**Department: Computer System Engineering**

**B.E 8th Semester**

**Semester: Fall 2022 Course**

**Subject: Control Engineering**

**Code: EE-201**

**Credit Hours: 3+1**

**Course Teacher: Dr. Wazir Muhammad (Asst. Professor)**

**Mode: Physical 16 Weeks**

**Linked SDG: 4 (Quality Education)**

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| **CLO No** | **CLO** | **Domain** | **PLO** | **WK** |
|  | **Describe** the basics of control system and its industrial application | C3 | 2 | 4 |
|  | **Interpret** transfer function and state space model of the physical systems | C3 | 3 | 4 |
|  | **Describe** routh-hurwitz method, root locus method and frequency the stability of the system by using domain techniques frequency | C4 | 3 | 4 |
|  | **Operate** MATLAB-SIMULINK to analyze system response by applying different inputs (step, ramp, impulse etc.) to the third and higher level systems | C4 | 5 | 4 |

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| **Weekly Lecture breakup** | | | |
| **Week** | **Topics** | **CLO No** | **PLO** |
| 1 | * Overview regarding OBE System * Course Introduction * Discussion about course design, CLOs, relationship with PLOs, Cognitive Domains and Knowledge Profile   Introduction to Control Engineering   * Basics of control system * Open-loop and closed-loop control systems * Block diagram terminology * Example of system for block diagrams * Signal flow graphs | 1 | 1 |
| 2 | * Types of Control System * Open-loop systems and its applications in various fields engineering * Closed-loop control systems its applications in various fields engineering | 1 | 1 |
| 3 | * Terminologies used in Control Engineering * Measures of performance * Comparison of Open-loop systems and Closed-loop control systems | 1 | 1 |
| 4 | **Dynamic System modeling:**   * Mechanical Translational Systems * Mechanical Rotational Systems | 1 | 1 |
| 5 | * Numerical and Problems related to * Mechanical Translational Systems   **Assignment # 1** | 1 | 1 |
| 6 | * Electrical Active Systems * Electrical Passive Systems * Electromechanical Systems | 3 | 1 |
| 7 | * Conversion of Electrical System to Equivalent Mechanical Systems and vice versa, * Thermal system * Fluid systems | 3 | 5 |
| 8 | * **Sessional Test # 1** | 3 | 5 |
| **Midterm Examination** | | | |
| **9** | **Laplace Transforms and Transfer Function**   * Mason Gain Formula to find transfer function * Mason’s formula application of electrical and mechanical systems * Development of nodal equations from signal flow graph * Development of signal flow graph from nodal equations | 3 | 5 |
| 10 | State Space Formulation   * State space formulation from differential equations, * State Space formulation from block diagram and signal flow graphs, * Control and Observer Canonical form of block diagrams and state space * Types of inputs like impulse, step, ramp and sinusoidal input * Solution of state space for different responses, * System linearization and its applications   **Assignment # 2 given as Complex Engineering Problem (CEP)** | 2 | 3 |
| 11 | Time Response of 1st and 2nd Order System   * Time response of the 1st and 2nd order systems (impulse, step, ramp etc.) * Time response characteristics, Frequency response of 1st and 2nd order systems * Time response of higher order systems | 2 | 3 |
| 12 | Study of System Stability   * Introduction to stability, * Poles and Zeros concept, * Ruth-Hurwitz stability criteria * Ruth-Hurwitz stability criteria applications, * Concept of Root-Locus | 2 | 3 |
| 13 | **Root Locus Design**   * Root Locus design * System stability by pole placement, * Compensator Design (Lead and Lag Compensator) * Design of PID Controller (P, PI and PID Controllers) * Different PID Controller Tuning method | 3 | 5 |
| 14 | **Sessional Test # 2** |  |  |
| 15 | Introduction to frequency plots, Bode Plots, System Stability using Bode Plots | 3 | 5 |
| 16 | Hands-on practice on Matlab R2017 | 1,2,3 | 1,3,5 |
| **Final Examination** | | (1,2,3) |  |