	Ministry of Higher Education and Scientific Research - Iraq Al-Mustaqbal University College for engineering and technology Department of Biomedical Engineering	

MODULE DESCRIPTOR FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	Biomedical signal processing			**Module Delivery**	
Module Type	Core			**Theory** **Lecture** **Lab**	
Module Code	UOMU0101061				
ECTS Credits	6				
SWL (hr/sem)	150				
Module Level	UGIII		**Semester of Delivery**	6	
Administering Department	Biomedical Engineering Dept.		**College**	Engineering	
Module Leader	Ahmed K. Abed		**e-mail**	ahmed.abed@utq.edu.iq	
Module Leader's Acad. Title			**Module Leader's Qualification**		
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	ER205	**Semester**	3

Co-requisites module	None	Semester	None

Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims أهداف المادة الدراسية	This course in biomedical signal processing presents the relationships among different theoretical measures of biomedical signals and an understanding of the information these measures provide regarding the sources of signals and the behaviors of their sources in response to natural or imposed perturbations. Biomedical engineering involves the application of engineering methods for the improvement of human health; the signals encountered by biomedical engineers are typically derived from biological processes. Often such signals are not well represented by the simple deterministic signals favored for illustrating the basic principles of signal processing. Real – world biomedical signals usually include stochastic components. Therefore, the biomedical engineering student must first recognize the range of possible signal types and be able to determine the most appropriate type of analysis for the signal of interest. By presenting signal processing as the process of developing and manipulating a model of the signal, this course develops the problems discussed above using an integrated framework. Four issues – (1) choosing a class of signal model, (2) selecting a specific form of the model, (3) evaluating indicators of adequacy of the model, and (4) subsequent processing is emphasized.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- demonstrate an advanced understanding of the principles of analog and digital signal processing. 2- know the fundamental tools that are used to describe, analyze and process biomedical signals. 3- know the fundamental tools that are used to describe, analyze and process biomedical signals. 4- know the fundamental tools that are used to describe, analyze and process biomedical signals.
Indicative Contents المحتويات الإرشادية	**-The Nature of Biomedical Signals,** The Reasons for Studying Biomedical Signal Processing, What **Is** a Signal? Some Principial Sources of Biomedical Signals, Continuous-Time and Discrete-Time, Types of Signals: Deterministic, Stochastic, Fractal and Chaotic, Signal Modeling as a Framework for Signal Processing. What **Is** Noise? **-Memory and Correlation,** Properties of Operators and Transformations, Energy and Power Signals, The Concept of Autocorrelation, Autocovariance and Autocorrelation for DT Signals, **-The Impulse Response,** Convolution Form of an LSI System, Convolution for Continuous-Time Systems, Convolution as Signal Processing, Relation of Impulse Response **to** Differential Equation, Convolution as a Filtering Process. **-Frequency Response,** Generalized Frequency Response, Frequency Response of Discrete-Time Systems, Ideal Filters, **-Modeling Continuous-Time Signals as Sums of Sine Waves,** The Fourier Series, The Frequency Response and Non-sinusoidal Periodic Inputs, Parseval's Relation for Periodic Signals, The Continuous-Time Fourier Transform (CTFT), Relationship of Fourier Transform to Frequency Response, Properties of the Fourier Transform, **-Responses of Linear Continuous-lime Filters to Arbitrary Inputs,** Conceptual Basis of the Laplace Transform, Properties of (Unilateral) Laplace Transforms, The Inverse

	(Unilateral) Laplace Transform, Transfer Functions, Biomedical Applications of Laplace Transforms. **-Modeling Signals as Sums of Discrete-Time Sine Waves,** The Discrete-Time Fourier Series, Fourier Transform of Discrete-Time Signals, Output of an LSI System, Relation of DFS and DTFT, Windowing, Sampling, The Discrete Fourier Transform (DFT), Biomedical Applications. **-Noise Removal and Signal Compensation,** Introductory Example: Reducing the ECG Artifact in an EMG Recording, Eigenfunctions of **LSI** Systems and the Z-Transform, Properties of the Bilateral 2-Transform, Poles and Zeros of Z-Transforms, The Inverse 2-Transform, Pole Locations and Time Responses, **The** Unilateral Z-Transform, Analyzing Digital Filters Using 2-Transforms (DT Transfer Functions, Overview: Design of Digital Filters, IIR, FIR Biomedical Applications of Digital Filtering. **-Modeling Stochastic Signals as Filtered White Noise,** Mean and Autocorrelation Function of a Random Process, General Linear Processes, Autoregressive (AR) Processes, Moving Average (MA) Processes, Harmonic Processes, Other Biomedical Examples. **-Scaling and Long-Term Memory,** Geometrical Scaling and Self-Similarity, Measures of Dimension, Self-Similarity and Functions of Time, Theoretical Signals Having Statistical Similarity, Measures of Statistical Similarity for Real Signals, Generation of Synthetic Fractal Signals. **-Nonlinear Models of Signals,** Nonlinear Signals and Systems: Basic Concepts, Measures of Nonlinear Signals and Systems,
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	93	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	57	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.5
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	3, 14	LO #1, and 4
	Assignments	2	10% (10)	4, 12	LO # 1, 2,3,4
	Projects / Lab.	2	10% (10)	Continuous	
	Report	0	10% (0)		
Summative assessment	**Midterm Exam**	2 hr	20% (20)	7	LO # 1-3
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1,2	**The Nature of Biomedical Signals**
Week 3	**Correlation**
Week 4	**The Impulse Response**
Week 5	**Frequency Response**
Week 6	**Responses of Linear Continuous –Time Filters to Arbitrary Inputs**
Week 7	**Discrete Time Modeling of Signals**
Week 8,9	**Digital Filters**
Week 10	**Electrocardiography**
Week 11	**ECG QRS Detection**
Week 12	**ECG Analysis Systems**
Week 13	**Noise Removal and Signal Compensation**
Week 14	**Modeling Stochastic Signals**
Week 15	**Nonlinear Models of Signal**

Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1,2	Fourier Series
Week 3,4	Fourier Transform
Week 5,6	RC-Filter design
Week 7,8	Correlation
Week 9,10	Bode plot -based Stability
Week 11,12	Z-Transform
Week 13,14	Digital Filter Design
Week 15,16	Final Exam.

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	**Biomedical Signal Processing and Signal Modeling** by Eugene N. Bruce A Wiley-Interscience Publication **JOHN WILEY & SONS, INC.** ISBN 0-471-34540-7	Yes
Recommended Texts		
Websites		

APPENDIX:

GRADING SCHEME مخطط الدرجات				
Group	**Grade**	التقدير	**Marks (%)**	**Definition**
Success Group (50 - 100)	**A** - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria

Fail Group (0 – 49)	**FX** – Fail	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
Note:				

NB Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

ملاحظة: هذا النموذج تم وضعه وتقديمه من قبل مديرية ضمان الجودة في وزارة التعليم العالي والبحث العلمي