



Republic of Yemen

Ministry of Higher Education & Scientific Research
Council of Academic Accreditation & Quality



Assurance of Higher Education (CAQA)

21 September University for medical and Applied Science

Faculty of Engineering and Computer
Department of Biomedical Engineering
Program of Biomedical Engineering

Course Specification of
Biomedical Signal Processing
Course Code. (07.12.721)

2024



T4: This Template is Developed and Approved by CAQA-Yemen, 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

I. General Information:

1.	Course Title:	Biomedical signal Processing				
2.	Course Code:	07.12.721				
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial /Seminar	Lab	Clinical
		3	2	--	2	--
4.	Level/ Semester at which this Course is offered:	4 th Level / 2 nd Semester				
5.	Pre –Requisite (if any):	07.12.706				
6.	Co –Requisite (if any):	07.12.719				
7.	Program (s) in which the Course is Offered:	Bachelor of Biomedical Engineering				
8.	Language of Teaching the Course:	English/Arabic				
9.	Location of Teaching the Course:	Faculty of Medical Technology				
10.	Prepared by:	Dr. Ammar Sharaf Al-deen				
11.	Date and Number of Approval by Council:					

II. Course Description:

This course covers the application of digital signal processing to biomedical problems. Labview or Matlab, a graphical programming language common in engineering, is used for both signal acquisition and processing. Applications include analysis of the electrocardiogram and other electrical signals generated by the body.

III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:		Referenced PILOs		
A. Knowledge and Understanding:		I, P or M/A		
a1	Understand the fundamental principles of signal processing and system analysis.	I	A4	Understand an examples of a biomedical engineering technology concept and methods related to

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				maintenance, measurement techniques, programming, creative engineering solutions, analytical skills, applied to healthcare quality and problems of medical devices issues.
B. Intellectual Skills:				
b1	Use the basic science as math, engineering and science to interpret data.	P	B1	Use the basic science, mathematical theories, engineering principles to analyze the problems of devices and/or processes relevant to biomedical engineering fields.
b2	Apply knowledge of math, engineering and science to understand the principle of biomedical signal processing.	P	B4	Apply the principles of biomedical devices maintenance and its various methods to work professionally in biomedical engineering field.
C. Professional and Practical Skills:				
c1	Evaluate how to apply specific mathematical techniques to solve problems in the areas of biomedical signals.	P	C2	Evaluate an engineering technique, modern analytical tools and required computer programs to analyzing and solve the problems of medical devices.
c2	Develop an understanding of and develop the skills necessary to communicate findings and interpretations in an effective laboratory report.	P	C3	Develop an engineering approach, engineering equipment, instruments to maintenance and conduct experiments, and present results in the biomedical engineering practice.

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D. Transferable Skills:				
d1	Work and communicate effectively with peers on multi-disciplinary teams to attain a common goal.	M/A	D1	Function effectively as an individual, team member, or leader in activities relevant to biomedical engineering, and collaborating to achieve a shared objective.
I= Introduced, P=Practiced or M/A= Mastered/Advanced				

(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	Understand the fundamental principles of signal processing and system analysis.	<ul style="list-style-type: none"> - Interactive lectures - Discussions - Laboratory Exercises - Self-learning 	<ul style="list-style-type: none"> - Final theoretical exam - Quizzes - Mid-term theoretical exam - Homework, and laboratory reports.
a2	Understand the fundamental principles of digital signal processing in particular, Fourier Series, Fourier Transforms, FIR, Frequency Response, and Sampling.		
(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1	Use the basic science as math, engineering and science to interpret data.	<ul style="list-style-type: none"> - Interactive lectures - Discussions - Problem-based learning - Laboratory Exercises - Self-learning 	<ul style="list-style-type: none"> - Final theoretical exam - Quizzes - Final practical exam - Mid-term theoretical exam
b2	Apply knowledge of math, engineering and science to understand the principle of biomedical signal		

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	processing.		<ul style="list-style-type: none"> Laboratory reports and lab teamwork.
(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	Evaluate how to apply specific mathematical techniques to solve problems in the areas of biomedical signals.	<ul style="list-style-type: none"> Interactive lectures Laboratory Exercises Simulation exercises 	<ul style="list-style-type: none"> Final theoretical exam Final practical exam Homework, and laboratory reports.
c2	Develop an understanding of and develop the skills necessary to communicate findings and interpretations in an effective laboratory report.		
(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 and communicate effectively with peers on multi-disciplinary teams to attain a common goal.	<ul style="list-style-type: none"> Laboratory Exercises Collaborative problem-solving exercises 	<ul style="list-style-type: none"> Laboratory reports and lab teamwork.

