



## University of Mosul College of Engineering Mechatronics Department



### Control Lab

#### About the Laboratory:

This laboratory aims at studying and analyzing various groups of control systems. The Third stage experiments are designed to study and analyze the linear control systems in time domain as well as studying the use of the proportional – integral - derivative (PID) controller. as well as students study the nature of linear or time-varying systems using the frequency and phase domains. The fourth stage experiments are designed to study and analyze different systems that contain some non-measurable variables. In addition, the experiments aim at designing various controllers using the method of field variables that express the system. Other classes, such as Fuzzy Logic and studying system estimator types, are also given in this laboratory within the Engineering Design subject for the fourth-year students. The laboratory provides weekly classes with a total of 8 hours per week and 20 students per class.

#### Laboratory Vision and Objectives:

##### The laboratory vision is:

1. To make the Control Laboratory within the distinguished and leading laboratories in the field of controlling various electronic systems.
2. To prepare engineering cadres capable of facing various problems and obstacles in the work field and in the control field.

##### The Laboratory objective is:

1. To provide students with the basics of knowledge in the process of controlling electronic systems and conducting different methods in the control process.
2. To prepare qualified engineers to build modern control algorithms.

3. This laboratory prepares qualified engineers to work on the restoration of the economic and industrial sector in the city of Mosul, as well as contribute to the social cohesion in the city.

*The Department of Mechatronics can hold a seminar for its graduates by hosting a group of employers in the private sector and representatives of foreign companies. The aim of the seminar is to present a set of ideas to create job opportunities for graduates with the support of those companies in terms of ideas and transfer of expertise to them.*

### Control laboratory experiments

#### **1- First Experiment: Introduction to Matlab**

**Objectives:** To study MATLAB Desktop Tools, Expressions, Matrices and Arrays.

**Practical of Experiment:** MATLAB program.

#### **2- Second Experiment: Transfer Function and Converting Between System Representations**

**Objectives:**

- State space to transfer function
- Transfer function to state space
- State space to zero/pole and transfer function to zero/pole
- Pole/zero to state space and pole/zero to transfer function
- Combining models

**Practical of Experiment:** MATLAB program.

#### **3- Third Experiment: State space analysis**

**Objectives:**

- State space representation
- Controllability matrix

- Observability matrix
- Canonical realizations

**Practical of Experiment:** MATLAB program.

**4- Fourth Experiment:** Step Response and Steady-State Error In Matlab

**Objectives:** Study the Step response in Matlab and Steady-state errors

**Practical of Experiment:** MATLAB program.

**5- Fifth Experiment: First Order System Analysis**

**Objectives:** To study open and close loop system using MATLAB.

**Practical of Experiment:** MATLAB program.

**6- Sixth Experiment:** Second Order System Analysis

**Objectives:** To study step response of second order closed loop system and determine the dynamics characteristics  $M_p$ ,  $T_p$ ,  $T_s$ ,  $T_r$ ,  $e_s$ .

**Practical of Experiment:** MATLAB program.

**7- Seventh Experiment:** Closed-Loop Control System using PID Controller

**Objectives:** To study step response of second order closed loop system using PID Controller

**Practical of Experiment:** MATLAB program.

**8- Eighth Experiment: Root-Locus**

**Objectives:** To locate the closed loop poles in s-plane, to investigate the closed loop system stability.

**Practical of Experiment:** MATLAB program.

**9- Ninth Experiment: : Effect of the Addition of Poles and Zeros on the open loop transfer function**

**Objectives:** Study effect of adding poles and zeros on the resultant output response.

**Practical of Experiment:** MATLAB program.

**10- Tenth Experiment:** Transfer Function of a DC Motor

**Objectives:** To determine the transfer function of a DC motor. Interaction between mechanical and electrical quantities of a motor.

**Practical of Experiment:** MATLAB program.

**11- Eleventh Experiment:** Simulation of a DC Motor Position Controller

**Objectives:** Build a DC motor and test different types of PID parameters for better response.

**Practical of Experiment:** MATLAB program.

**12- Twelfth Experiment:** Frequency Response Analysis

**Objectives:** Carry out open loop frequency response test on a given system and illustrate how to find phase and gain margins using bode plot.

**Practical of Experiment:** MATLAB program.

**13- Thirteenth Experiment:** Time and Frequency Response

**Objectives:** Study the relation between transient and frequency response of a second order closed-loop system.

**Practical of Experiment:** MATLAB program.

**14- Fourteenth Experiment:** Bode Plot

**Objectives:** Study frequency response analysis by using bode plot algorithm and investigate closed-loop stability.

**Practical of Experiment:** MATLAB program.

**15- Fifteenth Experiment:** Effect of the Addition of Poles and Zeros on the Root-Locus Plot

**Objectives:** Study effect of adding poles and zeros on the resultant output root-locus shaping, also the effect on time response.

**Practical of Experiment:** MATLAB program.