii) phase margin increases (iii) Bandwidth increases (iv) The response is slower. The following statements are correct

(A) (i), (ii) and (iii) **(B)** (i), (ii) and (iv)
(C) (ii), (iii) and (iv) **(D)** (i), (iii) and (iv)

f. Which of the following is the transfer function of the root loci as shown in Fig. 3.

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

(B) $\frac{K}{(1+sT_1)(1+sT_2)}$

(C) $\frac{K}{(s+T)^3}$

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

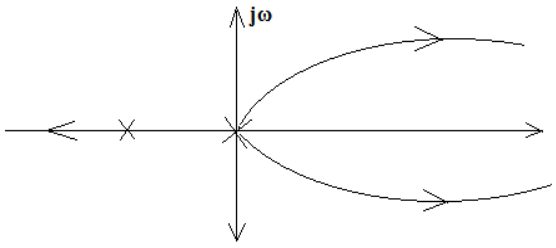

Fig. 3

g. The Nyquist plot shown in Fig.4 indicates

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

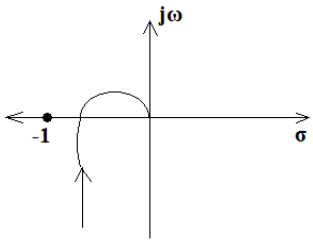

Fig. 4

h. The compensation configurations shown in Fig.5 indicates

(A) Series compensation
(B) Parallel compensation
(C) Feedback compensation
(D) Load compensation

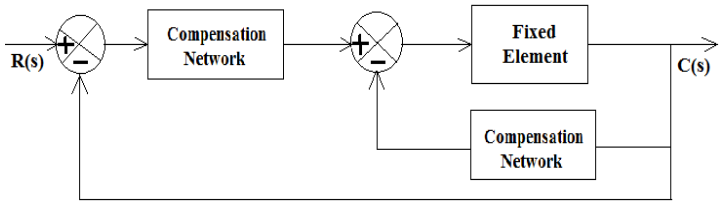

Fig. 5

i. Consider unity feedback control system with open loop transfer function $G(s)=\frac{as+1}{s^2}$. What is the value of 'a' so that the phase margin of 45°

(A) 1 **(B)** ∞
(C) Zero **(D)** 0.84

j. The poles of control system represented by mechanical system as shown in Fig. 6.

(A) –K/D
(B) –D/K
(C) –DK
(D) 0 and –K/D

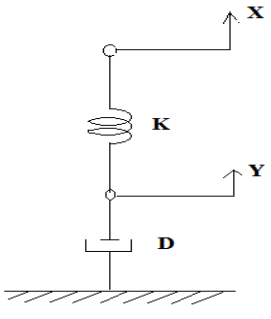

Fig. 6

ROLL NO. _____

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Answer any FIVE Questions out of EIGHT Questions.
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Q.2 a. Determine the transfer function of the Electrical system represented by circuit diagram shown in Fig.7. Also specify order and type of system from transfer function. **(8)**

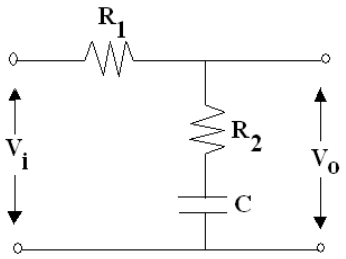

Fig. 7

b. Discuss time response for 1st order system corresponding to (i) Unit step input (ii) Unit Ramp input **(8)**

Q.3 a. Consider the control system represented by block diagram in Fig. 8. Draw the signal flow graph and determine the transfer function using Mason's gain formula. **(8)**

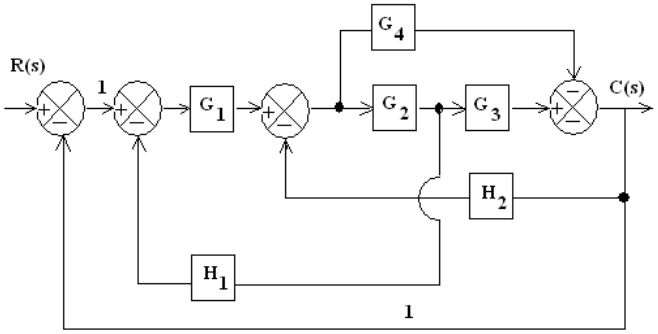

Fig. 8

b. Determine transfer function of armature controlled dc motor. **(8)**

Q.4 a. Discuss effect of feedback on sensitivity of closed loop control system due to (i) variation in G(s) (ii) variation in H(s) **(6)**

b. A closed loop transfer function of control system represented by block diagram as shown in Fig. 9 is $TF = \frac{14}{s^2 + 1.4s + 14}$. By using derivative control (Td.s), the damping ratio is to be made 0.7. Determine value of Td, rise time, peak time, and maximum overshoot with and without derivative control. Assume input signal is unit step. **(10)**

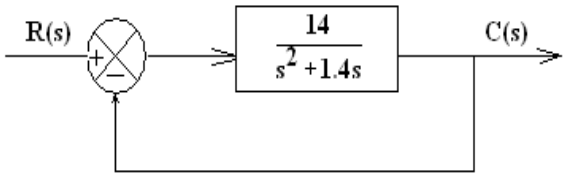

Fig. 9

Q.5 a. A unity feedback system has open loop transfer function $G(s)H(s) = \frac{Ke^{-s}}{s(s^2+5s+9)}$. Determine maximum value of K for the closed loop system to be stable. **(8)**

b. Discuss various static error coefficients. How these coefficients are related to steady state error. **(8)**

Q.6 a. Draw the root locus for unity feedback system which has open loop transfer function $G(s) = \frac{K(s+1)}{s(s-1)}$. (Write all rules which are applicable in this plot). **(10)**

b. Draw the circuit for phase lead network and find its transfer function. **(6)**

Q.7 a. The forward path transfer function of a unity feedback control system is $G(s) = \frac{100}{s(s+6.54)}$. Find (i) Resonance peak (Mr) (ii) Resonant frequency (ω_r) and (iii) bandwidth for the closed loop system **(8)**

b. Draw the Nyquist plot for unity feedback control system with open loop transfer function $G(s) = \frac{Ke^{-s}}{1+s}$. Using Nyquist stability criterion, determine the stability of the closed loop system. **(8)**

Q.8 Plot Bode plot and write effect of the following compensation networks
(i) Phase lead network (ii) Phase lag network **(16)**

Q.9 Explain various methods used for tuning of PID controllers. **(16)**