

University: Benha University
Faculty: Faculty of Engineering at Shoubra
Department offering the program: Electrical Engineering Department
Department offering the course: Computer Engineering Program

1- Course Data

Course Code & Title: ECE312C Control Systems (1) **Semester/Year:** First / 2021-2022
Specialization: Third Year Computer Engineering
Contact Hours: 5 **Lecture:** 3 **Practical/Practice:** 2

2- Course Aims

The aim of this course is to provide students with the basic knowledge and skills to model different systems and obtain their pulse transfer functions. Moreover, Analyze the discrete response for 2nd order systems and Design appropriate PID controller. Describe discrete control systems using state-space techniques. Finally, Judge the stability of discrete control systems using Jury method.

3- Course Contents (As indicated in the program Bylaw)

Introduction of control systems and feedback systems concepts, Modeling of discrete-time systems using difference equations and the Z-transform, Samples of test signals, State-space analysis, Time-response of control systems, Control systems stability, Digital controller design.

4- Program Competences Served by The Course (A2, B2 and B4)

Level (A) Engineering Competencies

On completing this course, students will be able to:

A.2 Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

Level (B) Electrical Engineering Competencies

At the end of this course, the students will be able to:

B.2 Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.

B.4 Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation and evaluate its suitability for a specific application.

5- Learning Outcomes (LO's)

At the end of the course, the student will be able to:

Cognitive Domain	
LO1	Calculate the pulse transfer function for open-loop and closed-loop discrete systems.
LO2	Check the performance of LTI discrete control system by its transient response and steady-state error.
LO3	Discuss the LTI discrete control system stability by Jury criterion
Psychomotor Domain	
LO4	Select the proper state variables to obtain the dynamic equation of LTI discrete system and its state transition matrix and/or state transition equation. (Matlab Application)
LO5	Design the proper PID controller to meet specific time-domain specifications of LTI discrete system (Matlab Application)

Affective Domain

LO6 Display a professional commitment to ethical practice when solving your assignments.

6- Mapping Learning Outcomes (LO's) with competences

LO's \ NARS	A2	B2	B4
Cognitive Domain			
LO1		■	
LO2			■
LO3		■	
Psychomotor Domain			
LO4			■
LO5	■		
Affective Domain			
LO6	■	■	■

7- Lecture Plan

a) Topics to be Covered weekly & Matrix of LO's

Week	Topics	Planned Hours	Learning Outcomes					
			LO1 B2-1	LO2 B4-2	LO3 B2-3	LO4 B4-4	LO5 A2-5	LO6
1	- Quality requirements for the course - Introduction to control systems	5	■		■		■	
2	-Z Transform and its properties, -Inverse Z Transform, -Mapping from S-plane to Z-plane,	5						■
3	-Zero-order hold (ZOH) and samplers, - Block Diagram Representation, - Calculation the pulse Transfer Function (PTF)	5	■					■
4	Solution of difference equation,	5		■				■
5	-Open-loop DLTI systems with ZOH - Closed-loop DLTI systems with ZOH	5		■				
6	-Time domain analysis of DLTI systems, -Parameter's calculation of transient response	5		■				■
7	-Closed-loop DLTI with digital PID controllers - Tuning PID controller parameters (Matlab)	5					■	
8	Error coefficients at step, ramp, and parabolic inputs	5		■				
9	Calculation of Steady-State Error for unity & non-unity feedback systems	5		■				■
10	-The Concept of Stability -The Stability Criterion using Bilinear transformation	5			■			
11	-The Stability Criterion using Jury test -Design the range of system gain for stability	5			■			■
12	- State and output equations of DLTI systems - Controllable canonical form - Observable canonical form	5				■		
13	- Diagonal canonical form - Jordan canonical form -T. F. from the dynamic equation	5				■		■
14	- Solving Discrete-time state equation - State Transition Matrix - State Transition Equation	5				■		

b) Additional private study/learning hours expected for students per week is **FOUR** hours

