Philadelphia University
Mechatronics Engineering Department
Faculty of Engineering
First Semester 2021/2022

Course Syllabus	
Course Title	**Digital Control**
Course Number	**0640441**
Class Time	**12:45-14:15 Sun/Tues**
Instructor	**Dr. Ahmad Jobran Al-Mahasneh**
email	**amahasneh@philadelphia.edu.jo**
website	**https://www.philadelphia.edu.jo/academics/amahasneh/**
Prerequisites	**Automatic Control; Microcontroller Systems**
Office Hours	**11.30 - 12.30 Sun/ Tues Mon/Wed 10.00-11.00 Office E406**
Text Book	**Microcontroller Based Applied Digital Control by Dogan Ibrahim, Wiley, 2006.**
References	**1- Discrete-time control systems Katsuhiko Ogata 2nd edition.** **2- Digital Control Engineering Analysis and Design, Second Edition, by M. Sami Fadali and Antonio Visioli, 2013.** **3- Digital Control of Dynamic Systems by Franklin, Powel, and Workman, 3rd edition. Addison-Wesley Publisher, 1997.** **4- Digital Control Systems: Design, Identification, and Implementation by Landau and Zito. Springer, 2006.**

Course Description:

This course provides the students with the needed background for analyzing, designing, and implementing digital controllers. Emphasize will be given to real-time control of mechatronic systems.

Course Objectives:

- Analyze and solve mathematical problems related to digital control theory.
- Understand the basic concepts of digital control theory.
- Analyze the response of closed-loop systems.
- Design digital controllers.
- Program and simulate digital controllers using MATLAB.
- Program digital controller algorithms using microcontrollers.

Course Academic Calendar	
Week #	Subject
Week 1	Introduction
Week 2	Concepts of discrete control systems.
Week 3	Sampling theory, quantization, and quantization error.
Week 4	Analog to digital and digital to analog conversion, Digital signals and coding.
Week 5	Sampled and Hold device, Mathematical model, Laplace transform of discrete signals.
Week 6	Laplace transform of discrete signals, Fourier transform.
Week 7	The sampling frequency, Reconstruction of sampling signal, Z-O-H.
Mid exam	
Week 8	Discrete-time systems, Transform methods, Z-transform, Properties of Z-transform
Week 9	Relation between s-plane and z-planes, Mapping method, Z- Transfer function for open-loop system.
Week 10	Z-Transfer function for closed- loop system, Characteristic equation q(z), Determination of T.Fs using MATLAB.
Week 11	Stability analysis techniques, Routh Hurwitz criterion for digital systems, Jury stability test.
Week 12	Root-Locus in z-plane of digital control system, Asymptotes, Break away point, The gain parameter.
Week 13	Stability in frequency domain, Nyquist stability criterion, Mapping of counters.
Week 14	Frequency response and Bode plot.
Week 15	Building and simulating of digital control systems using MATLAB.
Final exam	

Course Learning Outcomes with reference to ABET Student Outcomes:

Upon successful completion of this course, student should:

1.	Understand fundamentals of discrete-data systems by applying principles of engineering and mathematics.	[1]
2.	Study the discrete-time system operation based on Z-transform.	[1]
4.	Design and analyse digital control systems for different engineering applications using MATLAB.	[6]

Assessment Instruments

Evaluation of students' performance (final grade) will be based on the following three categories:

- **Mid Exam:** Mid exam will cover the first half of the material.

- **Homeworks and quizzes:** two homeworks and quizzes before and after the mid exam. Quizzes will cover the material discussed during the previous lectures.
- **Final Exam**: The final exam will cover all the class material.

Allocation of Marks	
Mid exam	30%
Homework and quizzes	30%
Final Exam	40%

Attendance policy:

The semester has in total 45 credit hours. Total absence hours from classes and tutorials must not exceed 15% of the total credit hours. Exceeding this limit without a medical or emergency excuse approved by the deanship will prohibit the student from sitting the final exam and a zero mark will be recorded for the course.