Question Bank

Subject: Control Systems

Subject Code: BTEC-504-18

Very Short Answer Type

1. Define an Industrial Control System (ICS)?

2. Give two examples of industrial control systems?

3. What is a transfer function?

4. What is a potentiometer used for in control systems?

5. Define a synchro and its role in control systems?

6. What is an LVDT and where is it used?

7. Differentiate between a DC servomotor and an AC servomotor?

8. What is the function of a tachogenerator in control systems?

9. Define Damping ratio?

10. List the time domain specifications?

11. Define Delay time, Rise time, Peak time, Peak overshoot, Settling time?

12. What are the different types of controllers?

13. What is a closed-loop control system?

14. Draw a basic block diagram of a closed-loop system?

15. What is the importance of signal flow graphs in control systems?

16. Define system stability in control systems?

17. What is steady-state accuracy?

18. Define transient accuracy in control systems?

19. What is disturbance rejection in control systems?

20. Define robustness in control systems?

21. What is a proportional control system?

22. How does an integral control system work?

23. What is derivative control?

24. Explain feedforward control in brief?

25.   What is a multi-loop control system?

26.   Define relative stability?

27.   State Routh's stability criterion?

28.   What do you mean by eigen values and eigen vectors?

29.   Define steady-state error?

30.   What is an error constant in control systems?

31.   What are performance specifications in the time domain?

32.   What is the root locus method?

33.   Define lead compensation?

34.   What is a polar plot?

35.   Define Bode plot?

36.   What does the Nyquist stability criterion state?

37.   What are performance specifications in the frequency domain?

38.   What is the purpose of frequency domain methods in control design?

39.   How is a compensator implemented using an op-amp?

40.   Name the test signals used in control system?

41.   What is a state variable in control systems?

42.   Define controllability in control systems?

43.   What is observability?

44.   What is an optimal control problem?

45.   Define nonlinear control systems?

46.   Define Gain Margin and Phase Margin?

47.   Define Corner frequency?

48.   What are M and N circles?

49.   What is a compensator? List the types of compensators?

50.   What is a dominant pole?

Short Answer Type

1. Explain the classification of industrial control systems with examples?

2. Derive the time response of a first-order system using unit step input?

3. Describe the working principle of a potentiometer in control systems?

4. Explain how a synchro is used in control systems?

5. Describe the working principle of an LVDT with a neat diagram?

6. State the applications of a.c servomotor?

7. Explain the role of tachogenerators in feedback control?

8. Draw and explain the block diagram of a closed-loop system?
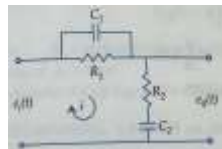
9. Determine the transfer function of Fig. 1?

Fig. 1

10. A mass system under equilibrium condition is shown in Fig. 2. Derive the system equation where M=10 kg; B=30 N/m/sec and K= 20 N/m?
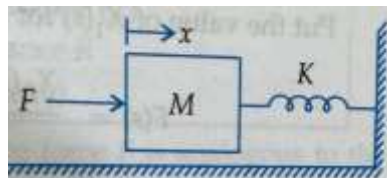

Fig. 2

11. Derive the transfer function of Fig. 3 using block diagram reduction technique?
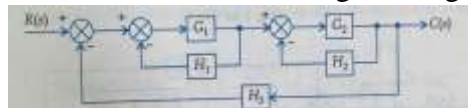

Fig. 3

12. Obtain the transfer function using Mason's gain formula of the signal flow diagram given in Fig. 4?

Fig. 4

13. Explain the concept of stability in control systems?

14. The open loop transfer function of a unity feedback system is given by
$G(S) = \frac{50}{(1+0.1s)(s+10)}$ Determine the static error coefficients K_p, K_v and K_a ?

15. Explain transient response of a First-order system with unit ramp input?

16. Check the stability of the system using the Routh stability criterion whose characteristic equation is given by

$s^5 + 2s^4 + 2s^3 + 4s^2 + 11s + 10 = 0$

17. Explain how proportional controllers affect system performance?

18. Discuss the benefits and limitations of integral controllers?

19. Explain how derivative controllers improve transient response?

20. Compare feedforward and feedback control systems?

21. Using Nyquist criterion investigate the closed loop stability of a control system whose open loop transfer function is given below

$$G(S)H(S) = \frac{K}{s(1+sT_1)(1+sT_2)}$$

22. Sketch the polar plot for $G(S) = \frac{1}{s(s+1)}$?

23. The forward path transfer function of unity feedback system is given by

$G(S) = \frac{K}{s(s+4)(s+5)}$ Sketch the root locus as K varies from zero to infinity?

24. Derive the transfer function for a lead compensator?

25. Explain the principle of lag compensation?

26. Explain the practical implementation of a compensator using an op-amp?

27. Derive the state model of a given control system?

28. Explain the concept of state-space representation in control systems?

29. What is controllability? How is it determined for a system?

30. Explain the concept of observability and its significance?

Long Answer Type

1. Discuss in detail the classification and applications of industrial control systems?

2. Derive the transfer function of a second-order system with unit step input and analyze its response?

3. Compare and contrast different types of servomotors with applications?

4. Sketch the polar plot for $G(S) = \frac{20}{s(s+1)(s+2)}$?

5. Describe the working of a closed-loop system with a practical example?

6. Discuss all the transient response specifications of second order system?

7. Discuss different stability criteria and their significance in control system design?

8. Discuss disturbance rejection, insensitivity, and robustness in control systems?

9. Explain PID controllers and their effect on system performance?

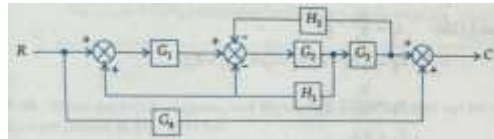10. Obtain the transfer function of the block diagram shown in Fig. 5 using Mason's gain formula?

Fig. 5

11. The open loop transfer function of a servo system with unity feedback is given by

    $G(S) = \frac{10}{(s+2)(s+5)}$ Determine the damping ratio, undamped natural frequency of oscillation. What is the percentage overshoot of the response to a unit step input?

12. The open loop transfer function of a unity feedback system is given by

    $G(S) = \frac{108}{s^2(s+4)(s^2+3s+12)}$ Find the static error coefficients and steady state error of the system when subjected to an input given by

    $$r(t) = 2 + 5t + 2t^2$$

13. By using the Routh stability criterion, determine the stability of the system represented by the following characteristic equation

    $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 16s + 4 = 0$

    If system found to be unstable, determine the number of roots of the characteristic equation in the right half s-plane?

14. Derive error constants and explain their role in system accuracy?

15. Draw the root locus for a system whose open loop transfer function is given by

$G(S)H(S) = \dfrac{K}{s(s+4)(s^2+4s+20)}$ Determine the breakaway point and stability condition?

16. Sketch the Bode plot for the open loop transfer function given

$$G(S)H(S) = \dfrac{1000}{(1+0.1s)(1+0.001s)}$$

Determine i) Gain Margin ii) Phase Margin iii) stability of the system

17. Draw the Bode plot for the open loop transfer function given

$$G(S)H(S) = \dfrac{50}{s(1+0.25s)(1+0.1s)}$$

Determine i) Gain crossover frequency   ii) Phase crossover frequency

     iii) Gain Margin   iv) Phase Margin   v) stability of the system

18. Discuss the following and find the transfer function

i) Thermal System   ii) Pneumatic System

19. Explain state variable formulation and solve a state-space equation?

20. Discuss state-space analysis, controllability, and observability in control systems?