Republic of Yemen

Ministry of Higher Education & Scientific Research

21 SEPTEMBER UNIVERSITY for MEDICALS & APPLIEED

SCIENCES

Faculty of

Engineering and Computer

Department of Biomedical Engineering

Course Specification of

Biomedical signals processing

Course No. (07.02.721)

2022/2023

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

I. Course Identification and General Information:					
1	Course Title:	Biomedical signals processing			
2	Course Code & Number:	07.02.721			
3	Credit Hours:	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
		3	2	--	1
4	Study Level/ Semester at which this Course is offered:	3 Level / 2 Semester			
5	Pre –Requisite (if any):	Math 3, Computer principles and programming,			
6	Co –Requisite (if any):	N/A			
7	Program (s) in which the Course is Offered:	Biomedical Engineering Technology			
8	Language of Teaching the Course:	English			
9	Study System:	Regular (semester)			
10	Mode of Delivery:				
11	Location of Teaching the Course:	University Campus			
12	Prepared by:	Dr. AMMAR ALI ALI ABDU			
13	Date of Approval:				

II. Course Description:

We use daily equipment's in which the signals are stored and treated digitally. Medical signal processing (MSP) is the mathematical manipulation of a discrete-domain information signal to modify or improve it in some way.

This course introduces the techniques of modern digital signal processing that are fundamental to a wide variety of application areas (e.g. Biomedical signals systems).

This course will cover introduction to discrete linear systems, discrete-time Fourier transform and

Linear time invariant systems, the Z transform, sampling and quantization , the discrete Fourier transform, properties of digital filters, finite impulse response (FIR) filters and infinite impulse response (HR)filters.

III. Course Intended Learning Outcomes (CILOs) : (مخرجات تعلم المقرر)		Referenced PILOs (مخرجات تعلم البرنامج)	
A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:			
a1	Identify applications of digital signal processing and how this is used in modern biomedical equipment's.	A1	Explain the appropriate models, theories, mathematical foundations, and techniques related to biomedical engineering technology context.
a2	Demonstrate and represent real world signals digital format and understand transform-domain representation of the signals.	A4	Clarify the biomedical devices maintenance principles and how these are important for solving biomedical devices and equipment's problems in health environment.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:			
b1	Formulate biomedical engineering problems in terms of MSP tasks.	B2	Analyze the impacts of problems related to the Biomedical equipments and its solution principles in a creative manner by
b2	Analyze digital and analog signals and compare different signal		

	processing strategies.		using a systematic and analytical thinking methods.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:			
c1	Apply basic math , science, and engineering to process signals analytically and numerically using MATLAB.	**C1**	Relate integrally knowledge of life science, biomedical engineering technology practice concepts, principles of engineering and techniques evaluation to solve problems relevant to biomedical engineering.
c2	Use computers and MATLAB program to create, analyze and process signals, and to simulate and analyze systems sound and image synthesis and analysis.	**C2**	Evaluate an engineering technique, modern analytical tools and required computer programs to analyzing and solve the problems of medical devices.
D. Transferable Skills: Upon successful completion of the course, students will be able to:			
d1	Work effectively as an individual and as a member of a team.	**D1**	Function effectively as an individual, team member, or leader in activities relevant to biomedical engineering, and collaborating to achieve a shared objective.

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1	Identify applications of digital signal processing and how this is used in modern biomedical equipment's.	▪ Lectures ▪ Discussion ▪ Assignment ▪ Self-learning	▪ Written Exam and quizzes. ▪ Observations. ▪ Reports evaluation.
a2	Demonstrate and represent real world.		

(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1	Formulate biomedical engineering problems in terms of MSP tasks.	▪ Exercises and problems solving. ▪ Discussion. ▪ Assignment. ▪ Discussion. ▪ Lab experiment.	▪ Written Exam and quizzes. ▪ Observations. ▪ Reports evaluation.
b2	Analyze digital and analog signals and system compare different signal processing strategies.		
b3	Evaluate systems in terms of general quality attributes and possible tradeoffs presented within the given problem.		

(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1	Apply basic math , science, and engineering to process signals analytically and numerically using MATLAB	▪ Lab experiments ▪ Discussion. ▪ Training at computer labs(Simulation)	▪ Reports evaluation. ▪ Observations.
c2	Use computers and MATLAB program to create, analyze and process signals, and to simulate and analyze systems sound and image synthesis and analysis.		