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction to Signal and Systems	Chapters 1: <ul style="list-style-type: none"> Mathematical Representation of Signals Mathematical Representation 	1 st	2	a1

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
		of Systems – Systems as Building Blocks			
2	Sinusoids	Chapter 2: – Review of Sine and Cosine Functions – Sinusoidal Signals – Sampling and Plotting Sinusoids.	2 nd	2	a1, b1
3	Sinusoids	Chapter 2: – Complex Exponentials and Phasors. – Phasor Addition – Time Signals	3 ^{ed}	2	a1, b1
4	Spectrum	Chapter 3: – The Spectrum of a Sum of Sinusoids – Sinusoidal Amplitude Modulation – Operations on the Spectrum – Periodic Waveforms	4 th	2	a1, b1, b2, c1
5	Spectrum	Chapter 3: – Fourier Series – Time–Frequency Spectrum – Frequency Modulation: Chirp Signals	5 th	2	a1, b1, c1
6	Sampling and Aliasing	Chapter 4: – Sampling – Spectrum View of Sampling and Reconstruction – Discrete-to-Continuous Conversion – The Sampling Theorem – Strobe Demonstration	6 th	2	a1, a2, b1, b2
7	Mid-Term Theoretical Exam	– All previous topics	7 th	2	a1, a2, b1, b2, c1
8	FIR Filters	Chapter 5: – Discrete-Time Systems – The Running-Average Filter – The General FIR Filter – The Unit Impulse Response and Convolution.	8 th	2	a2, b1, b2, c1

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
9	FIR Filters	Chapter 5: – Implementation of FIR Filters – Linear Time-Invariant (LTI) Systems – Convolution and LTI Systems – Cascaded LTI Systems	9 th	2	a2, b1, c1, c2
10	Frequency Response of FIR Filters	Chapter 6: – Sinusoidal Response of FIR Systems – Superposition and the Frequency Response – Steady-State and Transient Response.	10 th	2	a2, b1, b2, c1, c2
11	Frequency Response of FIR Filters	Chapter 6: – Properties of the Frequency Response – Graphical Representation of the Frequency Response – Cascaded LTI Systems – Running-Sum Filtering – Filtering Sampled Continuous-Time Signals.	11 th	2	a2, b1, c1, c2
12	Frequency Response	Chapter 10: – The Frequency Response Function for LTI Systems – Plotting the Frequency Response – Magnitude and Phase Changes.	12 th	2	a2, b1, b2, c1
13	Frequency Response	Chapter 10: – Response to Real Sinusoidal Signals – Ideal Filters – Application of Ideal Filters – Time-Domain or Frequency-Domain?	13 th	2	a2, b1, b2, c1, c2
14	Computing the Spectrum	Chapter 13: – Finite Fourier Sum – Too Many Fourier Transforms? – Time-Windowing – Analysis of a Sum of Sinusoids.	14 th	4	a2, b1, b2, c1, c2

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
15	Final Theoretical Exam	– All topics.	16 th	2	a1, a2, b1, b2, c1
Number of Weeks /and Units Per Semester			16	32	

B. Practical Aspect (Lab/Clinical) (if any):

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Lab 1 - Simple calculations in Labview or Matlab	1	2	a1, b1, d1
2	Lab 2 - Array calculations in Labview or Matlab	2	4	a1, a2, b1, d1
3	Lab 3 - Signal Generation	2	4	b1, b2, c1
4	Lab 4 - Spectrum Generation	2	4	b2, c1, c2, d1
5	Lab 5 - Frequency Response Analysis	2	4	a2, b2, c1, c2, d1
6	Lab 6 - Real world measurement of Biomedical Signals	2	4	b2, c1, c2, d1
7	Lab 7 – Computing of Biomedical Signals	2	4	b1, b2, c1, c2, d1
8	Final Practical Exam	1	2	a1, a2, b1, b2, c1
Number of Weeks /and Units Per Semester		14	28	