8- Teaching and Learning Methods

Learning Outcomes		Teaching and Learning Methods									
		Face-to-face Lecture	Online Lectures	Tutorial / Exercise	Group Discussions	Laboratory	Self-Reading	Presentation	Collaborate Learning (Team Project)	Research and Reporting	Brain Storming
Cognitive Domain	LO1	❖		❖						❖	❖
	LO2	❖		❖	❖					❖	❖
	LO3	❖		❖						❖	
Psychomotor Domain	LO4	❖		❖			❖			❖	
	LO5	❖		❖	❖		❖	❖	❖	❖	
Affective Domain	LO6				❖		❖				❖

Student Academic Counseling and Support

- Students are directed to contact teaching staff for academic support during specific office hours.
- Regarding this course, Instructor and TA will be available two hours a week as indicated on the timetable declared for students from the beginning of the semester.
- A WhatsApp group as well as E-learning website are created where students can attend online lecture / tutorial, ask questions and share files with teaching staff. Moreover, these groups are used to announce the student marks, changes to the timetable, exam days ...etc.
- There are no disabled students in the programs, so no special support is needed.

9- Student Assessment

a- Student Assessment Methods

Learning Outcomes		Assessment Methods*									
		Written Exams	Online Exams	Lab Exam	Pop Quizzes	In-class Problem Solving	Take-Home Exam	Research Assignments	Reporting Assignments	Project Assignments	In-class Questions
Cognitive Domain	LO1	●			●	●			●		●
	LO2	●			●	●			●		●
	LO3	●				●			●		
Psychomotor Domain	LO4	●			●	●		●			
	LO5	●				●				●	
Affective Domain	LO6	●				●		●			●

*There is one formative assessment (written Exam), and all other assessments are summative.

b- Assessment Schedule and Weight

Assessment	Week	Weight
Midterm Examination	7	20
Final Examination	(As Schedule)	80
Quizzes (3 times)	5, 10	5
Home assignments, and Reports	4, 11	5
Mini Project	8	15
Total		125

10- Facilities

The following facilities are needed for this course:

- | | | |
|---|---|---|
| <input checked="" type="checkbox"/> Classroom | <input type="checkbox"/> Smart Board | <input type="checkbox"/> Computer with software |
| <input type="checkbox"/> Lecture Hall | <input checked="" type="checkbox"/> White Board | <input checked="" type="checkbox"/> MIS system |
| <input type="checkbox"/> Sound and Microphone | <input checked="" type="checkbox"/> Data Show | <input checked="" type="checkbox"/> Internet Access |
| <input type="checkbox"/> Other: | | |

11- List of References

a- Course Notes

Lectures Notes in PDF

<https://bu.edu.eg/staff/mohamedselmy3-courses/18430> (to be updated)

b- Books

1. M. Sami Fadali, Antonio Visioli. **Digital Control Engineering: Analysis and Design**, Academic Press (Elsevier), 3rd Edition, 2020.
2. Anastasia Veloni, Nikolaos Miridakis. **Digital Control Systems: Theoretical Problems and Simulation Tools**, CRC Press, Taylor & Francis Group, 2018.
3. F. Golnaraghi and B. C. Kuo, “**Automatic control Systems**”, 10th ed., John Wiley & Sons, Inc. 2017.
4. Andrea Bacciotti, “**Stability and Control of Linear Systems**” Volume 185, Springer, 2019

c- Recommended Books

1. R. C. Dorf and R. H. Bishop, “**Modern Control Systems**”, Addison-Wesley, 11th Edition, 2014.
2. Liuping Wang, “**PID Control System Design and Automatic Tuning Using Matlab/Simulink**” Wiley Online Library, February 2020.
<https://onlinelibrary-wileycom.mplbci.ekb.eg/doi/10.1002/9781119469414>

d- Course websites

<https://bu.edu.eg/staff/mohamedselmy3-courses/18430> (to be updated)

<https://elearning.bu.edu.eg/> (to be updated)

- **Course Coordinator:** Dr. Ahmed M. Hussein / Dr. Mohamed Salah Selmy **Signature:**

- **Program Coordinator:** Assoc. Prof. Lamia Al-Refaee **Signature:**