



**B.E DEGREE EXAMINATIONS: MAY 2018**

(Regulation 2015)

Fourth Semester

**ELECTRONICS AND INSTRUMENTATION ENGINEERING**

U15EIT402 : Control Systems

**COURSE OUTCOMES**

- CO1:** Identify the mathematical model and find the transfer function of any system using various techniques such as block diagram reduction, signal flow graph etc.
- CO2:** Analyze the control system performance in time domain
- CO3:** Obtains the open loop and closed-loop frequency responses.
- CO4:** Find the stability of a given control system using frequency domain techniques.
- CO5:** Analyze whether the system is stable or not using various methods like Routh Hurwitz criterion, Root Locus, Bode plot, Nyquist plot.
- CO6:** Design compensators for control systems.

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. Depending on damping ratio, match the second order system classifications.

List I	List II
A. Undamped system	i. $\xi > 1$
B. Under damped system	ii. $\xi = 0$
C. Critically damped system	iii. $0 < \xi < 1$
D. Over damped system	iv. $\xi = 1$

CO2 [K<sub>1</sub>]

- |    |     |     |     |    |  |
|----|-----|-----|-----|----|--|
|    | A   | B   | C   | D  |  |
| a) | ii  | i   | iii | iv |  |
| b) | iii | iv  | ii  | i  |  |
| c) | ii  | iii | iv  | i  |  |
| d) | iii | i   | ii  | iv |  |
2. By which of the following the control action is determined when a man walks along a path? CO1 [K<sub>4</sub>]
- |          |          |
|----------|----------|
| a) Brain | b) Hands |
| c) Legs  | d) Eyes  |
3. For open loop control system, which of the following statement is/are correct? CO1 [K<sub>2</sub>]
1. Less expensive
  2. Recalibration is not required for maintaining the required quality of the input
  3. Construction is simple and maintenance easy
  4. Error are caused by disturbances



- |  |     |                   |
|--|-----|-------------------|
| 12. Define time variant and Time invariant systems.  | CO1 | [K <sub>1</sub> ] |
| 13. For the following transfer function, find the type and order of the system.<br>i) $G(s)H(s) = K / s^2(s+1)(s+2)$ ii) $G(s)H(s) = 10 / s^3(s^2+2s+1)$ | CO2 | [K <sub>2</sub> ] |
| 14. Derivative controller is not used alone in control systems. Justify.   | CO2 | [K <sub>1</sub> ] |
| 15. List the frequency domain methods to find the stability of the system.   | CO3 | [K <sub>2</sub> ] |
| 16. Calculate the corner frequencies for the transfer function $G(s) = 20 / s(1+3s)(1+4s)$   | CO3 | [K <sub>4</sub> ] |
| 17. How the roots of characteristic equation are related to stability?   | CO4 | [K <sub>2</sub> ] |
| 18. Mention the relation between stability and coefficient of characteristic polynomial.   | CO5 | [K <sub>2</sub> ] |
| 19. Define compensating networks. List its types.  | CO6 | [K <sub>1</sub> ] |
| 20. Interpret the observations that are made from the Bode's plot of the lag compensated system.   | CO6 | [K <sub>5</sub> ] |

**Answer any FIVE Questions:-**  
**PART C (5 x 14 = 70 Marks)**  
**(Answer not more than 300 words)**

**Q.No. 21 is Compulsory**

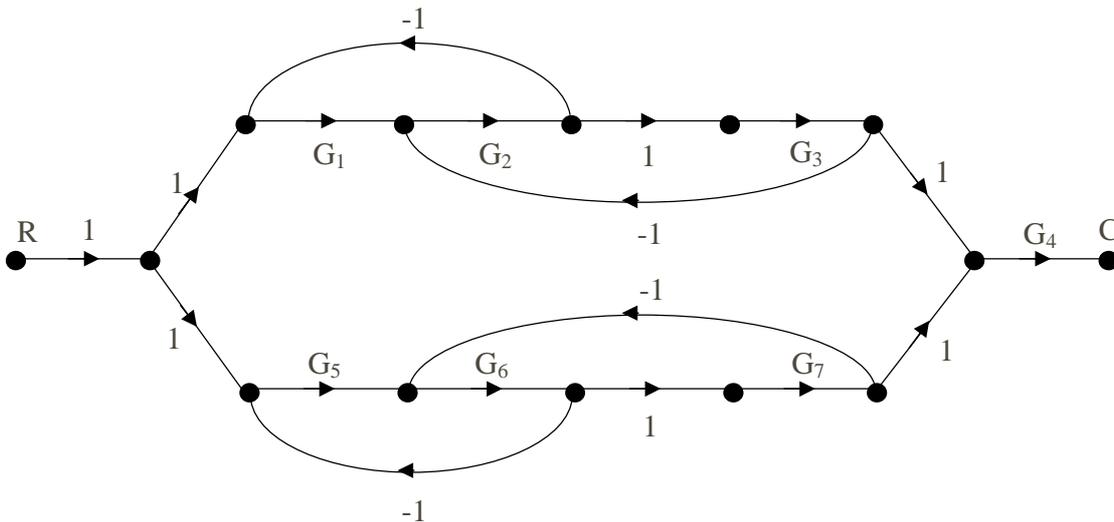
21. Construct bode plot for the system whose open loop transfer function is given below and evaluate
- gain cross over frequency
  - phase crossover frequency

CO3 [K<sub>5</sub>]

$$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$$

22. Develop the transfer function using Mason's Gain formula for the system whose signal flow graph is shown in figure.

CO1 [K<sub>6</sub>]



23. i) The response of a servomechanism is,  $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$  when subject to a unit step input. Obtain an expression for closed loop transfer function. Determine the undamped natural frequency and damping ratio. (7) CO2 [K<sub>2</sub>]

ii) The open loop transfer function of an automatic electric iron box is,

$$G(s) = \frac{10(s+2)}{s^2(s+1)}$$

(7) CO2 [K<sub>2</sub>]

Find, a) The position, velocity and acceleration error constants

b) The steady state error when the input is  $R(s) = \frac{3}{s} - \frac{2}{s^2} - \frac{1}{3s^3}$

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

$$G(s) = \frac{1}{s(1+s)(1+2s)}$$

CO4 [K<sub>3</sub>]

Sketch the polar plot and determine the gain margin and phase margin.

25. Examine the stability of the systems whose characteristic equation are

i)  $9s^5 - 20s^4 + 10s^3 - s^2 - 9s - 10 = 0$

ii)  $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$

CO5 [K<sub>2</sub>]

using Routh Hurwitz criterion. Comment on the location of roots of the characteristic equation.

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

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

CO5 [K<sub>2</sub>]

27. Describe the procedure of lag compensator using bode plot with an example.

CO6 [K<sub>1</sub>]

\*\*\*\*\*