Sr. No. OR.7502

**December 2023**

**B.Tech. (EL)- Vth SEMESTER**

**Control Systems (ELPC502)**

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| **Time: 3 Hours** | **Max. Marks:75** |

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| **Instructions:** | **1.** | *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.* |
| | **2.** | *Answer any four questions from Part -B in detail.* |
| | **3.** | *Different sub-parts of a question are to be attempted adjacent to each other.* |
| | **4.** | *May ask for semilog paper, graph sheet etc. from the Invigilator.* |

## PART -A

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| Q1 | (a) | Does y = mx + c represent a linear or non-linear system (wherein x, y are input & output variables resp.)? Reason out your answer. | (1.5) |
| | (b) | State the benefits of feedback. Is it always useful? | (1.5) |
| | (c) | State the Initial Value Theorem. What is its use? | (1.5) |
| | (d) | Define settling time ($t_s$). Is mere entry the first time into the tolerance band the only criterion for defining $t_s$? | (1.5) |
| | (e) | Define gain margin. Is it a time-domain specification? | (1.5) |
| | (f) | Define loop gain (for the purpose of signal flow graph algebra). | (1.5) |
| | (g) | Can derivative action alone be used? If not, why not? | (1.5) |
| | (h) | Define eigen values. How, if it all, these are related to characteristic equation? | (1.5) |
| | (i) | What do you mean by ISE performance criterion? Is it better than a single time domain specification, say, rise time? | (1.5) |
| | (j) | What do you mean by stability? | (1.5) |

## PART -B

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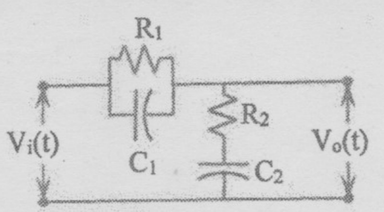
| Q2 | (a) | Determine the transfer function of the electrical network given in Fig.1:   Fig.1: Electrical Network | (11) |
| | (b) | What, if any, are the advantages of Open-Loop systems? | (4) |
| Q3 | (a) | Derive an expression for time response of first-order system to unit ramp input. Plot both the input & the output versus time. What are the initial & final slopes of the output curve? | (8) |
| | (b) | Comment upon the stability of the system with the characteristic eqn. as: $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ | (7) |
| Q4 | | Sketch the root locus plot of a unity feedback system with an open loop transfer function as G(s) = K/{s(s+2)(s+4)}. Also find the range of values of K for which the | (15) |

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| | | system has damped oscillations. What is the greatest value of K which can be used before continuous oscillations occur? Determine the frequency of continuous oscillations as well. | |
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| Q5 | (a) | Is Nyquist plot plotted for the loop transfer function or for the closed loop transfer function? Does it assess the stability of closed-loop system or of the open loop system? | (2) |
| | (b) | Draw the Bode Plot for the transfer function: $64(s+2)/\{s(s+0.5)(s^2+3.2s+64)\}$ | (13) |
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| Q6 | (a) | What is the role of lag compensation in design of controlled systems? What does it improve? Where can the compensator pole be placed? | (8) |
| | (b) | What exactly is improved by P, I & D control actions? Which part/ aspect of the response is not affected by each of these actions? | (7) |
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| Q7 | (a) | Discuss the concepts of controllability & observability. | (8) |
| | (b) | Distinguish between regulator & tracking problems? Is transfer function definable for nonlinear systems? | (7) |
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