GAU, Faculty of Engineering

Course Unit Title	Physical Electronics
Course Unit Code	ENG202
Type of Course Unit	Compulsory, All engineering students
Level of Course Unit	2nd Year BSc
National Credits	3
Number of ECTS Credits Allocated	6 ECTS
Theoretical (hour/week)	2
Practice (hour/week)	-
Laboratory (hour/week)	2
Year of Study	2
Semester when the course unit is delivered	4
Mode of Delivery	Face to Face, Laboratory Experiments, E-learning activities
Language of Instruction	English
Prerequisities and co-requisities	ENG201 Fundamentals of Electrical Engineering
Recommended Optional Programme Components	Basic background of Physics and Chemistry

Objectives of the Course:

- Teaching physical background of semiconductors
- Teaching physical and electrical properties of basic electronic devices; transistors and diodes
- Teaching analysis of basic diode and transistor circuits

Learning Outcomes

When this course has been completed the student should be able to		Assessment
1	explain the properties of intrinsic and doped semiconductors	1
2	explain physical behavior and regions of operation of semiconductor diodes	1,2
3	explain physical behavior of and regions of operation transistors	1,2
4	conduct DC analysis of basic diode circuits	1,2
5	conduct DC analysis of basic transistor circuits	1,2
6	test basic electrical behavior of electronic devices via measurements	3,5

Assessment Methods: 1. Written Exam, 2. Assignment, 3. Project/Report, 4. Presentation, 5 Lab. Work

Course's Contribution to Program

		CL
1	Ability to understand and apply knowledge of mathematics, science, and engineering	4
2	Ability to design and conduct experiments as well as to analyze and interpret data	4
3	Ability to work in multidisciplinary teams while exhibiting professional responsibility and ethical conduct	2
4	Ability to apply systems thinking in problem solving and system design	3
5	Knowledge of contemporary issues while continuing to engage in lifelong learning	2
6	Ability to use the techniques, skills and modern engineering tools necessary for engineering practice	3
7	Ability to express their ideas and findings, in written and oral form	4
8	Ability to design and integrate systems, components or processes to meet desired needs within realistic constraints	3
9	Ability to approach engineering problems and effects of their possible solutions within a well structured, ethically responsible and professional manner	3

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5:Very High)

Course Contents

Week	Theory	Application	Exams
1	Conduction, semiconductors, carriers.	Discussion on measurement basics.	
2	p-type and n-type doping, drift and diffusion mechanisms.	Introduction of essential measurement instruments	
3	Physical structure and behavior of the pn junction.	Experiment on simple resistor circuits	
4	Ideal diode, practical diode, electrical behavior and current-voltage curve. Diode models.	SPICE demonstration about diode electrical behavior.	
5	DC analysis of diode circuits. Body resistance and parasitic capacitors.	Experiment on diode operation regions.	Quiz #1
6	Diode applications (e.g. rectifiers).	Experiment on basic diode-resistor circuits.	
7	Zener diode and regulation. Other diode types.	Experiment on diode-based rectifiers.	
8			Midterm
9	Physical structure and behavior of the bipolar-junction transistor (BJT).	Experiment on Zener diode and regulation.	
10	BJT operation regions, electrical model (Ebers-Moll) and characteristics.	SPICE demonstration about BJT electrical behavior.	
11	DC biasing of BJT circuits.	Experiment on electrical behavior of BJT.	
12	Basic applications of transistors.	Experiment on switching and amplification ability of transistors.	Quiz #2
13	Physical structure and behavior of field-effect transistors (JFET, MOSFET).	SPICE demonstration about MOSFET electrical behavior.	
14	Operation regions, characteristics and DC biasing of FETs.	Experiment on electrical bahavior of MOSFET.	
15			Final

Recommended Sources

Textbook: R. Boylestad & L. Nashelsky, “Electronic Devices and Circuit Theory”, 10th edition, Prentice Hall, 2008.

Supplementary Material(s): A. Sedra & K.C. Smith, “Microelectronic Circuits”, 6th edition, Oxford University Press, 2010.

Assessment

Attendance	5%	
Assignments	10%	
Laboratory	10%	
Midterm Exam (Written)	20%	
Quizzes (Written)	20%	
Final Exam (Written)	35%	
Total	100%	

ECTS Allocated Based on the Student Workload

Activities	Number	Duration (hour)	Total Workload(hour)
Hours per week (Theoretical)	14	2	28
Hours per week (Laboratory)	14	2	28
Pre-Lab work preparation before experiments	10	2	20
Presenting of observations and laboratory practices as report	10	4	40
Preparation of the homeworks	5	3	15
Quizzes Preparation for quiz	2 2	1 8	18

Supervision a) Midterm Examination b) Self-study for exam	 1 1	 2 12	14
Final Exam a) Exam b) Self-study for exam	 1 1	 2 15	17
Total Workload			180
Total Workload/30 (h)			6.0
ECTS Credit of the Course			6