

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Digital Signal Processing		Module Delivery
Module Type	Core	☒ Theory ☐ Lecture ☒ Lab ☒ Tutorial ☐ Practical ☐ Seminar	
Module Code	CET3103		
ECTS Credits	5		
SWL (hr/sem)	150		
Module Level	3	Semester of Delivery	5
Administering Department	CET	College	EETC
Module Leader	Dr. Mohammed Joudah	e-mail	mjzaiter@mtu.edu.iq
Module Leader's Acad. Title	Lecturer	Module Leader's Qualification	Ph.D.
Module Tutor	Dr. Mohanad Ahmed Mezher	e-mail	mohanad.ahmed1@mtu.edu.iq
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Scientific Committee Approval Date		Version Number	1.0

Relation with other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	Semester	
Co-requisites module	None	Semester	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims أهداف المادة الدراسية	1. Demonstrate an understanding of basic discrete-time systems, linearity, time-invariance, stability, impulse response and discrete convolution. 2. Implement discrete time systems, recursive and nonrecursive realizations. 3. Perform Z transform and finding the inverse Z transform including its properties. 4. Demonstrate an understanding of frequency analysis of both continuous and discrete signals. 5. Demonstrate an understanding of frequency response of linear time invariant systems. 6. Demonstrate an understanding of discrete Fourier transform, its properties and applications. 7. Design FIR and IIR digital filters.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. State, prove and apply Shannon's sampling theorem 2. Relate signal to noise ratio (SNR) to number of samples averaged in signal sampling and averaging systems 3. Implement sampling of continuous time signals and reconstruct them from their samples by choosing appropriate parameters and functions. 4. Change the sampling rate of discrete-time signals, avoiding folding effects. 5. Describe the fundamental properties of linear time invariant systems. 6. Analyze signals and systems in the discrete time domain. 7. Compute the frequency response of linear and time-invariant discrete-time systems, implement decomposition into a minimum-phase system and an all-pass system, and describe generalized linear-phase systems. 8. Implement discrete-time systems using various structures. 9. Understand the importance of the discrete Fourier transform and algorithms for its fast computation. 10. Analyze discrete-time signals in the frequency domain, using the windowing method as well as the time-dependent discrete Fourier transform, and reconstruct the signal with the overlap-sum algorithm. 11. Write down, state the properties of, and apply Fourier Transforms in DSP systems 12. Analyze and implement systems in the field of Z transformation. 13. Design basic finite impulse response (FIR) and infinite impulse response (IIR)

	filters.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. <u>Introduction to DSP</u> Introduction to DSP, discrete signals and their properties. In addition, the concept of frequency in continuous time and discrete time signals. [5 hrs] <u>Discrete systems</u> Discrete systems, linear time-invariant systems, convolution theorem; Digital Signal Processing (DSP) is concerned with the processing of signals that are represented as sequences of finite-precision numbers. [10 hrs] <u>Sampling and reconstruction of analogue signals</u> Review of continuous-time signal and system analysis using Fourier ; Ideal impulse sampling and reconstruction of bandlimited signals; digital to analogue conversion, and practical considerations. [10 hrs] <u>Discrete-time sequences</u> Discrete-time signals and systems, linearity, time-invariance, stability, causality; discrete-time convolution, linear constant-coefficient difference equations, magnitude and phase response. [5 hrs] <u>The Discrete Fourier Transform</u> The discrete Fourier transform (DFT); properties of the DFT; circular convolution; linear convolution via the DFT and the overlap-add method; the radix-2 decimation-in-time fast Fourier transform (FFT) algorithm. [10 hrs] <u>The z-transform and its properties</u> The z-transform, region of convergence for the z-transform, inverse z-transform, z-transform properties. [10 hrs] <u>FIR filter design</u> Generalized linear-phase causal FIR filters; FIR linear-phase filter design using the window method; frequency-sampling design of FIR filters. [10 hrs] <u>IIR filter design</u> IIR filter design using the bilinear transformation; Filter design by impulse invariance response. [10 hrs]

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Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	The main strategy that will be adopted in delivering this module focuses on fostering active student engagement during exercises, fostering the development of critical thinking skills, and encouraging participation. This will be accomplished through a combination of classroom instruction, interactive tutorials, and the inclusion of engaging experiments that involve sampling activities that capture students' interest. The aim is to refine and enhance students' critical thinking abilities while ensuring their active involvement in the learning process.
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Student Workload (SWL)

الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	74	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعياً	5.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	76	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعياً	5.4
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)	5, 10	LO #1-4 , LO #4-10
	Assignments	2	10% (10)	2, 12	LO # 1-11
	Projects / Lab.	1	10% (10)	Continuous	
	Report	1	10% (10)	13	LO # 1-11
Summative assessment	Midterm Exam	2 hr	10% (10)	7	LO # 1-6
	Final Exam	4hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Signals, Systems and signal processing Basic element of digital signal processing, Advantages of digital over analog signal processing, Classification of Signals
Week 2	The Concept of frequency in Continuous and Discrete – time signals Continuous – time sinusoidal signals, Discrete – time sinusoidal signals, Harmonically related complex exponential.
Week 3	Analog –to-digital and digital-to-analog conversions Sampling of analog signals, The sampling theorem, Quantization and conversion, Digital-to-analog conversion, Analog-to-digital conversion.
Week 4	Analysis of digital signals and systems.
Week 5	Convolution in discrete time systems
Week 6	Deconvolution in discrete time systems
Week 7	Mid-term Exam
Week 8	Discrete-time systems Input/output description of systems, Block diagram representation of discrete-time systems, Classification of discrete-time system, Correlation of discrete-time signals, Properties of correlation.
Week 9	Time domain to frequency domain conversion Discrete-Fourier transform
Week 10	Fast-Fourier transform
Week 11	The Z-transform Direct Z-transform
Week 12	Inverse Z-transform, Properties of the Z-transform.
Week 13	Analogue Filtering versus Digital filtering
Week 14	Design methods of FIR Filters
Week 15	Design Methods of IIR Filters
Week 16	Preparatory week before the final Exam

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: Discrete and Continuous-Time Signals.
Week 2	Lab 2: Discrete-Time Systems.
Week 3	Lab 3: Frequency Analysis.
Week 4	Lab 4: Sampling and Reconstruction.
Week 5	Lab 5: Discrete Fourier Transform.
Week 6	Lab 6: The Z-transform.
Week 7	Lab 7: Digital Filter Design.

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Digital Signal Processing by John Proakis & D. G. Manolakis, 4/E. Pearson, 2006.	Yes
Recommended Texts	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.	No
Websites	https://www.youtube.com/watch?v=6dFnpz_AEyA&list=PL9567DFCA3A66F299	

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	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks 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.