

UNIVERSITY OF MACAU
FACULTY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Part A: Course Outline			
Course Title	Applied Electronics I		
Course Code	ELEC222	Year of Study:	2 nd
Compulsory/Elective	Compulsory		
Course Mode	Theoretical with substantial laboratory/practice content		
Course Prerequisites	ELEC231	Prerequisite Knowledge	Circuit Analysis
Class/Laboratory Schedule	3 hours lecture, 1.5 hours tutorial and 0.5 hours experiment per week		
Duration	One semester	Credit Units	3.5

Text Books and References	<p>[1] R. L. Boylestad and L. Nashelsky, <i>Electronic Devices and Circuit Theory</i>, 10th Edition, Prentice Hall, 2009.</p> <p>[2] A. S. Sedra and K. C. Smith, <i>Microelectronics Circuits</i>, 5th Edition, Oxford University Press, 2004.</p> <p>[3] J. D. Irwin, <i>Basic Engineering Circuit Analysis</i>, 7th Edition, Prentice-Hall, 2002.</p> <p>[4] R. C. Dorf and J. A. Svoboda, <i>Introduction to Electric Circuit</i>, 3rd Edition, John Wiley & Sons, 1996.</p> <p>[5] N. R. Malik, <i>Electronic Circuit Analysis, Simulation and Design</i>, Prentice-Hall, 1995.</p> <p>[6] D. Comer and D. Comer, <i>Fundamentals of Electronic Circuit Design</i>, John Wiley & Sons, 2003.</p> <p>[7] S. Franco, <i>Design with Operational Amplifiers and Analog Integrated Circuits</i>, McGraw-Hill, 1988.</p>
Course Description	<p>This course introduces basic signal, spectrum, and amplifier concepts for the analog electronic circuits. The electronic devices including diodes, bipolar junction transistors (BJTs), and Operational Amplifiers (Op-Amps) will be discussed. In each device; its analysis is firstly presented after a particular device physics overview, and then the design some circuit applications follow. The main focus of this course is not only to develop the student ability to analyze and design basic analog electronic circuits with passive components and/or the active elements like diode, transistors and Op-Amp. Besides, some experiments are provided to help students to have a thorough grasp of the basic electronic circuit problem. Throughout this course, only small signal analysis and low frequency operation are mainly considered in order to ease students to have the first interesting impression in this important discipline of the ECE program.</p>

<p>Topics Covered</p>	<ol style="list-style-type: none"> 1. Overview of the basic concepts of signal in time and frequency domain, gain, etc.; 2. Basic characteristics of ideal and non-ideal PN-diode; 3. Various diodes, e.g. Zener diode, light-emitting diode, etc. 4. Diode applications, e.g. rectifier, limiting and clamping circuits, etc.; 5. Basic characteristics of BJTs; 6. Biasing of BJT circuits; 7. BJT small signal model and its parameters; 8. Analysis of BJT circuits at DC and AC; 9. Applications of BJTs, i.e. amplifier, switch, etc; 10. Characteristics of both ideal and practical Op-Amp; 11. Analysis of both ideal and practical Op-Amp circuits; 12. Inverting and non-inverting configuration of Op-Amp circuits; 13. Basic circuit building blocks using Op-Amp; 14. Computer simulations of electric circuits including Op-Amp, diode and BJT.
<p>Course Objectives</p>	<ol style="list-style-type: none"> 1. To train the students the operational principle, analysis, design and application of the diode, [a, c, e]; 2. To train the students the operational principle, analysis, design and application of the bipolar junction transistor (BJT), [a, c, e]; 3. To train the students the operational principle, analysis, design and application of Operational Amplifier (Op-Amp), [a, c, e]; 4. To develop the students' ability on conducting engineering experiments, analyze experimental observations scientifically, [b, k]; 5. To initiate the students the understanding of the concepts, know-how and tools of Electronic Design Automation (EDA) for circuit analysis and design, [l]; 6. To develop the students' ability on preparing professional report, [g, l].
<p>Course Assessment</p>	<p>Quiz: 12%</p> <p>Simulation Practices: 6%</p> <p>Experiments: 27%</p> <p>Mid-term Exam. : 25%</p> <p>Final Exam. : 30%</p>

