



B.E DEGREE EXAMINATIONS : APRIL/ MAY 2016

(Regulation 2013)

Sixth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U13EET602 : Control Systems

(Graph sheet, Polar chart and Semilog sheet will be provided)

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Signal flow graph is a
 - a) Polar graph
 - b) Semi log graph
 - c) Special type of graph for analyzing modern control system
 - d) Topological representation of a set of differential equations
2. In two phase AC servo motor, the speed torque characteristic curve is linear. State True or False
3. The type-1 system has
 - a) no zero at the origin
 - b) no pole at the origin
 - c) simple pole at one origin
 - d) two poles at the origin
4. A system has $\frac{C(S)}{R(S)} = \frac{4}{S^2+4S+4}$ For unit step input the settling time for 2% tolerance band is _____
5. The log magnitude curve for a constant gain K is
 - a) A horizontal straight line
 - b) A horizontal straight line of magnitude $20 \log K$ decibels
 - c) An inclined line having slope K
 - d) An inclined line having slope -K
6. For a stable system, the gain margin is positive and phase margin is negative. State True or False.
7. The technique which gives transient response quickly as well as stability information is
 - a) Routh-Hurwitz criteria
 - b) Nyquist plot
 - c) Root locus plot
 - d) Bode plot
8. The mathematical expression for Nyquist stability criterion is _____
9. A lag compensator
 - a) increases the bandwidth
 - b) increases the speed of response
 - c) improves the steady state accuracy
 - d) increase the system gain at higher frequencies
10. Transfer function of the lead compensator is _____

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

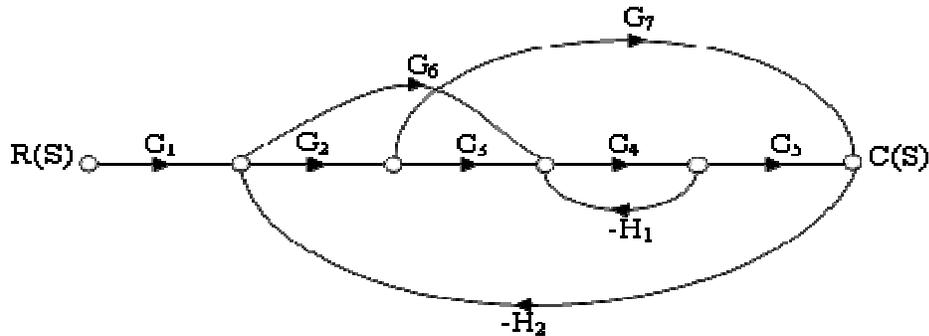
11. What are the analogous quantities for the mechanical elements Force, Mass, Stiffness in Electrical system by considering Force-voltage analogy?
12. List out the applications of servo motor.
13. Name the standard test signals for time response analysis.
14. Write the integral-differential equation of PID controller and its transfer function.
15. The damping ratio and natural frequency of oscillations for second order system is 0.5 and 8rad/sec respectively. Calculate the resonant peak and resonant frequency.
16. What are constant M and N circles?
17. State the necessary conditions for stability.
18. What are the effects of addition of open loop poles?
19. Name the types of compensating networks.
20. Draw the pole zero diagram of lag-lead compensator.

PART C (5 x 14 = 70 Marks)

(Answer not more than 400 words)

Q.No. 21 is Compulsory

21. (i) Using Mason's gain formula, Find the transfer function $C(S)/R(S)$. (10)



- (ii) Derive the transfer function of field controlled DC servo motor. (4)
22. (a) (i) Derive an expression for time response of second order under damped system (7)
when subjected to unit step input.
- (ii) A unity feedback system is characterized by an open loop transfer function (7)
———. Determine the gain K so that the system will have a damping
ratio of 0.5. For this value of K determine settling time, peak over shoot and
peak time for a unit step input.

(OR)

(b) The open loop transfer function of a unity feedback system is

$$G(S) = \frac{100}{s(s+10)}.$$

- (i) Find the static error constants and steady state error of the system when subjected to an input given by $r(t) = P_0 + P_1t + \frac{P_2}{2}t^2$.
- (ii) Find the dynamic error using the dynamic error coefficients.

23. (a) Construct a polar plot for a unity feedback control system has

$G(S) = \frac{40}{s(s+2)(s+5)}$. From the polar plot Find (i) gain margin and (ii) phase margin.

(OR)

(b) Construct the bode plots for a unity feedback control system having

$G(S) = \frac{100}{s(1+0.1s)(1+0.2s)}$. From bode plots determine (i) the phase cross over frequency (ii) gain cross over frequency (iii) gain margin (iv) phase margin. Comment on the stability of the system.

24. (a) The open loop transfer function of a unity feedback control system is given by $G(S) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. By applying Routh criterion, Discuss the stability of closed loop system as a function of K.

(OR)

(b) Sketch the root locus of a system having open loop transfer function

$$G(S) = \frac{K}{s(s+2)(s+4)(s+5)}.$$

25. (a) Explain in detail the design procedure of lead compensator using Bode plot.

(OR)

(b) The open loop transfer function of the uncompensated system

$G(S) = \frac{5}{s(s+2)}$. Design a suitable lag compensator for the system so that the static velocity error constant K_v is 20 sec^{-1} and the phase margin is at least 55° .
