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| **University of Management & Technology**School of Science & TechnologyDepartment of Electrical Engineeringlogo |
| EE 324 Control systems |
| **Pre-requisite** | **Linear Algebra, Differential Equations, Signals and Systems** |
| **Instructors** | **Jameel Ahmad;** **jameel.ahmad@umt.edu.pk** **Farhan Iqbal;** **farhan.iqbal@umt.edu.pk****Asif Hussain;** **asif.hussain@umt.edu.pk** **Muhammad Ilyas Khan;** **ilyas.khan@umt.edu.pk** |
| **Course****Objectives** | * To introduce modeling concepts in electrical and no-electrical domains.
* Application of Laplace transform to solve dynamic circuits/systems and obtaining the transfer function.
* To analyze dynamic systems and study their transient behavior.
* To study and analyze feedback control systems and to determine their stability and steady state behavior.
* To study, design and analyze feedback systems in time and frequency domain using root-locus, Bode’s and Nyquist plots and.
* To introduce state space design paradigm and its link with classical techniques.
* To develop command on the use of Matlab/Simulink to analyze feedback systems.

The course directly contributes to **objectives** a, d, e and f of the HEC Electrical Engineering Curriculum. |
| **Expected** **Outcomes** | In accordance with **HEC curriculum** outcomes a, b, d, e, g, h & i, upon completion of this course, students will understand:* The difference between open loop and closed-loop systems
* Laplace transform method, Transfer function of a system
* Transient and Steady state response
* Root-locus Analysis and Design
* Frequency-Response Analysis and Design using Bode and Nyquist Plots
* States Space Modeling and analysis.
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| **Textbook(s)****Reference:** | **Feedback Control Of Dynamic Systems**, Gene F. Franklin, 5/E, Pearson Education**Control Systems Engineering** , Norman S. Nise, 6th edition, Wiley Dec 2010 |
| **Grading Policy** | * Assignments & Quizzes: **20%**, Lab: **20%**
* Midterm: **20%,** Final Exam: **40%**
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**Course Schedule**

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| **Lectures** | **Topics** | **Textbook(TB)/****Reference(Ref) Readings** |
| 01-02 | **Overview:*** Introduction and Motivation to Control Systems; Basic types of control systems.
 | 1.1-1.2 |
| 03-05 | **Dynamic Models:*** Models of Electric circuits, Electromechanical systems and Heat-flow systems.
* Solution of first and second order differential equations; transient and study state part of the solution; interpretation of time constant, damping ratio and natural frequency.
 | 2.1-2.3 and handouts |
| 06-10 | **Dynamic Responses:*** Review of Laplace Transforms and its application to solution of differential equations.
* Transfer function, System Modeling Diagrams and block diagram reduction techniques. Effect of Pole Locations. Time-Domain Specifications. Effects of Zeros and Additional Poles.
* Stability and Routh’s stability criterion.
 | 3.1-3.5 and handouts |
| 11-14 | **Basic Properties of Feedback.** * The basic equations of control.
* Control of study state error.
* PID control.
 | 4.1-4.3 |
| **Mid-Term Exam (8th Week)** |
| 17-20 | **The Root-Locus Design Method.*** Root locus of basic feedback systems.
* Sketching Root-Locus; selected root loci.
* Design using dynamic compensation.
 | 5.1-5.5 |
| 21-24 | **The Frequency-Response Design Method.*** Frequency response and sketching Bode’s plots.
* Nyquist stability criterion and stability margins.
* Closed loop frequency-response.
 | 6.1-6.6 |
| 25-28 | **State Space Design.*** Advantages of state space.
* State space modeling.
* Analysis of state equations
 | 7.1-7.4 |
| 29-30 | **Course review.** |  |
| **End Term Exam ( 16th Week)** |