<p>Relationship to Program Objectives and Outcomes</p>	<p>This course primarily contributes to EEE program outcomes that develop students abilities to:</p> <ul style="list-style-type: none"> a. Ability to apply knowledge of mathematics, science and engineering. b. Ability to design and conduct experiments. e. Ability to identify, formulate and solve engineering problems. k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice. <p>This course secondarily contributes to EEE program outcomes that develop students abilities to:</p> <ul style="list-style-type: none"> c. Ability to design a system, component or process to meet desired needs. g. Ability to communicate effectively. l. An ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations. 																				
<p>Course Contents and Relationship to Program Criteria</p>	<table border="1" data-bbox="469 891 1469 1778"> <thead> <tr> <th data-bbox="469 891 580 969">Week no.</th> <th data-bbox="580 891 1254 969">Topics</th> <th data-bbox="1254 891 1385 969">Program Criteria</th> <th data-bbox="1385 891 1469 969">LO no.</th> </tr> </thead> <tbody> <tr> <td data-bbox="469 969 580 1070">1-2</td> <td data-bbox="580 969 1254 1070"> INTRODUCTION Overview of electronic signal, spectrum and frequency response, outlooks circuit analysis and circuit models. </td> <td data-bbox="1254 969 1385 1070">BS, CS, ES</td> <td data-bbox="1385 969 1469 1070">1</td> </tr> <tr> <td data-bbox="469 1070 580 1256">3-5</td> <td data-bbox="580 1070 1254 1256"> DIODES Introduction to semiconductor and PN junction, ideal diode, ideal diode circuits analysis, practical diode small signal model and its parameters, application of practical diodes, Zener diodes, rectifier circuits, limiting and clamping circuits, special diode types, SPICE diode model and simulation examples. </td> <td data-bbox="1254 1070 1385 1256">BS, CS, ES</td> <td data-bbox="1385 1070 1469 1256">3</td> </tr> <tr> <td data-bbox="469 1256 580 1536">6-10</td> <td data-bbox="580 1256 1254 1536"> BIPOLAR JUNCTION TRANSISTORS (BJTs) Semiconductor theory of BJTs, analysis of BJT circuits at DC and AC, DC and AC load lines, BJT small signal model and its parameters, power considerations, biasing the BJT for the circuit designs, common emitter, collector and base configurations for BJT amplifiers, amplifier coupling and multistage amplifier analysis and designs, transistor as a switch and its applications, general large-signal model for the BJT, the SPICE BJT model and simulation examples. </td> <td data-bbox="1254 1256 1385 1536">BS, CS, ES</td> <td data-bbox="1385 1256 1469 1536">4</td> </tr> <tr> <td data-bbox="469 1536 580 1778">11-14</td> <td data-bbox="580 1536 1254 1778"> OPERATIONAL AMPLIFIERS Introduction of Op-Amp, ideal Op-Am, ideal Op-Amp model and its parameters, inverting and non-inverting configuration circuits analysis, basic circuit building blocks using Op-Amp, advanced linear applications of ideal Op-Amp, practical Op-Amp, effect of finite open-loop gain and bandwidth, practical Op-Amp small signal model and its parameters, DC imperfections, ideal and practical SPICE model and its simulation examples. </td> <td data-bbox="1254 1536 1385 1778">CS, ES</td> <td data-bbox="1385 1536 1469 1778">3</td> </tr> </tbody> </table>	Week no.	Topics	Program Criteria	LO no.	1-2	INTRODUCTION Overview of electronic signal, spectrum and frequency response, outlooks circuit analysis and circuit models.	BS, CS, ES	1	3-5	DIODES Introduction to semiconductor and PN junction, ideal diode, ideal diode circuits analysis, practical diode small signal model and its parameters, application of practical diodes, Zener diodes, rectifier circuits, limiting and clamping circuits, special diode types, SPICE diode model and simulation examples.	BS, CS, ES	3	6-10	BIPOLAR JUNCTION TRANSISTORS (BJTs) Semiconductor theory of BJTs, analysis of BJT circuits at DC and AC, DC and AC load lines, BJT small signal model and its parameters, power considerations, biasing the BJT for the circuit designs, common emitter, collector and base configurations for BJT amplifiers, amplifier coupling and multistage amplifier analysis and designs, transistor as a switch and its applications, general large-signal model for the BJT, the SPICE BJT model and simulation examples.	BS, CS, ES	4	11-14	OPERATIONAL AMPLIFIERS Introduction of Op-Amp, ideal Op-Am, ideal Op-Amp model and its parameters, inverting and non-inverting configuration circuits analysis, basic circuit building blocks using Op-Amp, advanced linear applications of ideal Op-Amp, practical Op-Amp, effect of finite open-loop gain and bandwidth, practical Op-Amp small signal model and its parameters, DC imperfections, ideal and practical SPICE model and its simulation examples.	CS, ES	3
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<p>Contribution of Course to meet the professional component</p>	<p>In this course, different type of circuitry components, i.e. passive components, diode, transistors and operational amplifier are introduced as well as their analysis method and design. These will provide the students sufficient knowledge for the advance electronic aspects on analog circuit design.</p>																				
<p>Course Instructor(s)</p>	<p>Dr. Choi Wai Wa</p>																				
<p>Prepared by</p>	<p>Dr. Choi Wai Wa</p>																				

