Analog Electronics

1. **Course number and name:** 020ELAES1 Analog Electronics

2. **Credits and contact hours:** 6 ECTS credits, 2x1:15 lecture + 1:15 lab hours

3. **Instructor's or course coordinator's name:** Rayan Chehade MINA

4. **Text book:** Electronic Principles, 8th Edition, A. Malvino, D. Bates
   a. **Other supplemental materials:**

5. **Specific course information**
   a. **Catalog description:**
   This course covers the main low-power electronic components: 1) P-type and N-type semiconductors – P-N junction; 2) diodes: characteristics and application circuits (clipping, rectification…) – Zener diode (regulation) – Light-emitting diode. 3) Bipolar transistor: static operation (I – V characteristics, Biasing, Load line) – dynamic operation (amplifier circuits) – synthesis of amplifier circuits – Bipolar transistor as switches. 4) JFET and MOSFET transistors: I – V characteristics – resistive operation and amplification. 5) Operational amplifier (OA): differential structure and differential amplifier – static and dynamic performances – application circuits (Inverting/Non-inverting amplifiers, instrumentation amplifier, 1st order active filters). 6) Comparator: characteristics – performances and limitations – application circuits

   b. **Prerequisites or co-requisites:** Prerequisites 020SRLNI4 Linear Electrical Systems and Networks or 020SRLCI4 Linear Electrical Systems and Networks

   c. **Required**: Required for CCE students

6. **Specific goals for the course**
   a. **Specific outcomes of instruction:**
   Model and analyze the behavior of basic electronic components: diodes, BJT transistors, JFET and MOSFET transistors.
   Design and simulate transistor-based amplifier circuits.
   Evaluate the performances and limitations of electronic components.
   Extract relevant parameters from data sheets of electronic components.
   Design and analyze operational amplifier circuits to perform target functions.

   b. **KPI addressed by the course:**

KPI	a2	b1	b2	b3	c1	c2	i2	k2	k3
Covered	x	x	x	x	x	x			
Assessed	x	x	x	x	x	x	x	x	x
Give Feedback									

7. **Topics and approximate lecture hours:**

Identify Semiconductors and doping, P-N junction, Biasing of a PN junction. Recognize and identify Diodes: Definition, I – V characteristic, linear model and parameters (3 lectures)
Applications of diodes: Analyze and design rectifier circuits, Clipper and Limiters (2 lectures)
Recognize Zener diode and design regulation circuits (1 lecture)
Evaluate and design regulated power supply (1 lecture)
Lab1: Diodes (2 lectures)

Identify bipolar junction transistor: analyze DC operation and calculate quiescent point (1 lecture)
Analyze and recognize different biasing circuits (2 lectures)
Lab2: bipolar transistor – DC operation (2 lectures)

Bipolar transistor: analyze AC operation and identify small-signal equivalent model (1 lecture)
Evaluate, analyze and design BJT One-stage amplifiers: EC, CC, BC (2 lectures)
Evaluate, analyze and design BJT Multi-stage amplifiers (2 lecture)
Recognize Frequency effects and Bandwidth of BJT amplifiers (1 lecture)
Lab3: Design of BJT amplifier circuits – simulation, realization, measurement (2 lectures)

Identify JFET and MOSFET transistors: analyze and evaluate DC and AC operation, equivalent models (3 lectures)
Design FET one-stage amplifiers (2 lectures)
Lab4: Design of FET amplifier circuits – simulation, realization, measurement (2 lectures)

Recognize differential structure: analyze differential amplifier, theory, DC/AC analysis, evaluate mismatch and calculate CMRR (4 lectures)
Analyze Operational Amplifier: Basics, theory, DC and AC operation (1 lecture)
Evaluate Operational Amplifier Imperfections (1 lecture)
Lab5: Operational amplifier parameter measurements (1 lecture)

Application circuits: Design Inverting/Non-inverting amplifiers, instrumentation amplifier, 1^{st} order active filters (4 lectures)
Lab6: Operational amplifier applications and circuits (2 lectures)

Design and analyze Analog Comparators and applications (2 lectures)
Lab7: Analog Comparator applications and circuits (2 lectures)

Recognize and identify Amplifier classes: A, B, AB and C (2 lectures)
Lab8: Push-Pull design and measurements (2 lectures)