MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Material Science**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☒ **Tutorial** ☒ **Practical** ☐ **Seminar**	
Module Code	**MDER315**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	3		**Semester of Delivery**	5	
Administering Department	Biomedical engineering		**College**	College of Engineering	
Module Leader	Dr basem		**e-mail**		
Module Leader's Acad. Title	Assistant Lecturer		**Module Leader's Qualification**	M.SC	
Module Tutor	Muntadher Hasan Naeemah		**e-mail**	Phd.muntdher@gmail.com	
Peer Reviewer Name			**e-mail**	Hasnaa.Mohammad@alayen.edu.iq	
Scientific Committee Approval Date			**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

This course introduces the fundamental principles of **materials science**, emphasizing the relationship between the structure, properties, and performance of engineering materials. It covers the **classification of materials**, including metals, polymers, ceramics, and composites, and explores their structural and mechanical behavior. Students will study the **atomic structure and bonding in solids**, **crystal structure and directions**, and **crystalline defects** that influence material performance.

The course also examines the **iron–iron carbide (Fe–Fe_3C) phase diagram** and the **development of microstructure in iron–carbon alloys**, linking theoretical understanding with practical applications in metallurgy. In the **materials testing** section, students will perform **mechanical tests** such as tensile, compression, and hardness testing to evaluate material strength and deformation behavior.

By the end of the course, students will be able to analyze how microstructure and bonding affect mechanical properties, understand phase transformations in metals, and apply testing techniques to assess material performance in engineering applications.

Module Learning Outcomes

مخرجات التعلم للمادة الدراسية

Knowledge	A2	A2-1: Recognize the **fundamental concepts, structures, and properties** of engineering materials, including their atomic arrangements, bonding types, and influence on physical and mechanical behavior. A2-2: Classify different **engineering materials** such as **metals, polymers, ceramics, and composites**, and distinguish between **crystalline and noncrystalline solids**, explaining how structural variations affect material performance. A2-3: Apply **modern techniques, tests, and analytical processes**—such as **tensile, compression, and hardness testing**—to evaluate, interpret, and utilize materials effectively in **engineering and industrial applications**.
	A3	A3-1: Measure **standard material properties** accurately using established **tests and laboratory procedures**, including tensile, compression, and hardness tests, while maintaining precision and reliability in experimental work. A3-2 Analyze **experimental data**, interpret **structural characteristics**, and evaluate the **relationships between microstructure and material behavior** to draw logical conclusions and solve **engineering problems** related to material selection and performance.

	Skills	B1	B1.1 Function efficiently as an individual B1.2 Function as a member of multidisciplinary and multicultural teams
		B2	B2.1 Communicate effectively – graphically with a range of audiences using contemporary tools. B2.2 Communicate verbally and in writing with a range of audiences using contemporary tools.
	Ethics	C2	C1-1: Commit to quality standards. C1-2: Adhere to deadlines. C1-3: Strive for continuous improvement.

Indicative Contents

المحتويات الإرشادية

Introduction of Materials (3 hours)

Overview of materials science, its importance in engineering and technology, and the relationship between structure, properties, and performance.

Classification of Materials (5 hours)

Study of the major categories of materials—metals, polymers, ceramics, and composites—their characteristics, advantages, limitations, and typical applications.

The Structure of Solids and Classification of Solids (6 hours)

Examination of atomic and molecular arrangements in solids, including crystalline and noncrystalline structures, and how atomic order affects material behavior.

Crystal Structure and Crystal Directions (7 hours)

Detailed study of crystal systems, lattice parameters, unit cells, and crystal directions/planes (Miller indices) with emphasis on their significance in determining material properties.

Crystalline Defects (5 hours)

Description of point, line, surface, and volume defects, and their influence on the mechanical and electrical behavior of materials.

Bonding in Solids (4 hours)

Discussion of metallic, ionic, covalent, and secondary (Van der Waals) bonding types and their role in determining mechanical, electrical, and thermal properties.

