University of Macau

Faculty of Science and Technology

Department of Electrical and Computer Engineering

Part A: Course Outline

Course Title:	Digital Signal Processing		
Course Code:	ELEC370	Year of Study:	3
Course Mode:	Theoretical		
Compulsory/Elective:	Elective		
Course Prerequisites:	Signals and Systems, Mathematical Analysis		
Prerequisite Knowledge	Advanced calculus, Signals and systems, Linear system theory		
Class/Laboratory Schedule:	2.5-hour lecturer, 1 hour simulation and 0.5 hour tutorial per week		
Duration	One semester	Credit Units	3.5
Text Books and References:	[1] "Discrete-time Signal Processing", 3rd Edition, A.V. Oppenheim, R.W. Schafer, Pearson/Prentice Hall, 2010. [2] "Digital Signal Processing Using Matlab", V.K. Ingle, J.G. Proakis, PWS Publishing Company, 2000		
Course Description:	Digital Signal Processing focuses on the general and universal concepts in discrete-time signal processing It provides the fundamental theorems and properties of discrete-time linear systems, z-transform, frequency response, sampling, filter design and discrete-time Fourier Analysis.		
Topics Covered	1. Discrete-time signals and systems 2. Z-transform 3. Sampling Theorem and Reconstruction 4. Transform Analysis for Linear-time Invariant System 5. Structures for Discrete-Time systems 6. Digital Filter Design 7. DFT and FFT		
Course Objectives:	1. To introduce to students the fundamental theorems of discrete-time signals and systems. [a, g, k] 2. To prepare students to know the method of analyzing discrete-time signals and systems both in time-domain and frequency-domain. [a, e, g, k] 3. To make students understand how digital to analog and analog to digital converter operate and to understand the sampling process. [a, c] 4. To develop students with the ability to design and understand simple digital filters. [a, c, e, g, k] 5. To make students understand the implementation of the DFT in terms of the FFT, as well as some of its applications. [a]		

<table>
<tr><td></td><td>6. To work in a team environment to complete project assignments. [c, e, k, g]</td></tr>
<tr><td>Course Assessment:</td><td>Assignments : 10%
Quizzes :30%
Simulation Projects: 20%
Final Exam. : 40%</td></tr>
<tr><td>Relationship to Program Objectives and Outcomes</td><td>This course primarily contributes to EEE program outcomes that develop students abilities to:
a. Ability to apply knowledge of mathematics, science and engineering.
k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

This course secondarily contributes to EEE program outcomes that develop students abilities to:
c. Ability to design a system, component or process to meet desired needs.
e. Ability to identify, formulate and solve engineering problems
g. Ability to communicate effectively</td></tr>
<tr><td>Course Contents and Relationship to Program Criteria:</td><td>
<table>
<tr><th>Week no.</th><th>Topics</th><th>Program Criteria</th></tr>
<tr><td>3.5</td><td>Discrete-time Signals and Systems
Discrete-time signals and systems, Linear time invariant system and its properties, Difference equation, Frequency response, Discrete-time Fourier Transform</td><td>BS, CV, DM, LA,CS,</td></tr>
<tr><td>2.5</td><td>Z-transform
Definition and properties of z-transformer, Inverse z-transformer, Properties of reign of convergence</td><td>CV, CS</td></tr>
<tr><td>1.5</td><td>Sampling
Signal sampling, Reconstruction, C/D and D/C converter, Nyquist theorem, Discrete-time signal processing of continuous time system</td><td>CV, BS, ES,</td></tr>
<tr><td>1</td><td>Frequency response of LTI systems
Frequency Response of LTI System, System functions characterized by linear constant coefficient difference equation, Frequency response for rational system functions, Linear Systems with generalized linear phase</td><td>CV, ES</td></tr>
<tr><td>1.5</td><td>Structure for discrete-time systems
Block diagram representation of discrete-time system, Signal flow graph, Structure of IIR system, Structure of FIR system, Transposed form.</td><td>BS, DM,</td></tr>
<tr><td>2.5</td><td>Filter design
Design of infinite-impulse response filter, Design of finite-impulse response filter, Design filter using Matlab</td><td>BS, CS,ES, DM</td></tr>
<tr><td>1.5</td><td>DFT and FFT
Discrete-time Fourier transform, Circular convolution, Fast Fourier transform</td><td>CS, LA</td></tr>
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<tr><td>Contribution of Course</td><td>This course contributes primarily to the students’ knowledge of engineering topics. Students</td></tr>
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to meet the professional component:	should be able to understand the theoretical basis of discrete-time signal processing, analyze the discrete-time systems and design simple discrete-time systems. Students should be able to use simulation tools such as those available in Matlab.
Course Instructor(s):	Dr. Dai Ning-Yi
Prepared by:	Dr. Dai Ning-Yi

