UNIT II TIME RESPONSE

Unit I PART A

1. **Name the test signals used in control system**

   The commonly used test input signals in control system are impulse, step, ramp, acceleration and sinusoidal signals.

2. **What is step signal?**

   The step signal is a signal whose value changes from zero to A at t= 0 and remains constant at A for t>0.

3. **What is ramp signal?**

   The ramp signal is a signal whose value increases linearly with time from an initial value of zero at t=0. The ramp signal resembles a constant velocity.

4. **What is a parabolic signal?**

   The parabolic signal is a signal whose value varies as a square of time from an initial value of zero at t=0. This parabolic signal represents a constant acceleration input to the signal.

5. **What is transient response?**

   The transient response is the response of the system when the system changes from one state to another.

6. **What is steady state response?**

   The steady state response is the response of the system when it approaches infinity.

7. **cccc**

   The order of a system is the order of the differential equation governing the system. The order of the system can be obtained from the transfer function of the given system.

   The type number is the number of poles at the origin.

8. **Define damping ratio.**

   Damping ratio is defined as the ratio of actual damping to critical damping.

9. **List the time domain specifications.**

   The time domain specifications are

   i. Delay time

   ii. Rise time

   iii. Peak time

   iv. Peak overshoot

10. **Define delay time.**

The time taken for response to reach 50% of final value for the very first time is delay time.

11. Define rise time.

The time taken for response to rise from 0% to 100% for the very first time is rise time.

12. Define peak time.

The time taken for the response to reach the peak value for the first time is peak time.

13. Define peak overshoot.

Peak overshoot is defined as the ratio of maximum peak value measured from the Maxmium value to final value.

14. Define settling time.

Settling time is defined as the time taken by the response to reach and stay within specified error.

15. What is the need for a controller?

The controller is provided to modify the error signal for better control action.

16. What are the different types of controllers?

a. Proportional controller

b. PI controller

c. PD controller

d. PID controller

17. What is proportional controller?

It is a device that produces a control signal which is proportional to the input error signal.

18. What is PI controller?

It is a device that produces a control signal consisting of two terms –one proportional to error signal and the other proportional to the integral of error signal.

19. What is PD controller?

PD controller is a proportional plus derivative controller which produces an output signal consisting of two times -one proportional to error signal and other proportional to the derivative of the signal.

20. What is the significance of integral controller and derivative controller in a PID controller?

The proportional controller stabilizes the gain but produces a steady state error. The integral control reduces or eliminates the steady state error.

21. Why derivative controller is not used in control systems.

The derivative controller produces a control action based on the rate of change of error signal and it does not produce corrective measures for any constant error.

22. What is the disadvantage in proportional controller?

The disadvantage in proportional controller is that it produces a constant steady state error.

23. What is the effect of PD controller on system performance?

The effect of PD controller is to increase the damping ratio of the system and so the peak overshoot is reduced.

24. Why derivative controller is not used in control system?

The derivative controller produces a control action based on rare of change of error signal and it does not produce corrective measures for any constant error. Hence derivative controller is not used in control system

25. What is the effect of PI controller on the system performance?

The PI controller increases the order of the system by one, which results in reducing the steady state error. But the system becomes less stable than the original system.

26. What is steady state error?

The steady state error is the value of error signal e(t) when t tends to infinity.

27. What are static error constants?

The Kp, Kv, and Ka are called static error constants.

28. What is the drawback of static coefficients?

The main drawback of static coefficient is that it does not show the variation of error with time and input should be standard input.

29. What are the three constants associated with a steady state error?

Positional error constant

Velocity error constant

Acceleration error constant

30. What are the main advantages of generalized error co-efficient?

Steady state is function of time.

Steady state can be determined from any type of input

31. What are root loci?

The path taken by the roots of the open loop transfer function when the loop gain is varied from 0 to α are called root loci.

32. What is a dominant pole?

The poles lying close / on the imaginary axis are dominant poles.

