ROLL NO. _____

Code: AE11 **Subject: CONTROL ENGINEERI**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **JUNE 2012** **Max. Marks: 10**

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. The transfer function of the given block diagram is

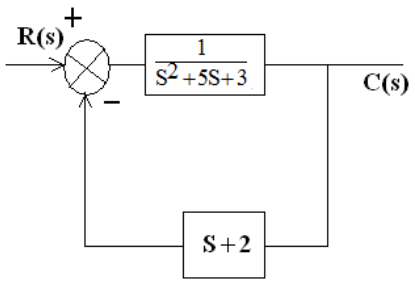


Fig. 1

(A) S^2+5S+3 **(B)** $S+2/S^2+5S+3$
(C) $1/S^2+6S+5$ **(D)** $S^3+7S^2+13S+6/ S+2$

b. The open loop transfer function of system is G(s) H(s)= $\frac{K(s+2)}{s(s+3)(s+4)}$. Its centroid is at s =

(A) –2.5 **(B)** –4
(C) –4.5 **(D)** 0

c. The position error coefficient for $G(s) = 100 (s+2)/s^2$

(A) 0 **(B)** ∞
(C) 100 **(D)** 2

d. Using Routh stability criteria, the system having characteristic equation f(s) is $s^4+ 8s^3+ 18s^2 +16s +5=0$ is _____.

(A) marginal stable **(B)** stable
(C) unstable **(D)** none of these

e. The source of supply for synchro pair is

(A) an inbuilt source of AC supply
(B) an inbuilt source of DC supply
(C) an external source of AC supply
(D) an external source of DC supply

f. The laplace transform of unit step function is

(A) zero **(B)** one
(C) 1/s **(D)** s

g. The effect of LEAD compensation on the system is

(A) It increases the bandwidth and makes the speed response slower
(B) It decreases the bandwidth and makes the speed response faster
(C) It decreases the bandwidth and makes the speed response slower
(D) It increases the bandwidth and makes the speed response faster

h. Integral error compensation is employed in feedback control systems to

(A) improve damping **(B)** improve speed of response
(C) reduce steady state error **(D)** increase the bandwidth

i. A type -1 plant is changed to type -2 feedback system by the following cascade control action:

(A) PD **(B)** PI
(C) Either PD or PI **(D)** Neither PD or PI

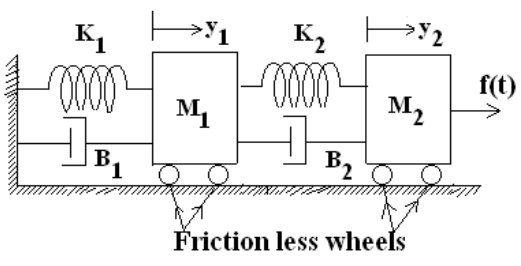
j. In a digital control system, selection of a large sampling period

(A) increases the stability margin
(B) decreases the stability margin
(C) has no effect on stability
(D) effects stability depending upon plant parameters

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

Q.2 a. Explain the reasons for dead-time element in process control loops. Show that dead-time can be represented by the transfer function e^{-st_D}. How do you approximate this transfer function by a rational function? **(8)**

b. Write down the differential equation describing the dynamics of the mechanical system shown in the Fig.2. Draw the electrical equivalent network using force-current analogy. **(8)**



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Q.3 a. Find the transfer function of signal flow graph as shown in Fig.3 using Mason's gain formula. **(8)**

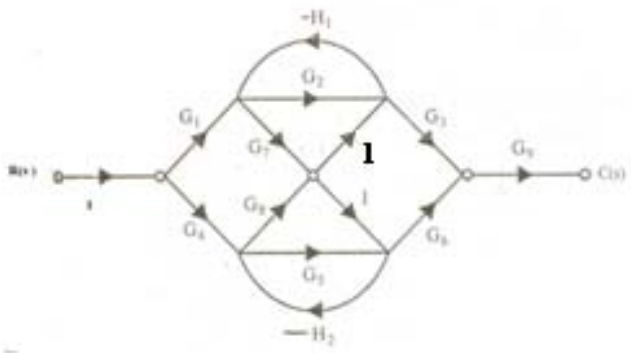

Fig.3

b. Explain working of LVDT with neat schematic diagram. **(8)**

Q.4 a. Comment on the role of positive feedback and negative feedback in closed –loop control configurations. **(6)**

b. Show with the help of examples that introduction of derivative mode of control in feedback system with proportional control makes the system response less oscillatory. What is its effect on steady- state accuracy? **(10)**

Q.5 a. Determine the values of 'K_{mar} and 'P', system is marginally stable and oscillates with frequency 4 rad/sec as shown in Fig.4. **(8)**

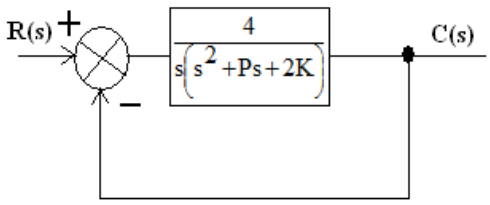

Fig. 4

b. A unity feedback system is characterized by the open loop transfer function $G(s) = \frac{1}{s(0.5s+1)(0.2s+1)}$.

(i) Determine the steady –state errors to unit-step, unit- ramp, and unit parabolic inputs

(ii) Determine rise time, peak time, peak overshoot, and settling time of the unit –step response of the system. **(8)**

Q.6 a. The open loop transfer function of negative feedback system is given by $G(s)H(s) = \frac{K}{s(s+2)(s^2+2s+5)}; K \geq 0$. Draw the root locus for the system indicating all the points. **(8)**

b. The unity feedback system with open loop transfer function is $G(s) = \frac{K}{(\quad)}$.

Design a lead compensator such that the dominant closed loop poles provide damping ratio of $\zeta = 0.5$ and ω_n =4 rad/sec. **(8)**

Q.7 a. Determine the stability of the open loop transfer function $G(s)H(s) = \frac{s+1}{s^2(s-2)}$ using Nyquist criteria. **(8)**

b. Obtain the values of settling time and peak overshoot from the Bode plot of the system having open loop transfer function

$$G(s)H(s) = \frac{0.5e^{-j\omega}}{j\omega(1+j\omega)(1+0.1j\omega)}$$ **(8)**

Q.8 A unity feedback control system has open loop transfer function

$$G(s) = \frac{K}{s(0.1s+1)(0.2s+1)}.$$

The specifications for the system are:

(i) K_v =30

(ii) Phase margin $\geq 40^o$

(iii) Bandwidth = 5 rad/sec.

Design a suitable compensation scheme. **(16)**

Q.9 Write short note on any **TWO**:

(i) Robust control system.

(ii) Advantages of the use of digital computers as compensator device.

(iii) Tuning of PID controller. **(8+8)**