	Ministry of Higher Education and Scientific Research - Iraq Al-Nahrain University College of Science Department of Medical Physics	

MODULE DESCRIPTOR FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	Solid State Physics			**Module Delivery**	
Module Type	CORE			☒**Theory** ☒**Lecture** ☐**Lab** ☒**Tutorial** ☐**Practical** ☒**Seminar**	
Module Code	MPHY3106				
ECTS Credits	5				
SWL (hr/sem)	125				
Module Level	3		**Semester of Delivery**	1	
Administering Department	MPHY		**College**	College of Science	
Module Leader	Marwa Abdul Muhsien		**e-mail**	marwa@nahrainuniv.edu.iq	
Module Leader's Acad. Title	Assistant Professor		**Module Leader's Qualification**	PhD	
Module Tutor	Zaid Malk Abbas		**e-mail**	zaid.malk@nahrainuniv.edu.iq	
Module Reviewer			**e-mail**		
Peer Reviewer Name			**e-mail**		
Review Committee Approval			**Version Number**		

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	1. Provide students with a fundamental understanding of the principles governing the structure and properties of solid materials. 2. Develop the ability to analyze crystal structures, bonding mechanisms, and lattice vibrations, and relate them to physical properties of solids. 3. Introduce the concepts of reciprocal lattice, X-ray diffraction, and band theory, enabling students to interpret the electrical, thermal, and optical behavior of materials. 4. Familiarize students with different classes of materials such as metals, semiconductors, insulators, magnetic, and superconducting materials, highlighting their physical mechanisms. 5. Encourage students to connect solid state physics principles with modern technological applications, such as electronic devices, nanomaterials, and advanced functional materials. 6. Motivate students to engage in independent learning and research in condensed matter physics and its applications in science and engineering
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Analyze the crystal structure of solids and use mathematical methods to describe periodic lattices, unit cells, and reciprocal space. 2. Apply Bragg's law and X-ray diffraction principles to determine crystal structures experimentally. 3. Understand and explain different types of bonding in solids (ionic, covalent, metallic, van der Waals, hydrogen bonding) and their impact on material properties. 4. Interpret the concepts of reciprocal lattice, Miller indices, and crystal planes, and use them in analyzing solid structures. 5. Apply the free electron model, nearly free electron model, and band theory to explain electrical conductivity in metals, semiconductors, and insulators. 6. Explain the concept of density of states, Fermi energy, and carrier concentration, and relate them to thermal and electrical properties of solids.
Indicative Contents المحتويات الإرشادية	**1. Crystal Structure** - Periodic arrays of atoms - Unit cell, basis and lattice parameters - Bravais lattices and crystal systems - Miller indices and crystal planes - Simple crystal structures: SC, BCC, FCC, HCP **2. X-ray Diffraction and Reciprocal Lattice** - Bragg's law - Structure factor and intensity

	- Reciprocal lattice and Ewald construction **3. Crystal Bonding** - Ionic, covalent, metallic, van der Waals, hydrogen bonding - Relation to material properties **4. Lattice Vibrations and Thermal Properties** - Vibrations of monatomic and diatomic lattices - Phonons and quantization of lattice vibrations - Heat capacity: Einstein and Debye models - Thermal conductivity **5. Free Electron and Band Theory** - Free electron model and density of states - Fermi energy and Fermi-Dirac statistics - Nearly free electron model - Origin of energy bands and band gaps - Metals, semiconductors, and insulators **6. Semiconductors and Superconductors** - Intrinsic and extrinsic semiconductors - Carrier concentration and conductivity - Superconductivity: basic properties and applications
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Inquiry-based learning: Encourages students to ask questions and discover concepts on their own through experiments and research projects, which enhances critical thinking and problem-solving skills. 2. Collaborative learning: Encouraging teamwork where students exchange ideas and collaborate in solving scientific questions and experiments. 3. Brainstorming and group discussion: This strategy helps to promote group thinking and the cultural exchange of scientific ideas among students. 4. Problem-based learning: Students learn physics by facing real issues and solving those using physics tools and concepts. 5. Constructive assessment: Using continuous assessment to measure students' progress and understanding of concepts, rather than relying solely on final exams.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.2

Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	62	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.13
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	1	10% (10)	Continuous	All
	Online Assignments	1	10% (10)	Continuous	All
	Onsite Assignments	1	10% (10)	Continuous	All
	Seminar	1	10% (10)	Continuous	All
Summative assessment	**Midterm Exam**	2 hr	10% (10)	14	LO # 1-13
	Final Exam	3hr	50% (50)	15	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	1.Crystal Structure - Periodic arrays of atoms - Unit cell, basis and lattice parameters
Week 2	Bravais lattices and crystal systems - Miller indices and crystal planes - Simple crystal structures: SC, BCC, FCC, HCP
Week 3	2. X-ray Diffraction and Reciprocal Lattice - Bragg's law
Week 4	Structure factor and intensity - Reciprocal lattice and Ewald construction
Week 5	3.Crystal Bonding - Ionic, covalent bonding
Week 6	Van der Waals, hydrogen bonding - Relation to material properties
Week 7	4. Lattice Vibrations and Thermal Properties - Vibrations of monatomic and diatomic lattice
Week 8	Phonons and quantization of lattice vibrations - Heat capacity: Einstein and Debye models - Thermal conductivity
Week 9	5. Free Electron and Band Theory - Free electron model and density of states
Week 10	Fermi energy and Fermi-Dirac statistics - Nearly free electron model

Week 11	Origin of energy bands and band gaps - Metals, semiconductors, and insulators
Week 12	6. Semiconductors and Superconductors - Intrinsic and extrinsic semiconductors
Week 13	Carrier concentration and conductivity - Superconductivity: basic properties and applications
Week 14	Mid Exam
Week 15	Final Exam

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Lab 1:
Week 2	Lab 2:
Week 3	Lab 3:
Week 4	Lab 4:
Week 5	Lab 5:
Week 6	Lab 6:
Week 7	Lab 7:

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Charles Kittel – Introduction to Solid State Physics, 8th Edition, Wiley, 2005.	No
Recommended Texts	Neil W. Ashcroft & N. David Mermin – Solid State Physics, Holt, Rinehart and Winston, 1976.	YES
Websites		

APPENDIX:

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	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note:

NB 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.



ملاحظة: هذا النموذج تم وضعه وتقديمه من قبل مديرية ضمان الجودة في وزارة التعليم العالي والبحث العلمي