University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Signals and Systems		
Course Code:	ELEC261	Year of Study:	2
Course Mode:	Theoretical with substantial laboratory/ practice content		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	ELEC231, MATH102		
Prerequisite Knowledge	Circuit Analysis, Differential and Integral Calculus		
Class/Laboratory Schedule:	3-hour lecturer, and 2-hour tutorial and/or laboratory per week		
Duration:	One semester	Credit Units	3.5
Text Books and References:	***[1] Signals and Systems***, (2nd Edition) by Alan V. Oppenheim, Alan S. Willsky, Prentice Hall International Edition, 1997 [ISBN: 978-0138147570] ***[2] Continuous and Discrete Signals and Systems*** (2nd Edition), by Samir S.Soliman, Mandyam D.Srinath, Prentice Hall, 1998. [ISBN: 978-0135184738] ***[3]*** **信號與系統**, 鄭君里, 楊為理, 應啟珩, 高等教育出版社, 2004. [ISBN: 704007981]		
Course Description:	This course introduces the fundamental and contemporary analysis methodologies of both continuous-time and discrete-time signals and systems which play an important role in such diverse areas of science and technology as circuit design, control systems, communications, biomedical engineering, energy generation and distribution systems, speech and video processing and so forth.		
Topics Covered	Basic Continuous-Time (C-T) and Discrete-Time (D-T) Signals and its Transformations. Basic System Properties. Linear Time-Invariant System Analysis: Properties, Convolution Sum and Convolution Integral, Impulse and Step Responses. C-T Fourier Analysis: Fourier Series and Fourier Transform. Time and Frequency Characterization of C-T Signals and Systems: Frequency Response, 1st- and 2nd-Order Systems, Bode Plots, Zero-State System Response. Introduction to Filtering, Modulation and Sampling. Laplace Analysis: Bi- and Uni-lateral Laplace Transform, Pole-Zero Plot and Stability, Transfer Function, Application in Circuit Analysis. Practice includes problem solving, MATLAB and Laboratory Works.		
Course Objectives:	1. Characterize the signal and systems using widely-accepted engineering terminology [a, c, e, h] 2. The use of frequency-domain analysis in the components of the signals as well as the properties of the systems [a, c, e, h]		

	3. To offer students the signal and system analysis experience through the real measurement laboratory as well as MATLAB simulation works [a, b, c, e, h, k] 4. Encourage the students to analysis and explain the physic world of signals and systems using mathematics [a, c, e, h]
Course Assessment:	Quizzes :15% Laboratory Works: 10% Mid-term Exam : 30% Final Exam: 45%
Relationship to Program Objectives and Outcomes	This course primarily contributes to EEE program outcomes that develop students abilities to: a. Ability to apply knowledge of mathematics, science and engineering. c. Ability to design a system, component or process to meet desired needs. e. Ability to identify, formulate and solve engineering problems. This course secondarily contributes to EEE program outcomes that develop students abilities to: b. Ability to design and conduct simulations and experiments. h. Broad education necessary to understand the impact of engineering solutions in global and societal context. 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

<table>
<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>1.5</td><td>Introduction
Introduction why the signals and systems analysis is important in the engineering worlds, and give some examples on engineering problems that can be solved by the topic covered in this course. continuous-time and discrete-time signals are presented with their properties, Singularity Functions, as well as the general property of systems.</td><td>ES, DIC</td></tr>
<tr><td>2.5</td><td>Linear Time-Invariant Systems
Concepts on Linear Time-Invariant (LTI) system, convolution sum and integral, property of LTI systems, LTI systems described by differential equations</td><td>ES, DIC, DE</td></tr>
<tr><td>3</td><td>Fourier Series Analysis
Fourier series on discrete and continuous-time periodic signals, convergence of Fourier series, properties of Fourier series, Filters.</td><td>ES, DIC, CV</td></tr>
<tr><td>2</td><td>Fourier Transform Analysis
Basic concepts of Fourier Transform of continuous-time aperiodic signals, properties of Fourier Transform, Fourier Transform of periodic signals, Fourier Transform and differential equations.</td><td>ES, DIC, DE, CV</td></tr>
<tr><td>1.5</td><td>Time and Frequency Characterization of Signals and Systems
Brief introduction on the relationship between time- and frequency-domain of signals and systems, magnitude and phase of frequency response, time- and frequency-domain characteristics of filters, 1st order and 2nd order systems, Bode-Plots</td><td>ES, DIC, DE, CV</td></tr>
<tr><td>0.5</td><td>Sampling
Introduction to Sampling Theorem, reconstruction, the effect of aliasing.</td><td>ES</td></tr>
<tr><td>0.5</td><td>Communication Systems
Different types of Modulation – Amplitude Modulation, Frequency Modulation, Phase Modulation, Demodulation</td><td>ES</td></tr>
<tr><td>2.5</td><td>Laplace Transform and Its Application in Circuit Analysis
The Laplace Transform analysis, Region of Convergence (ROC), pole-zero plot, geometric evaluation of Fourier transform by pole-zero plot, Properties of Laplace Transforms, Analysis of LTI systems using Laplace Transform, Transfer Function and its block diagram representations, Unilateral Laplace Transform and its application in circuit analysis.</td><td>ES, DIC, DE, CV</td></tr>
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<tr><td>Contribution of Course to meet the professional component:</td><td>This course educates students with basic skills on the analysis the signals and systems in both time-domain and frequency domain, which is important in many engineering sense that need the classification on different components in the signals as well as understanding the system property. The material on this course find important applications in many engineering aspects, such as telecommunications, control systems, circuit designs, signal processing, etc.</td></tr>
<tr><td>Course Instructor(s):</td><td>Dr. Sai-Weng Sin</td></tr>
<tr><td>Prepared by:</td><td>Dr. Sai-Weng Sin</td></tr>
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Part B: General Course Information and Policies

Instructor: Dr. Sai-Weng Sin Office: JLG212D

Office Hour:
Dr. Sin: Friday 3:30~5:30 p.m. or by appointment Phone: 8795
E-mail: terryssw@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 electronics 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**
Power Electronics	1	3	3	1

Remark:

- Objective for “Problem Solving” can be achieved by assignments, quizzes, mid-term exam, final exam and projects.
- 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 subject that is related to broad range fundamental knowledge in electrical engineering.
- Objective for “Technical Competence” can be achieved by using fundamentals of math and science in electrical and electronics engineering and experience in engineering project design.

Program Criteria Policy:

Course VS Program Criteria

Scale: 5 (Highest) to 1 (Lower)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Signals and Systems		5			3	2		5	

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
Signals and Systems	H	S	H	N	H	N	N	S	N	N	S	N

The electrical and electronics 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

ELEC261 Signals and Systems

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**
3	1	1	14	70	2/4 hours	45	55

Term: 3th

Hours			**Percentage content of**					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
42	3/25	0	40	10	30	20	0	0

Design Elements

% of Design Content	**Design Content in Course Work**	**Design Project**	**Design Content in Laboratories**
20%	0	0	X

Course Assessment Policy:

- Homework assignments will be given to students according to the course progress. 3 Quizzes will then be held to justify the students learning progress is satisfactory or not.
- 1-2 laboratories will be performed during the semester. 2-3 students form one group and group report should be handed up.
- 1 mid-term exam and 1 final exam.