COURSE DESCRIPTIONS

Faculty	**Engineering**				
Department	**Department of Renewable Energy Engineering**			**NQF level**	7
Course Title	Power Electrics Laboratory	**Code**	703311	**Prerequisite**	Power Electrics
Credit Hours	1 credit	**Theory**	30 min	**Practical**	150 min
Course Leader	Dr. Jamal Alsadi	**email**	j.alsadi@jadara.edu.jo		
Lecturers	Dr. Amer Al-Canaan	**emails**	a.alcanaan@jadara.edu.jo		
Lecture time	13:30 -16:00 Sun, Tue	**Classroom**	-	**Attendance**	
Semester	Summer 2021/2022	**Production**	2019	**Updated**	2022

Short Description

In this laboratory, students apply and validate the theoretical principles of power electronics. The topics in this practical course include switching power supplies, power converters, power inverters, motor drives, and motor soft starters. Students will be building/simulating different kinds of circuits in order to convert between AC and DC using LTSPice/Tina circuit simulators.

Course Objectives

-
- To be familiar with power electronics components: their types, functionality, how to measure and test:
- Passive components: resistors, inductors and capacitors.
- Semiconductor components: power diodes, transistors, thyristors, TRIACs, and DIACs
- To understand AC-DC conversion techniques.
- To be able to measure and interpret the current, power and voltage in power electronics circuits.
- To be able to simulate the current, power and voltage in power electronics circuits.
- To be able to determine the resistivity of a piece of metal experimentally
- Explain the operation; calculate the performance parameters of each converter such as the average and RMS values of the load voltage and current, power and power factor, efficiency of the converter and the ripple factor.
- Have the ability to specify the voltage and current ratings of the semiconductors for single- phase and three-phase uncontrolled and phase-controlled rectifiers feeding passive loads.
- Understand the applications of power semiconductor devices and power electronic converters to power supplies and DC motor drives.
- Explain the operation of the step-down (buck) and step-up (boost) DC-DC
- Explain the operation of the single-phase and three-phase AC-to-AC converters and their industrial applications.
- Explain the operation of the half-bridge and full-bridge single-phase

Learning Outcomes

A. Knowledge - Theoretical Understanding

Upon successful completion of this course, student should:

a.1 Learn/understand the basic concepts of power electronics components and systems including, power diodes, transistors, thyristors, TRIACs, and DIACs, uncontrolled rectifiers, phase-controlled rectifiers, DC-AC converters and inverters. (K1)

B. Knowledge - Practical Application

a.2 Conduct practical experiments and **measure** electrical quantities, such as resistance, equivalent resistance, voltage, power, efficiency and current. (K2)

C. Skills - Generic Problem Solving and Analytical Skills

b.1 Compute voltage, current, power and **analyse** power electronics circuits using Kirchof's current and voltage laws.

D. Skills - Communication, ICT, and Numeracy

b.3 Perform group work and **write** technical report to analyse and describe basic operation of power electronics devices, such as DC/AC conversion circuits.

E. Competence: Autonomy, Responsibility, and Context

Teaching and Learning Methods

Standard Lecture
Online Lecture
Inside lab. experiments
Multi-media Content
Tutorials
Simulation using Tina and LTSPice circuit simulators

Assessment Methods

Class Participation and Assignments

Reports (10 report.)

Quizzes {(3-5) quizzes of (10-15) minutes will be conducted during the semester. The materials of the quizzes are set by the lecturer}

Midterm Exam

Final Exam

Course Contents

Week	Hours	CLOs	Topics	Teaching & Learning Methods	Assessment Methods
1	5	a1, a2	Introduction to Tina and LTSpice electric circuit simulators Fundamental of power electronics	Experimental learning Discussions and analysis	
2	5	a1, a2, b1, b3	1. V-I characteristics of SCR and measure latching and holding currents. 2. UJT trigger circuit for half wave and full	Experimental learning	Reports # 1 & 2

			wave control.		
3	5	a1, a2, b1, b3	3. single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without freewheeling diode Wheatstone Bridge 4. single phase (i) fully controlled (ii) half controlled bridge rec- tifiers with resistive and inductive loads	Discussions and analysis	**Quiz #1** Reports # 3 & 4
4	5	a1, a2, b1, b3	5. three-phase fully/half controlled bridge rectifier with resis- tive and inductive loads	Experimental learning	Report # 5 **Midterm exam**
5	5	a1, a2, b1, b3	6. single-phase ac voltage regulator with resistive and inductive loads. 7. single phase cyclo-converter	Discussions and analysis	**Quiz #2** Reports # 6 & 7
6	5	a1, a2, b1, b3	8. triggering of (i) IGBT (ii) MOSFET (iii) power transistor RC, RL and RLC transient circuits with DC sources 9. operation of IGBT/MOSFET chopper circuit	Experimental learning	Reports # 8 & 9
7	5	a1, a2, b1, b3	10. MOSFET/IGBT based single-phase series-resonant inverter. 11. MOSFET/IGBT based single-phase bridge inverter	Experimental learning	Reports # 10 & 11
8	5	a1, a2, b1, b3	Revision **Final Exam**	Discussions and analysis	**Final exam**

Infrastructure	
Textbook	Laboratory notes and manual
References	Engineering Circuit Analysis, W.H.Hayat, Kemerly and Durbin, 6th Edition.
Electronic materials	Experiment procedures, simulator manuals
Other	**Tables, manuals**

Course Assessment Plan						
Assessment Method		**Grade**	**CLOs**			
			a.1	**a.2**	**b.1**	**b.3**
First (Midterm)		**20%**	10	5	5	
Second (if applicable)						
Final Exam		**40%**	20	10	10	
Coursework		**40%**				
Coursework assessment methods	Assignments					
	Case study					
	Discussion and interaction					
	Group work activities					
	Lab tests and assignments/attends		5	5	10	10
	Presentations					
	Quizzes				10	
Total		**100%**	35	20	35	10

Plagiarism
Plagiarism is claiming that someone else's work is your own. The department has a strict policy regarding plagiarism and, if plagiarism is indeed discovered, this policy will be applied. Note that punishments apply also to anyone assisting another to commit plagiarism (for example by knowingly allowing someone to copy your code). Plagiarism is different from group work in which a number of individuals share ideas on how to carry out the coursework. You are strongly encouraged to work in small groups, and you will certainly not be penalized for doing so. This means that you may work together on the program. What is important is that you have a full understanding of all aspects of the completed program. In order to allow proper assessment that this is indeed the case, you must adhere strictly to the course work requirements as outlined above and detailed in the coursework problem description. These requirements are in place to encourage individual understanding, facilitate individual assessment, and deter plagiarism.