(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies

d1	Work effectively as an individual and as a member of a team.	▪ Small group discussion	▪ Presentation

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction to MSP and discrete linear system.	– Discrete time signals. – Application of MSP – Special sequences – Shift invariance	1	2	a1,a2
2	Introduction to MSP and discrete linear system.	– Stability and causality. – Impulse response. – Deference equation.	2	2	a1,a2
3	Discrete time Fourier transform and Linear time invariant systems	– Transform definition. – Theorems. – Frequency response of linear time invariant systems.	3	2	a1,a2,b1 ,b2,c1
4	Discrete time Fourier transform and Linear time invariant systems	– Phase and group delays – MATLAB computation….	4	2	a1,a2,b1 ,b2,c1
5	The Z transform	– Z transform by summation of left ,right, and tow-sided sequences.	5	2	a1,a2,b1 ,b2,c1

		– Regions of conference and Z transform properties. – Inverse Z transform.			
6	**Sampling**	- Fourier transform review. - Sampling continuous-time signals : Sampling theorem.	6	2	a1,a2,b1 ,b2,c1
7	**Quantization**	– Aliasing, – Re- Sampling digital signals. – Quantization.	7	2	a1,a2,b1 ,b2,c1
8	Mid-Term Theoretical Exam	– All previous topics	8	2	-
9	**The Discrete Fourier transform**	– Definition of DFT and relation to Z transform. – . Properties of the DFT. Linear and periodic convolution using the DFT – Zero padding spectral leakage, resolution and windowing in the DFT	9	2	a1,a2,b1 ,b2,c1
10	**Properties of digital filters**	– Averaging filter. – Recursive smoother. – First-order unity gain resonator.	10	2	b1,b2,c1 ,c2
11	**Properties of digital filters**	– Second-order unity gain resonator.	11	2	b1,b2,c1 ,c2

		– All-pass filters. – Equalization filters.			
12	**Finite impulse response (FIR) filters**	– Window design techniques. – Kaiser window design technique. – Equiripple approximations.	12	2	b1,b2,c1 ,c2
13	**Infinite impulse response (HR) filters**	– Bilinear transform method.	13	2	b1,b2,c1 ,c2
14	**Infinite impulse response (HR) filters**	– Examples of bilinear transform method	14	2	b1,b2,c1 ,c2
15	**Review**	From unites from 1 to 10	15	2	b1,b2,c1 ,c2
16	**Final Theoretical Exam**	All topics	16	2	-
Number of Weeks /and Units Per Semester			**16**	**32**	

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Laboratory Initialization and Rules and Matlab overview.	1	2	a1,a2 ,b1,b2, c1,c2,d1
2	Discrete and Continuous-Time Signals.	2	4	
3	Discrete-Time Signals	2	4	
4	Frequency Analysis	1	2	
5	Sampling and Reconstruction	2	4	
6	Digital filter Design	2	4	
7	DFT and FFT	2	4	
Number of Weeks /and Units Per Semester		**12**	**24**	

V. Teaching Strategies of the Course:

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

- Lectures
- Discussion
- Assignment
- Self-learning
- Lab experiments
- Training at computer labs(Simulation)
- Small group discussion

VI. Assessment Methods of the Course:

- Written tests (mid and final terms Exam and quizzes(.
- Class discussion.
- Presentation

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Discrete Time Fourier Transform	4	2.5	a2
2	Digital filters	12	2.5	b1,b2
Total			5	

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Attendance for lectures	weekly	7	7%	a1,a2,b1,b2,c1,c2

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2	Homework / Tasks /Assignments	4,12	5	5%	a1,a2,b1,b2,c1,c2,d1
3	Quiz 1	6	1.5	1.5%	a1,a2,b1,b2,c1
4	Midterm Exam	8	15	15%	a1,a2,b1,b2,c1,c2
5	Quiz 2	14	1.5	1.5%	a1,a2,b1,b2,c1
6	Labs	1,2,...14	20	20%	a1,a2,b1,b2,c1,c2
7	Final Exam	16	50	50%	a1,a2,b1,b2,c1,c2,d1
Total			100	100%	

IX. Learning Resources:

1- Required Textbook(s) (maximum two)

1- *John G. Proakis and Dimitris G.* Manolakis ,(2007).**Digital Signal Processing : Principles, Algorithms ,and Applications , 4th edition , Pearson Education , ISBN: 0-13-228731-5.**

2- *Oppenheim A, Schafer R ,and Buck* **J,(1999), Discrete-Time Signal Processing ,3rd Edition ,Prentice Hall.**

2- Essential References:

1- E.W.Kamen,B.S.Heck ,(2000),Fundamentals of signals and System Using Matlab ,Prentice Hall.