Part B: General Course Information and Policies

Instructor	Dr. Choi Wai Wa
E-mail	welsyc@umac.mo
Ext.	8468
Office	BI-A702
Office Hour	By appointment

Programme Educational Objectives

- 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.
- 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.
- Market Acceptance:** Graduates will have successful careers in the academic environment, industrial and government organizations.
- 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
Applied Electronics I	1	3	2	1

Remark:

- Objective for “Problem Solving” can be achieved by assignments, quizzes, mid-term exam and final exam.
- Objective for “Leadership and Communication” can be achieved by experiments. However, leadership training is not given by this course.
- Objective for “Market Acceptance” can be achieved as this course provides fundamental knowledge in electronics.
- 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 and computer simulation.

Program Criteria Policy

Course vs. Program Criteria
Scale: 5 (Highest) to 1 (Lower)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Applied Electronics I			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
Applied Electronics I	H	H	S	N	H	N	S	N	N	N	H	S

The electrical and electronics engineering program outcomes are:

- Ability to apply knowledge of mathematics, science and engineering.
- Ability to design and conduct experiments.
- Ability to design a system, component or process to meet desired needs.
- Ability to function on multidisciplinary teams.
- Ability to identify, formulate and solve engineering problems.
- Understanding of professional and ethical responsibility.
- Ability to communicate effectively.
- Broad education necessary to understand the impact of engineering solutions in global and societal context.
- Recognition of the need for and an ability to engage in life-long learning.
- Knowledge of contemporary issues.
- Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
- An ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations.

Curriculum Detail

ELEC321 Applied Electronics III

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	1.5	0.5	14	70	2/5 hours	100	100

Term: 5th

Hours			Percentage content of					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
40	8/20	2	20	10	30	25	0	15

Design Elements

% of Design Content	Design Content in Course Work	Design Project	Design Content in Laboratories
25%	X	0	X

Course Assessment Policy

Course notes, tutorial notes, tips of weekly study and class news are posted on the course web according to the course progress. Assignments will be given to students according to the course progress, and, selected assignments' answers will be posted onto course web accordingly in addition to the weekly tutorial classes;

- 5 quizzes will be given and only the best 4 are counted;
- 3 experiments will be performed. 2 students form a group and group reports should be submitted.
- A 2-hours mid-term exam and a 3-hours final exam will be required respectively.