Part B: General Course Information and Policies

Instructor: Dr. Dai Ning Yi Office: B1-A703
Office Hour: Monday 3:00~5:00 p.m. or by appointment Phone: 8470
e-mail: nydai@umac.mo

Programme Educational Objectives

1. **Problem Solving:** Graduates have the ability to think in a critical and evaluative manner and to consider a broad perspective, in order to solve technical and nontechnical problems.
2. **Leadership and Communication:** Graduates will provide effective leadership, act in an ethical manner and skills will include the ability to communicate well and to work successfully within diverse groups.
3. **Market Acceptance:** Graduates will have successful careers in the academic environment, industrial and government organizations.
4. **Technical Competence:** Graduates will be technically competent and have a thorough grounding in the fundamentals of math and science in electrical and computer engineering and experience in engineering design. They will be able to use modern engineering techniques, skills, and tools to fulfill societal needs.

Scale: 1 (Highest) to 4 (Lowest)

	Problem Solving	**Leadership and Communication**	**Market Acceptance**	**Technical Competence**
Measurement And Instrumentation II	1	4	2	1

Remark:

- Objective for “Problem Solving” can be achieved by assignments, quizzes, simulation projects and final exam.
- Objective for “Leadership and Communication” can be achieved by report writing. However, leadership training is not given by this course.
- Objective for “Market Acceptance” can be achieved by the course contents

that are required in industries.

- Objective for “Technical Competence” can be achieved by using fundamentals of math and science in electrical and computer engineering and experience in computer simulation.

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Digital Signal Processing			3	4	2		3	2	3

Terms:

Probability and Statistics (PS), Differential and Integral Calculus (DIC), Basic Science (BS), Computer Science (CS), Engineering Science (ES), Differential Equation (DE), Linear Algebra (LA), Complex Variables (CV), Discrete Mathematics (DM)

Program Outcome Policy:

Course VS Course Outcomes

(H= Highly Related, S = Supportive, N = None)

Course	a	b	c	d	e	f	g	h	i	j	k	l
Digital Signal Processing	H	N	S	N	S	N	S	N	N	N	H	N

The electrical and computer engineering program outcomes are:

a. Ability to apply knowledge of mathematics, science and engineering.

b. Ability to design and conduct experiments.

c. Ability to design a system, component or process to meet desired needs.

d. Ability to function on multidisciplinary teams.

e. Ability to identify, formulate and solve engineering problems.

f. Understanding of professional and ethical responsibility.

g. Ability to communicate effectively.

h. Broad education necessary to understand the impact of engineering solutions in global and societal context.

i. Recognition of the need for and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

l Ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations

Curriculum Detail

ELEC 370 Digital Signal Processing

Timetabled work in hours per week			No of teaching weeks	Total hours	No /Duration of exam papers	Max marks available from:	
Lecturer	Tutor	Practice				Exams	Course
2.5	0.5	1	14	56	2/2 hours And 1/3 hours	70	30

Term: 6th

Hours			Percentage content of					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
37	12/7	0	60	0	10	10	0	20

Design Elements

% of Design Content	Design Content in Course Work	Design Project	Design Content in Laboratories
10%	X	X	X

Course Assessment Policy:

- Homework assignments will be given to students according to the course progress, no late homework is accepted.
- Two two-hour Quizzes will be held during the semester.
- Three simulation projects will be performed during the semester. Two students form one group and group report should be handed up.
- One three-hour final exam will be performed.