The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2023/2024

Course:	Integrated Circuits – 0903562 (3 Cr. – Elective Course)
Instructor:	Dr. Hani Jamleh Office: E301, Telephone: 06/5355000 ext 22844, Email: h.jamleh@ju.edu.jo Office Hours: Will be posted soon
Platform:	Moodle (https://elearning.ju.edu.jo/)
Catalog description:	Basic concepts of operational amplifier. Input differential amplifier stage characteristics. Operational Amplifier: voltage transfer characteristic, analysis, and design. Practical Op-Amp limitations. The common mode rejection ratio (CMRR). Opamp circuits and applications: Linear circuits and nonlinear circuits. Integrated circuit fabrication, layout and design rules. Device physics and MOS models. Single-stage amplifiers. Differential amplifiers. Multiple-stage amplifiers. Current mirrors and references. Frequency response. Noise. Feedback techniques for Integrated Circuits. Introduction to switched-capacitor circuits. Nanometer design issues.
Prerequisites by course:	EE 0903362 Digital Electronics (pre- or co-requisite)
Prerequisites by topic:	Students are assumed to have a background in the following topics: • Basic Electronics: Understanding of electronic components and circuit theory. • Circuit Analysis: Proficiency in analyzing electrical circuits. • Semiconductor Devices: Knowledge of diode, BJT, and MOSFET operations. • Mathematics: Skills in calculus, linear algebra, and differential equations. • Signals and Systems: Basics of signal processing and frequency response.
Textbook:	Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco, McGraw-Hill, 3rd. ed., 2001.
References:	1. "Analog Integrated Circuit Design" by David A. Johns and Ken Martin 2. "CMOS Analog Circuit Design" by Phillip E. Allen and Douglas R. Holberg 3. "Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith 4. "The Art of Electronics" by Paul Horowitz and Winfield Hill
Schedule:	On Campus [16 Weeks, 42 lectures (50 minutes each) including exams]
Course goals:	The overall objective is to introduce the student to the basics of integrated circuits analysis and design, and their related fabrication issues. This course emphasizes: • The fundamental concepts of operational amplifiers, including voltage transfercharacteristics and differential amplifier stages. • The linear and nonlinear circuits, incorporating practical Op-Amp limitations, CMRR,and feedback techniques.

- Exploring integrated circuit design, including fabrication processes, MOS models,and advanced topics like nanometer-scale challenges.

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

Upon successful completion of this course, a student will:	[SO]
1. To understand the basic concepts and functions of operational amplifiers.	[1]
2. To analyze and design differential amplifier stages.	[2]
3. To explore practical limitations and design challenges in Op-Amp circuits.	[1, 7]
4. To gain knowledge of integrated circuit fabrication and design rules.	[1, 7]
5. To apply principles of feedback and frequency response in circuit design.	[2]
6. To uderstand some nanometer issues in Integrated Circuits design and fabrication.	[1, 7]

Course topics:

	Hrs 6
1. Introduction to Operational Amplifiers. Overview, basic concepts, and historical importance of operational amplifiers (Op-Amps).	6
2. Differential Amplifier Characteristics & Op-Amp Analysis, differential amplifier basics, input stage characteristics, voltage transfer characteristics, and practical Op-Amp limitations.	4
3. Common Mode Rejection & Linear/Nonlinear Circuits. Understanding CMRR, techniques to improve it, and design/analysis of linear and nonlinear Op-Amp circuits.	6
4. Integrated Circuit Fabrication & Device Physics. Overview of IC fabrication processes, layout design rules, and fundamentals of device physics and MOS models.	6
5. Single-Stage and Differential Amplifiers. Design, analysis, and stability considerations for singlestage and differential amplifiers, including multi-stage techniques.	4
6. Current Mirrors, References & Frequency Response. Principles of current mirrors, reference circuit design, frequency response analysis, and noise mitigation.	6
7. Feedback Techniques & Switched-Capacitor Circuits. Introduction to feedback principles, stability, compensation, and basics of switched-capacitor circuits.	4
8. Nanometer Design Issues. Challenges and techniques in nanometer-scale IC design, with a look into future trends.	

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. Academic integrity must be maintained.
Assessment & grading policy:	First Exam 10% Assignments 10% Midterm Exam 30% Projects 0% Final Exam 50% Lab Reports 0% Quizzes 0% Presentation 0%

Total	100%

Last Revised: Feb 2024