The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Electronics (I) – 0903261 (3 Cr. – Required Course)**

Instructor: Dr. Raed Al-Zubi
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Office Hours: Will be posted soon

Course website: http://elearning.ju.edu.jo/

Catalog description: Introduction to semiconductors. Conduction in metals. Intrinsic and extrinsic semiconductors. Electrical properties of semiconductors. Diffusion process in semiconductors. The PN junction diode. Open-circuited junction. Forward, reverse biased junction. VI static characteristics. Temperature effects. Small and large-signal models. Junction capacitance and switching times. Diode types and applications. Rectification. Rectifier filters. Clipper and clamper circuits. Voltage multipliers. Zener, varactor and Schottky diodes. LED and Photodiode applications. Bipolar Junction Transistors (BJT): Ebers-Moll mode. CB and CE characteristics. DC biasing and analysis. BJT as a switch and amplifier. Small-signal models. Transistor ratings. Field-effect Transistor (FET): VI characteristics of JFET and MOSFET. FET transistor as a switch and amplifier. Small-signal models. The MOSFET transistor. Transistor ratings.

Prerequisites by course: **EE** **0903211** Electrical Circuits (I) (pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Basic electrical circuit analysis techniques.
- Solution of ordinary differential equations.

Textbook: **Microelectronics Circuit Analysis and Design by Donald A Neamen, McGraw-Hill Education, 4th edition, 2009.**

References:
1. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith, Oxford University Press, 7th edition, 2015.
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky, 11th edition, Pearson, 2012.
3. Fundamentals of Microelectronics by Behzad Razavi, 2nd edition, Wiley, 2013.

4. Electronics Fundamentals: A Systems Approach by by Thomas L. Floyd and David M. Buchla, 1st edition,Pearson, 2013.
5. Schaum's Outline of Electronic Devices and Circuits by Jimmie J. Cathey, McGraw-Hill Education, 2nd Edition, 2002.
6. Semiconductor Physics And Devices: Basic Principles by Donald A. Neamen, McGraw-Hill, 4th Edition, 2011.
7. The Art of Electronics by Paul Horowitz and Winfield Hill, Cambridge University Press, 3rd edition, 2015.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is is to introduce the student to semiconductor devices, specifically circuit analysis, design, and applications of diode circuits, BJT basic structure and operation, DC biasing, small-signal circuit model, and possible amplifier configurations. FET types, basic structure and operation, DC biasing, small-signal circuit model, and possible amplifier configurations.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will: **[SO]**

1. Understand semiconductor materials, types and properties. **[1]**
2. Understand the P-N junction principle of operation and characteristics. **[1]**
3. Be able to analyze and design circuits containing diode applications including the different half-wave and full-wave rectifier circuit's configurations and bridge rectifiers. **[1]**
4. Understand the operation of a P-N junction in the breakdown region. **[1]**
5. Learn how to analyze circuits containing Zener diode applications such as Zener diode based voltage regulators. **[1]**
6. Understand the physical structure, principle of operation and characteristics of BJT transistors and FET transistors in both: MOSFET and JFET transistors. **[1]**
7. Be able to perform DC analysis of BJT and FET circuits and determine the bias point of a transistor. **[1]**
8. Become familiar with the different biasing configurations of a BJT and FET amplifier circuits. **[1]**

Course topics:

Hrs

1. Units, Semiconductor Materials: Intrinsic, extrinsic, n-type, and p-type semiconductors, doped semiconductor materials, P-N junction and characteristics, depletion region and threshold voltage, reverse and forward biasing of P-N junctions, P-N junctions in breakdown region, and i-v characteristics. **5**
2. Diodes: The ideal diode, real diodes, physical operation of diodes, analysis of diode circuits, the small-signal model and its application, operation in the reverse breakdown region (Zener diodes), rectifier circuits, limiting and clamping circuits. **11**
3. Bipolar Junction Transistors (BJTs):Physical structure and modes of operation, operation of the npn transistor in the active mode, circuit symbols and conventions, analysis of transistor circuits at DC, the transistor as an amplifier, small-signal equivalent circuit models, biasing the BJT for discrete-circuit design, basic single-stage BJT amplifier configuration, the transistor as a switch–cutoff and saturation. **13**

4.	Field-Effect Transistors (FETs): Structure and physical operation of the MOSFET and JFET transistors, current-voltage characteristics, DC analysis of MOSFET & JFET circuits, the MOSFET as an amplifier, biasing in MOSFET amplifier circuits, basic configurations of single-stage MOSFET amplifiers.	**13**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021