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| **22EE504** | | **CONTROL SYSTEMS**  (Font type: Times New Roman, Font size:11, Style :Bold letters in UPPER case) | **3** | **1** | **0** | **4** |
| **Course Objectives** *(Times New Roman,11 font size, Bold letters in Capitalize Each Word)* | | | | | | |
| Each course contains 3 to 6 course objectives  *(Times New Roman,11 font size, Sentence case)*   * To understand the basic concepts of open loop and closed loop control systems. * To analyse the given system in time domain. * To understand the concept of frequency domain analysis * To understand the concept of stability of system * To design the compensator for different control systems | | | | | | |
| **Programme Outcomes (POs)** *(Times New Roman,11 font size, Bold letters in Capitalize Each Word)* | | | | | | |
| Indicate only mapped Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) of the respective course.  *(Times New Roman,11 font size, Sentence case)*   |  |  | | --- | --- | | PO1 | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. | | PO2 | **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences | | PO3 | **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. | | PO4 | **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. | | PSO1 | Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems | | PSO2 | Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society | | | | | | | |
| **Course Outcomes (COs)** (Font type: Times New Roman, font size:11, Style :Bold letters in Capitalize Each Word) | | | | | | |
| The students will be able to *(Times New Roman,11 font size, Sentence case)*   |  |  | | --- | --- | | **CO1** | Develop a mathematical model of a physical system and compute the transfer function usingBlock diagram reduction technique and Signal flow graph. | | **CO2** | Analyze the performance of first and second order system and compute the steady state error fordifferent test signals. | | **CO3** | Analyze the frequency response of a given system. | | **CO4** | Examine the stability of a given system using various methods. | | **CO5** | Design a lag, lead and lag lead compensator for open loop system and examine a system usingstate variable techniques. | | | | | | | |
| **Articulation Matrix** (Font type: Times New Roman, font size:9, Style :Bold letters in Capitalize Each Word)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CO.**  **No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | | 1 | 3 | 3 | 1 | 3 |  |  |  |  |  |  |  |  | 2 | 1 | | 2 | 3 | 3 |  | 2 |  |  |  |  |  |  |  |  | 2 | 2 | | 3 | 3 | 3 |  | 3 |  |  |  |  |  |  |  |  | 1 | 2 | | 4 | 3 | 3 |  | 3 |  |  |  |  |  |  |  |  | 2 | 1 | | 5 | 3 | 3 | 1 | 3 |  |  |  |  |  |  |  |  | 2 | 2 | | | | | | | |
| **UNIT I** | **MATHEMATICAL MODEL OF PHYSICAL SYSTEMS** (Font type: Cambria, size: 10, Style: *Bold letters in* UPPER case) | | **10 Hours** | | | |
| *Syllabus content  (Font type : Times New Roman, size: 11 ,Style: normal letters in Sentence case)*  Introduction- Basic Elements of control Systems-Open loop and closed loop system - Elements of Control system - Transfer function of mechanical translational and rotational system, electrical system - Electrical analogy of mechanical system - Block diagram reduction technique - Signal flow graph. | | | | | | |
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| **UNIT II** | **TIME DOMAIN ANALYSIS** (Font type: Cambria, size: 10, Style: *Bold letters in* UPPER case) | | **8 Hours** | | | |
| Standard test signals - Time response of first order and second order systems for unit step test signals - Time domain Specifications-Steady state response - Static error constants - steady state error - Effects of proportional derivative, proportional integral systems. | | | | | | |
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| **UNIT III** | **FREQUENCY DOMAIN ANALYSIS** (Font type: Cambria, size: 10, Style: *Bold letters in* UPPER case) | | **9 Hours** | | | |
| Frequency response of systems - Frequency domain specifications - Correlation between frequency domain and time domain specifications - Bode plot, Polar plot | | | | | | |
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| **UNIT IV** | **STABILITY ANALYSIS OF CONTROL SYSTEM**(Font type: Cambria, size: 10, Style: *Bold letters in* UPPER case) | | **9 Hours** | | | |
| Concepts of stability - Necessary conditions for Stability-Characteristics equation - Location of roots inS plane for stability - Routh Hurwitz criterion-Nyquist stability criterion- Root Locus technique- Relative Stability | | | | | | |
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| **UNIT V** | **COMPENSATOR DESIGN** (Font type: Cambria, size: 10, Style: *Bold letters in* UPPER case) | | **9 Hours** | | | |
| Compensators, Deign of Lag compensator - Lead compensator - Lag-lead compensator (using Bode plot) - Concept of state, state variable, state model, Controllability and observability | | | | | | |
| (Times New Roman, 11)**Tutorial** | | | **15 Hours** | | | |
| (Times New Roman, 11)**Total** | | | **60 Hours** | | | |
| **References**(Font type: Cambria, size: 10, Style: *Bold letters in Sentence* case) | | | | | | |
| *(Font type: Times New Roman, size: 11)*   1. I.J.Nagrath and M.Gopal, Control System Engineering, NewAge International Publisher,2018 2. M.Gopal, Control System Principles and Design, TataMcGraw-Hill,2012. 3. K.Ogatta, Modern Control Engineering, Pearson Education, NewDelhi, 2015 4. BenjaminC. Kuo, Automatic Control Systems, Prentice-Hall of India Pvt. Ltd.2014 5. M.N.Bandyopadhyay, Control Engineering Theory and Practice, 9thEdition, John Wiley & Sons, 2006. 6. https://archive.nptel.ac.in/courses/107/106/107106081/ | | | | | | |