



Register Number:.....

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

Fifth Semester

MECHATRONICS ENGINEERING

MCT109:Control Systems

(Semi log Sheets , polar Sheet and Graph sheets need to be provided)

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

- Which one of the following is an element of mechanical rotational system?
 - Mass
 - Spring
 - Inertia
 - Force
- A path that starts at an input node and ends at output node, and along which no node is transverse more than once is known as
 - Path gain
 - Forward path gain
 - Forward path
 - Individual loop gain
- The increase in Undamped natural frequency with constant damping ratio causes the rise time and settling time to
 - Increase
 - Decrease
 - Be constant
 - Zero
- The steady state error of type 1 system with unit parabolic input is
 - 1
 - Zero
 - 1
 - Infinity
- A system with gain margin close to unity or a phase margin close to zero is
 - Highly stable
 - Oscillatory
 - Relatively stable
 - Unstable
- Polar plot of $G(j\omega) = 1/[j\omega(1+j\omega t)]$
 - Crosses the negative real axis
 - Crosses the negative imaginary axis
 - Crosses the positive imaginary axis
 - Crosses the positive real axis
- The example for critically stable system is
 - RC circuit
 - RL circuit

- c) Pendulum d) LC circuit
8. The damping ratio of a system having the characteristic equation $S^2 + 2S + 8 = 0$ is
- a) 0.353 b) 0.300
 c) 0.330 d) 0.250
9. Which one of the following compensations is adopted for improving transient response of a negative unity feedback system?
- a) Phase lead compensation b) Phase lag compensation
 c) Gain compensation d) Both phase lag compensation and gain compensation
10. Lead compensation means
- a) Adding a dominant Pole b) Adding a pole
 c) Adding a zero d) Adding a dominant zero

PART B (10 x 2 = 20 Marks)

11. The open loop system gain increases by 20%. Calculate the value of the change in the closed loop gain assuming unity feedback.
12. Distinguish between self loop and non touching loop.
13. Determine the damped frequency of oscillation of a second order system having a damping ratio of 0.8 and natural frequency of oscillation of 10 rad/sec.
14. Sketch the response of a second order under damped system.
15. List the advantages of Bode plot.
16. Define phase cross over frequency and gain cross over frequency
17. State the advantages of Nyquist plot.
18. What is centroid? How it is calculated?
19. What is compensation?
20. Draw the typical Bode plots of lag compensator.

PART C (5 x 14 = 70 Marks)

21. a) (i) Write the differential equations governing the mechanical rotational system shown in fig 1. Draw the force-voltage and force-current electrical analogous circuits and verify by writing mesh and node equations.

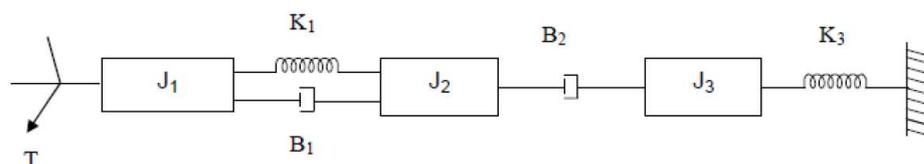


fig.1

(OR)

- b) (i) Describe the working principle of stepper motor with neat sketch the different schemes (8)
- (ii) Summarize the rules for block diagram reduction techniques. (6)

22. a) (i) For a unity feedback control system the open loop transfer function $G(S) = 10(S+2) / S^2 (S+1)$. Find (a) position, velocity and acceleration error constants. (b) the steady state error when the input is $R(S)$ where $R(S) = 3/S - 2/S^2 + 1/3S^3$

(OR)

- b) Derive the expressions for Rise time, Peak time, Peak overshoot, delay time.

23. a) (i) The open loop transfer function of a unity feedback system is given by $G(S) = 1/S^2(1+S)(1+2S)(1+3S)$. Draw the polar plot and determine the gain margin and phase margin

(OR)

- b) (i) Sketch the bode plot for the following transfer function and determine phase margin and gain margin $G(S) = 0.75(1+0.2S) / S (1+0.5S) (1+0.1S)$

24. a) (i) Sketch the root locus plot of a unity feedback system with an open loop transfer function $G(S) = K / S (S+3) (S+5)$. Determine the value of K so that the dominant pair of complex poles of the system has a damping ratio of 0.4.

(OR)

- b) (i) Construct Routh array and determine the stability of the system represented by the characteristics equation $S^7 + 9S^6 + 24S^4 + 24S^3 + 24S^2 + 23S + 15 = 0$.

25. a) (i) Discuss the steps to be followed to design a lead - lag compensator based on bode plot approach.

(OR)

- b) (i) Draw the typical RC lead compensator network and derive the transfer function. Also explain the design procedure of lead compensator with its frequency response curve.