2- McClellan,Shafer,and Yoder, (2003),Signals Processing First,1ST Edition, Prentice Hall

3- Electronic Materials and Web Sites etc.:

Websites:

- Simulation program: MATLAB.

X. Course Policies: (Based on the Uniform Students' By law (2007) تترك كما هي

1	**Class Attendance:** Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds (15 without excuses 25% with excuses).
2	**Tardiness:** A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	**Exam Attendance/Punctuality:** No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	**Assignments & Projects:** Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.

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5	**Cheating:** Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	**Forgery and Impersonation:** Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	**Other policies:** The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.

Second Part of Course Specification

Faculty of Medical Technology

Department of Biomedical Engineering Technology

Course Specification of

Biomedical signals processing

Course No. (07.02.721)

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

Biomedical signals processing

Course No. (07.02.732)

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member:	Dr. Ammar Ali Ali Abdu						
Location& Telephone No.:	Sanaa - 775207752						
E-mail:	dr.ammar.ali2018@gmail.com	SAT	SUN	MON	TUE	WED	THU
Office Hours							

2020/2021

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

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			Lecture	**Exercise**	
		3	2	--	1
4	**Study Level/ Semester at which this Course is offered:**	**3** Level / **2** Semester			
5	**Pre –Requisite (if any):**	Math 3, Computer principles and programming,			
6	**Co –Requisite (if any):**	N/A			
7	**Program (s) in which the Course is Offered:**	Bachelor in Biomedical Engineering Technology			
8	**Language of Teaching the Course:**	English			
9	**Study System:**	Regular (semester)			
10	**Mode of Delivery:**				
11	**Location of Teaching the Course:**	University Campus			
12	**Prepared by:**	Dr. Ammar Ali Ali			
13	**Date of Approval:**				

II. Course Description:

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III. Course Intended Learning Outcomes (CILOs) :(مخرجات تعلم المقرر)

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a1	Identify applications of digital signal processing and how this is used in modern biomedical equipment's.
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IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
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2	Introduction to MSP and discrete linear system.	– Stability and causality. – Impulse response. – Deference equation.	2	2
3	Discrete time Fourier transform and Linear time invariant systems	– Transform definition. – Theorems. – Frequency response of linear time invariant systems. –	3	2
4	Discrete time Fourier transform and Linear time invariant systems	– Phase and group delays – MATLAB computation….	4	2
5	The Z	– Z transform by summation of left ,right,	5	2

	transform	and tow-sided sequences. – Regions of conference and Z transform properties. – Inverse Z transform.		
6	Sampling	- Fourier transform review. - Sampling continuous-time signals : Sampling theorem.	6	2
7	Quantization	– Aliasing, – Re- Sampling digital signals. – Quantization.	7	2
8	Mid-Term Theoretical Exam	– All previous topics	8	2
9	The Discrete Fourier transform	– Definition of DFT and relation to Z transform. – . Properties of the DFT. Linear and periodic convolution using the DFT – Zero padding spectral leakage, resolution and windowing in the – DFT	9	2
10	Properties of digital filters	– Averaging filter. – Recursive smoother. – First-order unity gain resonator.	10	2
11	Properties of digital filters	– Second-order unity gain resonator. – All-pass filters. – Equalization filters.	11	2

12	**Finite impulse response (FIR) filters**	– Window design techniques. – Kaiser window design technique. Equiripple approximations.	12	2
13	**Infinite impulse response (HR) filters**	– Bilinear transform method.	13	2
14	**Infinite impulse response (HR) filters**	Examples of bilinear transform method	14	2
15	**Review**	From unites from 1 to 10	15	2
16	**Final Theoretical Exam**	All topics	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
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V. Teaching Strategies of the Course:

– Lectures
– Discussion

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- Assignment
- Self-learning
- Lab experiments
- Training at computer labs(Simulation)
- Small group discussion

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- Presentation

VII. Assignments:

No.	Assignments	Week Due	Mark
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Total			5

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2	Homework / Tasks /Assignments	4,12	5	5%
3	Quiz 1	6	1.5	1.5%
4	Midterm Exam	8	15	15%
5	Quiz 2	14	1.5	1.5%
6	Labs	1,2,...14	20	20%

7	Final Exam	16	50	50%
Total			100	100%

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1- Required Textbook(s) (maximum two): مثال example

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