2021-2022	Mechanical Engineering	Year 3 - Sem. 5
ELEC317	**Electronics**	Mandatory
ECTS: **2**	*Coordinator:* Dr. Carine Kassis	*Language:* English/French
Total hours: **27 h**	*Lectures:* Dr. Houssein Houssein, Dr. Carine Kassis, Dr. Lana Damaj	

Description:

This course is an introduction to electronics, where the first part focuses on the analog circuits while the second part is dedicated to the digital part, with the following content:
P-N junction: Diode, Zener diode. Bipolar transistors (BJT) - Amplifiers - Sampling of analog signals – Binary Systems - ADC / DAC converters - Combinatorial logic circuit - Elementary gates: OR, AND, NOT, exclusive OR, Ball algebra, Karnaugh diagrams. Decoders, Encoders. Multiplexers, Demultiplexers, Comparators. Adders, Subtractors, Arithmetic and Logic Units. Application.

Learning outcomes:

- Illustrate working principle of different electronic circuit and their application in real life;
- Analyze simple electronic circuits based on diodes and BJT transistors with special focus on designing amplifiers with discrete components;
- Design and analyze bias circuits for BJTs and Operational Amplifiers for the basic categories (CE, CC, CB);
- Perform Analysis at AC of Amplifiers based on BJTs using small signal models;
- Perform basic arithmetic calculations and conversion between binary, decimal and hexadecimal;
- Simplify Boolean expressions using theorems and DeMorgan's law;
- Convert truth tables to sum of products logic, use a Karnaugh map to simplify logic statements containing no more than 4 variables and utilize NAND and NOR gates to implement any logic;
- Design any combination circuit using gates, decoders and multiplexers;
- Demonstrate basic skills on using electronic devices simulation programs and on applying them in homework and laboratory exercises.

Content:

- Diodes: Introduction - Intrinsic semiconductor – Doping - PN junction - PN Junction Diode - Diode biasing - Diode Modeling - Diode Equation - Diode applications (Rectifier, Limiter Circuits, …) - Zener Diode – Voltage Regulation
- Operational Amplifier: Introduction - Transfer characteristic of an Op Amp - Virtual short circuit principle - Elementary functions of Op Amps (Inverting, Non-Inverting, Subtraction and Addition of Signals, Integrator, Differentiator, Buffer) - Nonlinear applications of Op Amps (Comparator, 2-Threshold Comparator)
- Bipolar Junction Transistors (BJT): Introduction - Device structure and physical operation - Current-Voltage characteristics - BJT circuits at DC - Applying the BJT in amplifier design - Biasing the BJT - Small signal operation and models – Different Amplifier Configurations (Common Emitter Amplifier - Common Collector Amplifier)
- Digital Systems and information: Digital Systems, Computers, and Beyond - Information Representation – Sampling Theory – ADC and DAC - Number Systems - Arithmetic Operations - Base Conversion – Code Types (Decimal, Gray) – Signed Numbers: Complements - Signed Binary Numbers - Signed Binary Addition and Subtraction - Overflow
- Combinational Logic Circuits: Binary logic and gates: Binary Variables – Logical Operations – Operator Definitions – Truth Tables – Logic Gates – Logic Diagrams. Boolean algebra: Theorems - Boolean Function Evaluation - Expression Simplification – Complementing Functions – Implementation Circuits. Standard forms: Canonical Forms – Minterms – Sum of Minterms – Sum of Products. Circuit Optimization: Cost Criteria - Karnaugh K-Maps applied for 2 to 4 Variables - Prime Implicant Selection Rule - Don't Care. Additional Gates: Buffer – NAND/NOR – XOR/XNOR – Odd and Even Functions.
- Combinational Logic Design: Design Procedure: Steps - Technology Mapping – Verification. Combinational Logic: Rudimentary logic functions - Decoding using Decoders - Encoding using Encoders - Selecting using Multiplexers.

References:

- A. Sedra, K.C. Smith, Microelectronic Circuits, 6th Edition, Oxford University Press, 2010.

- M.M. Mano, C.H. Kime, T. Martin, Logic & Computer Design Fundamentals, 5th Edition, Pearson, 2015.

Evaluation Method:

Assessment in the following areas will be converted to points, to compute your final grade in this course:

- Mid-Term
- Final Exam
- Attendance and Participation

Description :

Ce cours est une introduction à l'électronique, où la première partie se base sur les circuits analogiques tandis que la deuxième partie est dédiée à la partie numérique, avec le contenu suivant :
Jonction P-N : Diode, diode Zener. Transistors bipolaires (BJT) - Amplificateurs - Échantillonnage de signaux analogiques - Systèmes binaires - Convertisseurs CAN/CNA - Circuit logique combinatoire - Portes élémentaires : OU, ET, NON, OU exclusif, Algèbre Booléenne, diagrammes de Karnaugh. Décodeurs, Encodeurs. Multiplexeurs, Démultiplexeurs, Comparateurs. Additionneurs, soustracteurs, Unités Arithmétiques et Logiques. Application.