MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Physics** **الفيزياء**			**Module Delivery**	
Module Type	**Basic**			☒ **Theory** ☐ **Lecture** ☐ **Lab** ☒ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**CS 114**				
ECTS Credits	**6**				
SWL (hr./sem)	**150**				
Module Level		UGI	**Semester of Delivery**		1
Administering Department		Department of Communications and Intelligent Digital Systems Engineering	**College**	Engineering	
Module Leader	Asst. Prof. Dr. Mohammad T. Yaseen		**e-mail**	mtyaseen@uomosul.edu.iq	
Module Leader's Acad. Title		Assist. Prof.	**Module Leader's Qualification**		Doctor
Module Tutor	Asst. Prof. Dr. Shamil Hamzah Hussein		**e-mail**	Shamil_alnajjar84@uomosul.edu.iq	
Peer Reviewer Name		Asst. Prof. Dr. Saad Ahmed Ayoub	**e-mail**	sa_ah_ay@uomosul.edu.iq	
Scientific Committee Approval Date		1/1/2026	**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims أهداف المادة الدراسية	• **To establish** the fundamental principles of quantum mechanics and atomic models that underpin modern electronics. • **To explain** the energy-band theory of solids and classify materials as conductors, semiconductors, and insulators based on their electronic structure. • **To analyze** charge carrier behavior in semiconductors, including concepts of drift, diffusion, mobility, and conductivity in both intrinsic and extrinsic materials. • **To investigate** the formation and electrical characteristics of the p-n junction, which is the foundational building block of most semiconductor devices. • **To equip** students with the ability to solve practical problems related to carrier statistics, junction properties, and basic device parameters.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. **Explain** the historical development of atomic models and the principles of quantum mechanics relevant to electronics. 2. **Differentiate** between conductors, semiconductors, and insulators using energy-band theory. 3. **Calculate** key parameters such as electron energy, carrier velocity, and photon wavelength in atomic structures. 4. **Analyze** charge transport phenomena, including drift and diffusion currents, in semiconductors. 5. **Determine** the carrier density and Fermi level position in intrinsic and extrinsic semiconductors. 6. **Apply** the principles of the Hall effect to determine material properties like carrier type and density. 7. **Analyze** the formation, biasing, and electrical characteristics of a p-n junction diode. 8. **Compute** critical junction parameters such as barrier potential, depletion width, and junction capacitance.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. **Part A:** [**8 hrs**.] **Foundations of Electronics Physics (Approx. 25-30%)** • Atomic Models (Thomson, Rutherford, Bohr) • Quantum Concepts (De Broglie Hypothesis, Photon Energy) • Electron Energy Levels and Spectra • Energy-Band Theory of Solids (Metals, Semiconductors, Insulators) • Fermi-Dirac Statistics Revision problem and tutorial classes [**2 hrs**.] Quizzes [**1 hr**.] **Part B:** [**8 hrs**.]

	Semiconductor Properties and Transport Phenomena (Approx. 35-40%) • Intrinsic and Extrinsic Semiconductors • Carrier Concentration and Fermi Level • Electrical Conductivity, Resistivity, and Mobility • Drift and Diffusion Currents • Work Function and Electronic Emission • Hall Effect and its Applications Quizzes [**1 hr**.] **Part C:** [**8 hrs**.] **Semiconductor Devices and P-N Junction (Approx. 30-35%)** • Formation of the P-N Junction and Depletion Region • Barrier Potential and Energy Band Diagram • Junction Biasing (Forward and Reverse) and I-V Characteristics • Depletion Capacitance and Junction Parameters • Analysis and Problem-Solving for Diode Circuits Revision problem and tutorial classes [**4 hrs**.] Quizzes [**1 hr**.]

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	This module employs a multi-faceted pedagogical strategy to bridge fundamental physics and practical electronics. The learning journey begins with a conceptual foundation, exploring atomic models and quantum mechanics to establish the core principles governing electron behavior. This theoretical framework is systematically applied to the energy-band theory of solids, enabling students to classify materials and understand semiconductor physics. The strategy heavily emphasizes problem-based learning, requiring students to actively calculate key parameters from carrier densities and Fermi levels to barrier potentials and depletion widths thereby translating abstract concepts into quantitative analysis. This approach ensures that learners not only grasp the operational principles of semiconductor devices like the p-n junction diode but also develop the analytical skills necessary for device characterization and circuit application.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	48	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	102	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6

Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150

Module Evaluation
تقييم المادة الدراسية

		Time/ Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	8% (16)	4,8,11	LO #1, 4, 6 and 7
	Assignments	3	4% (12)	2 to 13	LO #1, 2, 3, 4, 5 and 7
	Projects	---	----	----	-----
	Report	1	7% (7)	Continuous	All
	classwork	1	5% (5)	13	LO #1, 2, 3, 4, 5 and 7
Summative assessment	Midterm Exam	2 hr.	10% (10)	12	LO # 4-7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

Weeks	Material Covered	Key Contents
Week 1	Introduction to Atomic Models	Thomson's "Plum Pudding," Rutherford's Nuclear Model
Week 2	The Bohr Model	Bohr's Postulates, Electron Energy Levels for Hydrogen
Week 3	Quantum Foundations	De Broglie Hypothesis, Wave-Particle Duality
Week 4	Energy Band Theory	Band Formation, Conductors, Insulators, Semiconductors
Week 5	Fermi-Dirac Statistics	Fermi Function, Fermi Energy, Carrier Distribution
Week 6	Transport Phenomena I	Drift Current, Mobility, Conductivity
Week 7	Transport Phenomena II	Diffusion Current, Einstein Relation, Total Current Density
Week 8	Intrinsic & Extrinsic Semiconductors	Doping, n-type & p-type, Carrier Concentration
Week 9	**Mid-Term Exam** / The p-n Junction I	Depletion Region Formation, Built-in Potential
Week 10	The p-n Junction II	Biasing (Forward/Reverse), I-V Characteristics, Ideal Diode Equation
Week 11	The p-n Junction III	Depletion Capacitance, Junction Breakdown
Week 12	Work Function & Contacts	Electronic Emission Types, Metal-Semiconductor Contacts

Week 13	The Hall Effect	Principle, Hall Voltage & Coefficient, Determining Carrier Density
Week 14	Diode Applications	Rectifiers, Zener Diodes, LEDs, Photodiodes
Week 15	Course Review	Comprehensive Review & Problem-Solving

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Floyd, Thomas L. Electronics Fundamentals: Circuits, Devices and Applications (Floyd Electronics Fundamentals Series). Prentice-Hall, Inc., 2006.	Yes
Recommended Texts	Donald A. Neamen. (2003). "SEMICONDUCTOR PHYSICS AND DEVICES". 3rd Edition, ISBN 0-07-232107-05, USA. (can be downloaded from the Course web page/classroom).	Yes
Websites	Nashelsky, L., & Boylestad, R. L. (2021). Electronic Devices and Circuit Theory Eleventh Edition.	

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks (%)	Definition
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.