Iron–Iron Carbide ($Fe–Fe_3C$) Phase Diagram (6 hours)

Study of the $Fe–Fe_3C$ equilibrium diagram, phase transformations in steels, and interpretation of phase regions relevant to metallurgical processes.

Development of Microstructure in Iron–Carbon Alloys (5 hours)

Examination of how cooling rates, carbon content, and heat treatment affect microstructure (pearlite, ferrite, austenite, cementite) and resulting material properties.

Materials Testing and Mechanical Testing (9 hours)

Introduction to testing methods for evaluating mechanical behavior of materials.

	Laboratory and theoretical analysis of tensile, compression, and hardness tests to assess strength, ductility, and resistance to deformation.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Lectures Brainstorming strategy Practical demonstrations Research projects Rapid tests Interactive learning strategy Indirect learning strategy.

Student Workload (SWL) الحمل الدراسي للطالب (15 اسبوع)			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	93	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	57	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.8
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	10% (10)	5 and 10	A2
	Attendance		%10(10)		
	Projects / seminar	1	15% (10)	Continuous	A2,A3
	Lab.		10% (10)		
Summative assessment	**Midterm Exam**	1 hr	10% (10)	7	A2,A3
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري 15 أسبوعا		
	Material Covered	LOs
Week 1	• Introduction of Materials	
Week 2	• Classification of Materials – Overview	A2,B1,B2,C1
Week 3	• Metals	A2,B1,B2,C1
Week 4	• Polymers	A3,B1,B2,C1
Week 5	• Ceramics and Composites	A2,B1,B2,C1
Week 6	• Structure of Solids – Classification of Solids	A2,A3,B1,B2,C1
Week 7	• Crystal Structure	A2
Week 8	• Crystal Directions and Planes (Miller Indices)	A2,A3,B1,B2,C1
Week 9	• Crystalline Defects	A2,A3,B1,B2,C1
Week 10	• Bonding in Solids	A2 ,B1,B2,C1
Week 11	• Iron–Iron Carbide (Fe–Fe_3C) Phase Diagram – Part I	A2,A3,B1,B2,C1
Week 12	• Iron–Iron Carbide (Fe–Fe_3C) Phase Diagram – Part II	A2,B1,B2,C1
Week 13	• Development of Microstructure in Iron–Carbon Alloys	A2,B1,B2,C1
Week 14	• Introduction to Materials Testing	B1,B2,C1
Week 15	• Mechanical Testing of Materials (Tensile, Compression, and Hardness Tests)	B1,B2,C1
Week 16	**Preparatory week before the final Exam**	**A2,A3**

Delivery Plan (Weekly Syllabus) المنهاج الأسبوعي المختبر 15 أسبوعا		
	Material Covered	LOs
Week 1	• Laboratory Orientation and Safety Rules	A3
Week 2	• Identification and Classification of Engineering Materials	A3
Week 3	• Physical Properties of Metals	A3
Week 4	• Observation of Polymer Samples	A3
Week 5	• Examination of Ceramics and Composites	A3
Week 6	• Structure of Solids	A3
Week 7	• Crystal Structure Models	A3
Week 8	• Miller Indices and Crystal Directions	A3
Week 9	• Crystalline Defects	A3
Week 10	• Bonding in Solids	A3
Week 11	• Fe–Fe_3C Phase Diagram Simulation	A3
Week 12	• Heat Treatment of Steel	A3
Week 13	• Microstructure Examination	A3
Week 14	• Tensile and Compression Testing	A3
Week 15	• Hardness Testing	A3

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Materials Science and Engineering an Introduction	yes
Recommended Texts	*Materials Science and Engineering: An Introduction* — William D. Callister Jr *Foundations of Materials Science and Engineering* — Willaim Smith & Javed Hashemi	No
Websites	https://eng.alayen.edu.iq//colleges/e/42	

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.