Syrian Arab Republic

Higher Institute for Applied Sciences and Technology

Course Specification Document

Title	Basics in Electronic and Logical Circuits

Credits	5 ECTS

Aims	This course aims to introduce the student to the basic electronic components: P-N diode, bipolar junction transistor, and field-effect transistor, along with their properties and applications. Analysis of transistor amplifiers, the operation of differential amplifiers and operational amplifiers, signal digitization, analog-to-digital converters, logical gates, electronic memories. This will contribute to their study of other specialized courses and later in their professional practice.

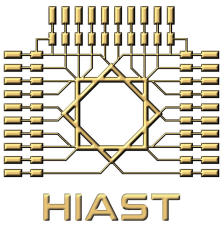
Intended learning outcomes

On successful completion of this course, the student will be able to:

- Understand the characteristics and applications of P-N Diodes, Bipolar Junction Transistors and Field Effect Transistors.
- Analyze and design transistor amplifiers and operational amplifiers along with their applications, especially analog to digital converters and digital to analog converters.
- Understand the components of logic gates and electronic memories.
- Design and implement Transistor amplifiers circuits.
- Design and implement operational amplifier circuits for linear and non-linear applications.
- Design logic gates and electronic memories.

Syllabus

- **Electric Circuits Analysis:** A Reminder of electrical principles, electric circuits analysis methods (superposition, using Kirchhoff laws with junctions and loops, nodal and mesh analysis, Thevenin and Norton equivalences of a sub-circuits).
- **P-N Junction (its working principle, modelisation and basic applications):** Semi-conductors, P-N junction (diodes), diode modeling for small signals and high frequencies, characteristic curves, ideal diodes, diode applications (rectification, clipping, power supplies, peak tracking, DC recovering), special diodes (Zener, Schottky , solar cells, LEDs).
- **Bipolar Junction Transistor (its working principle, its modelisation, characteristic curves and basic applications):** Transistor structure, working modes, symbolism, configurations, characteristic curves, modelisation for variable signals, the transistor as an amplifier, quiescent point, common emitter and common base amplifiers, high-frequency modelisation, band-width and Miller effect.



- **Field Effect Transistor (its working principle, its modelisation, characteristic curves and basic applications):** Working principle of MOSFET, characteristic curves, transistor polarization, the transistor as an amplifier, transistor small signal and high frequency modelisation, MOSFET amplifier configurations.
- **Transistor Amplifiers (Basic configurations, linking transistor amplifiers):** MOSFET-BJT transistors comparison, current mirrors, multi-transistor amplifiers.
- **Differential Amplifier and Operatoional Amplifier:** Differential amplifier (common mode and differential mode amplification), operational amplifier, linear applications of operational amplifier, non-linear applications of operational amplifier.
- **Signal digitization, analog to digital converters and digital to analog converters.**
- **Logic gates:** CMOS, pseudo NMOS, ECL, TTl and Pass Transistor logic gates.
- **Electronic memories:** ROM, PROM, EAROM and RAM Memories.
- **A reminder of number representation and counting methods:** A review of the number systems, methods of conversion between them and arithmetic operations in the binary system, representation of negative numbers in the computer.
- **Properties of logical gates:** Logical gates and their properties, practical applications on logical gates, Boolean algebra and explanation of famous identities and their use by simplifying logical equations.
- **Algebric expressions and Carnot Tables:** Ideal forms of algebric expressions and Carnot Tables.
- **Combinatory circuits: T**he adder circuit, the comparator circuit, the multiplexer circuit, the encoder circuit, and the decoder circuit.
- **Basics of sequential circuits:** Sample and hold circuits, flip-flops.
- **Sequential circuits:** Sequential circuits (synchronous and asynchronous), analysis of synchronous sequential circuits and explanation of state diagrams.
- **Design of synchronous sequential circuits:** Design of synchronous sequential circuits by Mealy method, design of synchronous sequential circuits by Moore method, design of counters.
- **Registers:** Parallel registers, serial registers, shift registers**.**
- **Memories:** Types and construction of memories, methods of addressing and expansion.