Subject: CONTROL ENGINEERING

Time: 3 Hours **Max. Marks: 100**

JUNE 2011

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. What is not *true* in respect of presence of negative feedback in the system?

(A) increases accuracy **(B)** causes instability
(C) reduces effect of noise **(D)** decreases bandwidth

b. The equation relating the voltage v(t) and current i(t) for $t \geq 0$ for a series RLC circuit with zero current at the time of closure of switch and zero charge on C at t = 0 is given by:

(A) $i(t)(R + \omega L + 1/\omega C) = v(t)$
(B) $Ld^2 i(t)/dt^2 + R\, di/dt + 1/C = dv/dt$
(C) $i(t)\left[R^2 + (\omega L - \omega C)^2\right]^{1/2} = v(t)$
(D) None of the above

c. A temperature control system is known as :

(A) process control system
(B) cascade control system
(C) servomechanism
(D) open loop control system

d. Routh Hurwitz criterion gives the number of:

(A) roots in right half of s-plane
(B) roots in left half of s-plane
(C) roots in right half of s-plane and / or roots on imaginary axis
(D) roots in left half of s-plane and / or roots on imaginary axis

e. A system has transfer function (1 - s) (1 + s). It is known as:

(A) low pass system **(B)** high pass system
(C) band pass system **(D)** all pass system

f. The initial slope of the Bode plot for a type 2 system intersects 0 dB axis at :

(A) $\omega = 0$ **(B)** $\omega = k$
(C) $\omega = k^{1/2}$ **(D)** $\omega = k^2$

g. Given that the transfer function G(s) is $k/(s^2(1+s))$, state the type and order of the system:

(A) 2 and 3 **(B)** 3 and 2
(C) 3 and 3 **(D)** 1 and 3

h. The effect of adding poles and zeroes can be determined quickly by:

(A) Nicholos chart **(B)** Nyquist plot
(C) Bode plot **(D)** Root locus

i. Phase angle of a system is used to specify:

(A) absolute stability **(B)** relative stability
(C) time response **(D)** frequency response

j. The initial slope of the bode plot for a transfer function having no poles at origin is :

(A) – 10 dB / decade **(B)** 0 dB / decade
(C) 10 dB / decade **(D)** 24 dB / decade

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

Q.2 a. With examples, explain open loop & closed loop control systems and analog & digital control systems. **(10)**

b. With the help of a neat block diagram, explain the working of a computer controlled system. Give one typical example of a physical system using computer control. **(6)**

Q.3 a. What are steady state response and transient response of a control system? Give the total response y(t) of the differential equation :
$(d^2y/dt^2) + 3\ dy/dt + 2y = 1$ with initial conditions $y(0) = 0$ and $(dy/dt)_{t=0} = 1$. **(8)**

b. What are poles and zeroes of F(s)? Draw the pole - zero map of F(s) when $F(s) = \left(2s^2 - 2s - 4\right) / \left(s^3 + 5s^2 + 8s + 6\right)$ **(8)**

Q.4 a. What is Routh stability criterion? How is it applied? State the properties of a continuous system transfer function. **(8)**

b. What are the steps involved in evaluating the performance of multiple inputs to a control system? What are the conditions for this evaluation? Explain with a typical example. **(8)**

Q.5 a. What is a signal flow graph, a node and a branch? Explain with suitable diagrams. State and explain the rules of algebra of signal flow graph. **(8)**

b. Draw the signal flow graph for the block diagram given in Fig.1. Find the transfer function using Mason's Gain formula. **(8)**

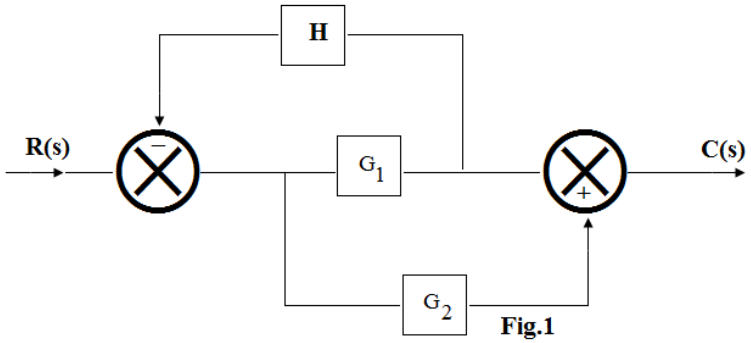

Fig.1

Q.6 a. Give definitions of the sensitivity for the mathematical model T(k), the transfer function of a linear time-invariant system, its magnitude and its phase angle with respect to parameter k. Explain with the help of an example. **(6)**

b. How are the error constants for more general systems related to those of continuous unity feedback systems? Enumerate the design methods for analysis and design of control system. **(10)**

Q.7 a. Sketch the Nyquist Stability Plot for $GH(s) = 1/s^2(s+p), p > 0$. **(10)**

b. State and explain the Nyquist stability criterion. **(6)**

Q.8 a. With a typical example, illustrate the construction of the root-locus for a closed loop continuous system with a given open loop transfer function. **(10)**

b. How will you determine the gain and phase margins from the root- locus **(6)**

Q.9 a. How does a Bode-plot method differ from Nyquist analysis of Control systems? Why logarithmic scale is used for drawing bode plot? **(6)**

b. Give the Bode plot of the transfer function G H(s) = 1/(s+1). **(10)**