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
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No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	None			
2				
3				
4				
Number of Weeks /and Units Per Semester				

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	All Laboratory Assignments	All Weeks	10	b1, b2, c1, c2, d1
Total			30	

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	Homework, Quizzes & Assignments	All Weeks	10	10%	a1- d1
2	Mid-Term Theoretical Exam	Week 9	20	20%	a1, a2, b1, b2, c1
3	Final Practical Exam and Practical Experiments	Week 15	20	20%	a1, a2, b1, b2, c1
4	Final Theoretical Exam	Week 16	50	50%	a1, a2, b1, b2, c1

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No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
Total			100%	100%	-

IX. Learning Resources:

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

- Signal Processing First, McClellan, Schafer & Yoder 1st Edition 2003.
- Signal Processing First, McClellan, Schafer & Yoder 2nd Edition 2012.

2- Essential References:

- Ganesh Naik, Biomedical Signal Processing: Advances in Theory, Algorithms and Applications, 2020, MARCS Institute, Western Sydney University, Penrith, Australia
- Rangaraj M. Rangayyan, Sridhar Krishnan, Biomedical Signal Analysis, 2024, John Wiley & Sons, Inc.

3- Electronic Materials and Web Sites etc.:

Websites:

- Online courses from Coursera and edX
- IEEE Engineering in Medicine and Biology Society (EMBS)

Journals:

- Journal of Biomedical Engineering.
- Biomedical Engineering Reviews.

Other Web Sources:

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

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 25% of total classes.
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.

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Faculty of Medical Technology

Department of Biomedical Engineering

Program of Biomedical Engineering

Course Plan (Syllabus) of Biomedical Signal Processing Course Code. (07.12.721)

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member:		Office Hours					
Location & Telephone No.:							
E-mail:		SAT	SUN	MON	TUE	WED	THU

2024/2025

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II. Course Identification and General Information:

1.	Course Title:	Biomedical signal Processing				
2.	Course Code:	07.12.721				
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial /Seminar	Lab	Clinical
		3	2	--	2	--
4.	Level/ Semester at which this Course is offered:	4th Level / 2nd Semester				
5.	Pre –Requisite (if any):	07.12.706				
6.	Co –Requisite (if any):	07.12.719				
7.	Program (s) in which the Course is Offered:	Bachelor of Biomedical Engineering				
8.	Language of Teaching the Course:	English/Arabic				
9.	Location of Teaching the Course:	Faculty of Medical Technology				
10.	Prepared by:	Dr. Ammar Sharaf Al-deen				
11	Date and Number of Approval by Council:					

III. Course Description:

This course covers the application of digital signal processing to biomedical problems. Labview or Matlab, a graphical programming language common in engineering, is used for both signal acquisition and processing. Applications include analysis of the electrocardiogram and other electrical signals generated by the body.

IV. Course Intended Learning Outcomes (CILOs) :

Upon successful completion of the Course, student will be able to:

A. Knowledge and Understanding:

a1

Understand the fundamental principles of signal processing and system analysis.

B. Intellectual Skills:

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A. Knowledge and Understanding:	
a1	Understand the fundamental principles of signal processing and system analysis.
B. Intellectual Skills:	
b1 Use the basic science as math, engineering and science to interpret data.	
b2	Apply knowledge of math, engineering and science to understand the principle of biomedical signal processing.
C. Professional and Practical Skills:	
c1 Evaluate how to apply specific mathematical techniques to solve problems in the areas of biomedical signals.	
c2	Develop an understanding of and develop the skills necessary to communicate findings and interpretations in an effective laboratory report.
D. Transferable Skills:	
d1 Work and communicate effectively with peers on multi-disciplinary teams to attain a common goal.	
I= Int rod uc ed, P= Pr act ice d or M/ A= Ma ste red /A	

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A. Knowledge and Understanding:

a1

Understand the fundamental principles of signal processing and system analysis.

V. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction to Signal and Systems	Chapters 1: – Mathematical Representation of Signals – Mathematical Representation of Systems – Systems as Building Blocks	1 st	2
2	Sinusoids	Chapter 2: – Review of Sine and Cosine Functions – Sinusoidal Signals – Sampling and Plotting Sinusoids.	2 nd	2
3	Sinusoids	Chapter 2: – Complex Exponentials and Phasors. – Phasor Addition – Time Signals	3 ^{ed}	2
4	Spectrum	Chapter 3: – The Spectrum of a Sum of Sinusoids – Sinusoidal Amplitude Modulation – Operations on the Spectrum – Periodic Waveforms	4 th	2
5	Spectrum	Chapter 3: – Fourier Series – Time–Frequency Spectrum – Frequency Modulation: Chirp Signals	5 th	2

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Reviewed by:

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Dr. Awadh Al-Kubati

Dr. Mohammed
Al-shamahi

Dr. Abdulrahman
Obaid

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
6	Sampling and Aliasing	Chapter 4: – Sampling – Spectrum View of Sampling and Reconstruction – Discrete-to-Continuous Conversion – The Sampling Theorem – Strobe Demonstration	6 th	2
7	Mid-Term Theoretical Exam	– All previous topics	7 th	2
8	FIR Filters	Chapter 5: – Discrete-Time Systems – The Running-Average Filter – The General FIR Filter – The Unit Impulse Response and Convolution.	8 th	2
9	FIR Filters	Chapter 5: – Implementation of FIR Filters – Linear Time-Invariant (LTI) Systems – Convolution and LTI Systems – Cascaded LTI Systems	9 th	2
10	Frequency Response of FIR Filters	Chapter 6: – Sinusoidal Response of FIR Systems – Superposition and the Frequency Response – Steady-State and Transient Response.	10 th	2
11	Frequency Response of FIR Filters	Chapter 6: – Properties of the Frequency Response – Graphical Representation of the Frequency Response – Cascaded LTI Systems – Running-Sum Filtering – Filtering Sampled Continuous-Time Signals.	11 th	2
12	Frequency Response	Chapter 10: – The Frequency Response Function for LTI Systems – Plotting the Frequency Response	12 th	2

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Magnitude and Phase Changes.		
13	Frequency Response	Chapter 10: – Response to Real Sinusoidal Signals – Ideal Filters – Application of Ideal Filters – Time-Domain or Frequency-Domain?	13 th	2
14	Computing the Spectrum	Chapter 13: – Finite Fourier Sum – Too Many Fourier Transforms? – Time-Windowing – Analysis of a Sum of Sinusoids.	14 th	4
15	Final Theoretical Exam	– All topics.	16 th	2
Number of Weeks /and Units Per Semester			16	32

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction to Signal and Systems	Chapters 1: – Mathematical Representation of Signals – Mathematical Representation of Systems – Systems as Building Blocks	1 st	2
2	Sinusoids	Chapter 2: – Review of Sine and Cosine Functions – Sinusoidal Signals – Sampling and Plotting Sinusoids.	2 nd	2
3	Sinusoids	Chapter 2: – Complex Exponentials and Phasors. – Phasor Addition – Time Signals	3 ^{ed}	2
4	Spectrum	Chapter 3: – The Spectrum of a Sum of Sinusoids – Sinusoidal Amplitude Modulation – Operations on the Spectrum	4 th	2

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Periodic Waveforms		
5	Spectrum	Chapter 3: – Fourier Series – Time–Frequency Spectrum – Frequency Modulation: Chirp Signals	5 th	2
6	Sampling and Aliasing	Chapter 4: – Sampling – Spectrum View of Sampling and Reconstruction – Discrete-to-Continuous Conversion – The Sampling Theorem – Strobe Demonstration	6 th	2
7	Mid-Term Theoretical Exam	– All previous topics	7 th	2
8	FIR Filters	Chapter 5: – Discrete-Time Systems – The Running-Average Filter – The General FIR Filter – The Unit Impulse Response and Convolution.	8 th	2
9	FIR Filters	Chapter 5: – Implementation of FIR Filters – Linear Time-Invariant (LTI) Systems – Convolution and LTI Systems – Cascaded LTI Systems	9 th	2
10	Frequency Response of FIR Filters	Chapter 6: – Sinusoidal Response of FIR Systems – Superposition and the Frequency Response – Steady-State and Transient Response.	10 th	2
11	Frequency Response of FIR Filters	Chapter 6: – Properties of the Frequency Response – Graphical Representation of the Frequency Response – Cascaded LTI Systems – Running-Sum Filtering	11 th	2