33.What are the main significances of root locus?

a. The main root locus technique is used for stability analysis.

b. Using root locus technique the range of values of K, for as table system can be determined

Part b

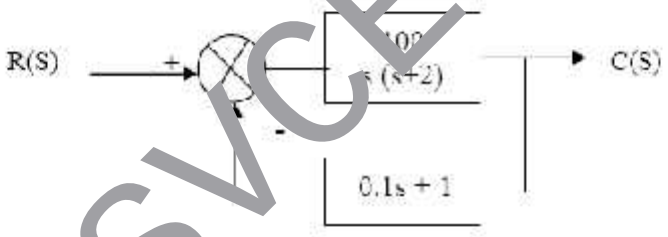
PART B

1.(a) Derive the expressions and draw the response of first order system for unit step input. (8)

(b) Draw the response of second order system for critically damped case and when input is unit step. (8)

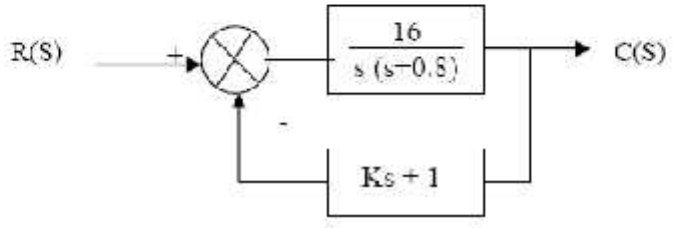
2. Derive the expressions for Rise time, Peak time, Peak overshoot, delay time (16)

3. A positional control system with velocity feedback is shown in fig. What is the response of the system for unit step input. (16)



4. (i) Measurements conducted on a Servomechanism show the system response to be $c(t)=1+0.2\,e^{-60t}-1.2\,e^{-10t}$, when subjected to a unit step. Obtain an expression for closed loop transfer function. (8)

(ii). A positional control system with velocity feedback is shown in fig. What is the response c(t) to the unit step input. Given that $\zeta = 0.5$ and also calculate rise time, peak time, Maximum overshoot and settling time. (8)



5. (i) A unity feedback control system has an open loop transfer function G(S)= 10/S(S+2).Find the rise time, percentage over shoot, peak time and settling time. (8)

(ii) A closed loop servo is represented by the differential equation d^2c/dt^2 +8 dc/dt = 64 e Where c is the displacement of the output shaft r is the displacement of the input shaft and e= r-c.Determine undamped natural frequency, damping ratio and percentage maximum overshoot for unit step input. (8)

6. 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 (16)

7. The open loop transfer function of a servo system with unity feed back system is G(S) = 10/ S(0.1S+1).Evaluate the static error constants of the system. Obtain the steady state error of the system when subjected to an input given Polynomial $r(t) = a_0 + a_1 t + a_2/2\, t^2$ (16)

8. The unity feedback system is characterized by an open loop transfer function is G(S)= K / S(S+10).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 overshoot and time to Peak overshoot for a unit-step input. (16)

9.(i) For a servomechanisms with open loop transfer function(S)=10/(S+2)(S+3).What type of input signal gives constant steady state error and calculate its value. (8)

(ii) Find the static error coefficients for a system whose G(S)H(S)=10/ S(1+S)(1+2S)and also find the steady state error for r(t)=1+ 1 + t^2/2. (8)

10.(i) Obtain the response for unity feedback system whose open loop transfer function is G(S) = 4 / S (S+5) and when the input is unit step. (8)

(ii) A unity feedback system has an amplifier with gain K_A=10 and gain ratio G(S) = 1 / S (S+2) in the feed forward Path .A derivative feedback ,H(S)=S K_D is introduced as a minor loop around G(S).Determine the derivative feed back constant ,K_D ,so that the system damping factor is 0.6 (8)

11.(i) Explain P,PI,PID,PD controllers (8)

(II) Derive the expressions for second order system for under damped case and when the input is unit step. (8)

12.A unity feedback control system has an open loop transfer function G(S)= K / S (S^2+4S+13).Sketch the root locus. (16)

13. Sketch the root locus of the system whose open loop transfer function is

G(S)= K / S (S+2)(S+4).Find the value of K so that the damping ratio of the closed loop system is 0.5 (16)

14. A unity feedback control system has an open loop transfer function $G(S)= K (S+9) / S (S^2+4S+11)$.Sketch the root locus. (16)