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| 1. **Linear Control System** | | | | | | | | | | | |
| **Contact Hours** | | | Modeling of electrical, mechanical and biological control systems, Open and closed-loop systems, Block diagrams. Second order systems. Step and impulse response. Performance criteria. Steady state error. Sensitivity, s-plane system stability. Analysis and design with the root loci method. Frequency domain analysis, Bode plots, Nyquist criterion, gain and phase margins, Nichols charts. The State-space method, state equations, flow graphs, Stability, compensation techniques. Simulation and Controller design using MATLAB. | | | | | **Credit Hours:** | | | |
| Theory | | **48** | Theory | | **03** | |
| Practical | | **48** | Practical | | **01** | |
| **Total** | | **96** | **Total** | | **04** | |
| **SUGGESTED COURSE LEARNING OUTCOMES:**  Upon successful completion of the course, the student will be able to: | | | | | | | | | | | |
| **S. No** | **CLO** | | | | | | **Domain** | **Taxonomy Level** | **PLO** | | |
| **1** | Develop a mathematical model using input/output Differential equations, Transfer Functions and State Space for Linear Time Invariant electrical and mechanical systems. | | | | | | Cognitive | **3** | **2** | | |
| **2** | Analyze the stability of Linear Time Invariant complex engineering systems using Routh’s Criteria, Root Locus, Bode plots and State Space analysis. | | | | | | Cognitive | **3** | **2** | | |
| **3** | Design a compensator to achieve desired closed loop response for a system using, Root Locus, Bode plots and State Space. | | | | | | Cognitive | **5** | **3** | | |
| **4** | Use Matlab and Simulink for modeling and simulation of complex engineering systems. | | | | | | Psychomotor | **2** | **5** | | |
| **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**  The course is designed so that students will achieve the following PLOs: | | | | | | | | | | | |
| **1** | Engineering Knowledge: | | |  | **7** | Environment and Sustainability: | | | | |  |
| **2** | Problem Analysis: | | | **√** | **8** | Ethics: | | | | |  |
| **3** | Design/Development of Solutions: | | | **√** | **9** | Individual and Team Work: | | | | |  |
| **4** | Investigation: | | |  | **10** | Communication: | | | | |  |
| **5** | Modern Tool Usage: | | | **√** | **11** | Project Management: | | | | |  |
| **6** | The Engineer and Society: | | |  | **12** | Lifelong Learning: | | | | |  |
| **Course outline:**  Modeling of electrical, mechanical and biological control systems, Open and closed-loop systems, Block diagrams. Second order systems. Step and impulse response. Performance criteria. Steady state error. Sensitivity, s-plane system stability. Analysis and design with the root loci method. Frequency domain analysis, Bode plots, Nyquist criterion, gain and phase margins, Nichols charts. The State-space method, state equations, flow graphs, Stability, compensation techniques. Simulation and Controller design using MATLAB.    **Note:**Practical work is based on the above theoretical course.    **Recommended Books:**   1. Katsushiko, Ogata, “Modern Control Engineering,” McGraw-Hill, `5th edition 2. R. C.Dorf and R. H. Bishop, “Modern Control Systems,” 12th edition 3. B.C. Kuo, “Automatic Control Systems” 7th edition | | | | | | | | | | | |