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Filtering Sampled Continuous-Time Signals.		
12	Frequency Response	Chapter 10: – The Frequency Response Function for LTI Systems – Plotting the Frequency Response – Magnitude and Phase Changes.	12 th	2
13	Frequency Response	Chapter 10: – Response to Real Sinusoidal Signals – Ideal Filters – Application of Ideal Filters – Time-Domain or Frequency-Domain?	13 th	2
14	Computing the Spectrum	Chapter 13: – Finite Fourier Sum – Too Many Fourier Transforms? – Time-Windowing – Analysis of a Sum of Sinusoids.	14 th	4
15	Final Theoretical Exam	– All topics.	16 th	2
Number of Weeks /and Units Per Semester			16	32

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction to Signal and Systems	Chapters 1: – Mathematical Representation of Signals – Mathematical Representation of Systems – Systems as Building Blocks	1 st	2
2	Sinusoids	Chapter 2: – Review of Sine and Cosine Functions – Sinusoidal Signals – Sampling and Plotting Sinusoids.	2 nd	2
3	Sinusoids	Chapter 2: – Complex Exponentials and Phasors. – Phasor Addition – Time Signals	3 ^{ed}	2

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
4	Spectrum	Chapter 3: – The Spectrum of a Sum of Sinusoids – Sinusoidal Amplitude Modulation – Operations on the Spectrum – Periodic Waveforms	4 th	2
5	Spectrum	Chapter 3: – Fourier Series – Time–Frequency Spectrum – Frequency Modulation: Chirp Signals	5 th	2
6	Sampling and Aliasing	Chapter 4: – Sampling – Spectrum View of Sampling and Reconstruction – Discrete-to-Continuous Conversion – The Sampling Theorem – Strobe Demonstration	6 th	2
7	Mid-Term Theoretical Exam	– All previous topics	7 th	2
8	FIR Filters	Chapter 5: – Discrete-Time Systems – The Running-Average Filter – The General FIR Filter – The Unit Impulse Response and Convolution.	8 th	2
9	FIR Filters	Chapter 5: – Implementation of FIR Filters – Linear Time-Invariant (LTI) Systems – Convolution and LTI Systems – Cascaded LTI Systems	9 th	2
10	Frequency Response of FIR Filters	Chapter 6: – Sinusoidal Response of FIR Systems – Superposition and the Frequency Response – Steady-State and Transient Response.	10 th	2
11	Frequency Response of	Chapter 6: – Properties of the Frequency	11 th	2

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No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
	FIR Filters	<ul style="list-style-type: none"> Response – Graphical Representation of the Frequency Response – Cascaded LTI Systems – Running-Sum Filtering – Filtering Sampled Continuous-Time Signals. 		
12	Frequency Response	Chapter 10: <ul style="list-style-type: none"> – The Frequency Response Function for LTI Systems – Plotting the Frequency Response – Magnitude and Phase Changes. 	12 th	2
13	Frequency Response	Chapter 10: <ul style="list-style-type: none"> – Response to Real Sinusoidal Signals – Ideal Filters – Application of Ideal Filters – Time-Domain or Frequency-Domain? 	13 th	2
14	Computing the Spectrum	Chapter 13: <ul style="list-style-type: none"> – Finite Fourier Sum – Too Many Fourier Transforms? – Time-Windowing – Analysis of a Sum of Sinusoids. 	14 th	4
15	Final Theoretical Exam	– All topics.	16 th	2
Number of Weeks /and Units Per Semester			16	32

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	Lab 1 - Simple calculations in Labview or Matlab	1	2
2	Lab 2 - Array calculations in Labview or Matlab	2	4
3	Lab 3 - Signal Generation	2	4
4	Lab 4 - Spectrum Generation	2	4
5	Lab 5 - Frequency Response Analysis	2	4
6	Lab 6 - Real world measurement of Biomedical Signals	2	4
7	Lab 7 – Computing of Biomedical Signals	2	4

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No.	Tasks/ Experiments	Number of Weeks	Contact Hours
8	Final Practical Exam	1	2
Number of Weeks /and Units Per Semester		14	28

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	Lab 1 - Simple calculations in Labview or Matlab	1	2
2	Lab 2 - Array calculations in Labview or Matlab	2	4
3	Lab 3 - Signal Generation	2	4
4	Lab 4 - Spectrum Generation	2	4
5	Lab 5 - Frequency Response Analysis	2	4
6	Lab 6 - Real world measurement of Biomedical Signals	2	4
7	Lab 7 – Computing of Biomedical Signals	2	4
8	Final Practical Exam	1	2
Number of Weeks /and Units Per Semester		14	28

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	Lab 1 - Simple calculations in Labview or Matlab	1	2
2	Lab 2 - Array calculations in Labview or Matlab	2	4
3	Lab 3 - Signal Generation	2	4
4	Lab 4 - Spectrum Generation	2	4
5	Lab 5 - Frequency Response Analysis	2	4
6	Lab 6 - Real world measurement of Biomedical Signals	2	4
7	Lab 7 – Computing of Biomedical Signals	2	4
8	Final Practical Exam	1	2
Number of Weeks /and Units Per Semester		14	28

C. Tutorial Aspect:

No.	Tutorial	Number of Weeks	Contact Hours
1	None		
2			
3			
4			
Number of Weeks /and Units Per Semester			

VI. Teaching Strategies of the Course:

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Sharaf Al-deen	Dr. ----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-shamahi	Dr. Abdulrahman Obaid

- Interactive lectures
- Discussions
- Problem-based learning
- Laboratory Exercises
- Simulation exercises
- Self-learning
- Collaborative problem-solving exercises

VII. Assessment Methods of the Course:

- Final theoretical exam
- Quizzes
- Final practical exam
- Mid-term theoretical exam
- Laboratory reports and lab teamwork.
- Homework, and laboratory reports.

VIII. Assignments:

No.	Assignments	Week Due	Mark	A l i g n e d C I L O s (s y m b o l s)

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
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No.	Assignments	Week Due	Mark	Alignments (symbols)
1	All Laboratory Assignments	All Weeks	10	b1, b2, c1, c2, d1
Total			30	

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

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
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No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Courses Learning Outcomes
1	Homework, Quizzes & Assignments	All Weeks	10	10%	a1, d1
2	Mid-Term Theoretical Exam	Week 9	20	20%	a1, a2, b1, b2, c

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No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
					1
3	Final Practical Exam and Practical Experiments	Week 15	20	20%	a1, a2, b1, b2, c1
4	Final Theoretical Exam	Week 16	50	50%	a1

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No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
					a2 b1 b2 c1
Total			100 %	100%	-

X. Learning Resources:

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
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<ul style="list-style-type: none"> 1- Required Textbook(s) (maximum two):
<p>Signal Processing First, McClellan, Schafer & Yoder 1st Edition 2003.</p> <ol style="list-style-type: none"> Signal Processing First, McClellan, Schafer & Yoder 2nd Edition 2012.
<p>2- Essential References:</p>
<ol style="list-style-type: none"> Ganesh Naik, Biomedical Signal Processing: Advances in Theory, Algorithms and Applications, 2020, MARCS Institute, Western Sydney University, Penrith, Australia Rangaraj M. Rangayyan, Sridhar Krishnan, Biomedical Signal Analysis, 2024, John Wiley & Sons, Inc.
<p>3- Electronic Materials and Web Sites etc.:</p>
<p>Websites:</p> <ol style="list-style-type: none"> Online courses from Coursera and edX IEEE Engineering in Medicine and Biology Society (EMBS) <p>Journals:</p> <ol style="list-style-type: none"> Journal of Biomedical Engineering. Biomedical Engineering Reviews. <p>Other Web Sources:</p>

XI. Course Policies: (Based on the Uniform Students' Bylaw (2007))

X. Course Policies: (Based on the Uniform Students' By law (2007))	
1	<p>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 25% of total classes.</p>
2	<p>Tardiness: A student will be considered late if he/she is not in class after 10 minutes of the start time of class.</p>
3	<p>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.</p>
4	<p>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.</p>
5	<p>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.</p>
6	<p>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.</p>

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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.

Prepared by:

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deen

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Dr. Abdulrahman
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