MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	Engineering Materials			**Module Delivery**	
Module Type	Support or related learning activity			☒ **Theory** ☒ **Lecture** ☐ **Lab** ☒ **Tutorial** ☐ **Practical** ☒ **Seminar**	
Module Code	ATU12023				
ECTS Credits	3				
SWL (hr/sem)	75				
Module Level	1		**Semester of Delivery**	2	
Administering Department	ATU12		**College**	PMETC	
Module Leader	Name		**e-mail**	E-mail	
Module Leader's Acad. Title			**Module Leader's Qualification**		
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module		**Semester**	
Co-requisites module	Manufacturing Processes and Strength of Materials	**Semester**	3 4

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1. Materials Science & Engineering is the study of mechanical, physical, and chemical properties of engineering materials, such as metals, ceramics, polymers, and composites. 2. The objective of a Materials Engineer is to predict and control material properties through an understanding of atomic, molecular, crystalline, and microscopic structures of engineering materials. 3. A Materials Engineer is an essential member of an engineering team responsible for synthesis and processing of advanced materials for manufacturing. 4. A graduate's work may be in areas as diverse as automobile, aerospace, biomedical, or microelectronics manufacturing. Opportunities are available through these industries in the area of research, quality control, product development, design, synthesis, and processing operations.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks. 1. Utilize the structure-properties relationship to predict the properties of a material. 2. Select the materials and properties appropriate for a specific application. 3. Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems. 4. Apply thermodynamics and kinetics in the process design of materials system in order to produce desired structure and properties. 5. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. 6. Select appropriate materials characterization tools, utilize the tool safely, and interpret experimental results. 7. Utilize modern tools and techniques to alter, characterize, and measure materials properties and to design processes according to accepted standards. 8. Demonstrate use of materials engineering in emerging applications. 9. Design and analyze appropriate experiments to measure or optimize specific engineering properties, incorporating statistical procedures. 10. Select and evaluate economic impact of the materials, design, and/or processes.
Indicative Contents المحتويات الإرشادية	**Indicative content includes the following.** **Part A - Engineering materials:** -Introduction to ores, elements and materials {Iron ores, Periodic table of elements, Engineering materials}., **Classification of engineering materials** **-Crystal structure**: atomic arrangement {BCC, FCC and HCP structures}, Atomic packing factor. **-Imperfections in crystals**: {Point defects, Dislocations and grain boundaries}, Solidification of metals and alloys

	- Structure of ingots chilled {Columnar and central equi-axed grains, Dendritic segregation.} [8 hrs], **Part B - Thermal equilibrium diagrams** -Solubility in the solid state, Phases, Solid solutions, compounds and mechanical mixtures. -**Lever rule**: {Eutectic, Eutectoid and Peritectic reactions}., **Applications on binary phase diagrams**, Components completely soluble, completely insoluble or partially soluble in the solid state. [5hrs] **Part C – Mechanical properties of metals:** - Specifications and standards, Normal stress and shear stress, Strain, Tensile and compression tests, Stress-strain diagram. **-Application on mechanical testing and properties,** Determination of Young's modulus, Yield stress, Proof stress, Ultimate tensile strength, Fracture stress, ductility - Hardness and impact toughness [4 hrs] **Part D – Iron and Steel:** - Fe-Fe3C phase diagram, Allotropy, Microstructure of carbon steels, Effect of carbon content on microstructure & mechanical properties of carbon steel. **Carbon steel** -Types, Properties and uses of carbon steel, Low, medium, and high carbon steel, Tool carbon steel. **-Cast Iron** Types, properties and uses of cast iron White, grey, nodular and malleable cast iron. [4 hrs]. **Part E– Non- destructive inspection:** - Liquid penetrant, Magnetic particle, X-rays, Ultrasonic. [2 hrs] **Part F–Materials** **-Nano materials**, Characterization of nano particles and nano structures, Classification, Applications of nano materials in technology and medicine. **-Plastics**, Introduction to plastics technology, Microstructure and polymerization , Structure of plastics materials., Classification, properties and uses of plastics. - **Ceramics and glass**, Structure, defects, properties and uses of ceramics., Structure, properties and uses of glasses. **-Composite Materials**, Classification: metal matrix, ceramic matrix and polymer matrix composites, Reinforcing phase: fibers, flakes, and particles. Composite's structure and volume fraction, Properties and uses of composites [7 hrs]

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	30	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**75**		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	3	10% (10)	5,17 and 14	LO #1, #2, #3 and #4, LO #5, and #6 LO #11, #12 and #13
	Assignments	2	10% (10)	4 and 13	LO #3, #4 and #6, #7
	Projects / Lab.	1	10% (10)	0	0
	Report	2	10% (10)	6,10	0
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	**Introduction** -Introduction to ores, elements and materials -Iron ores -Periodic table of elements -Engineering materials. **-Classification of engineering materials**
Week 2	**Crystal structure** - Atomic arrangement - BCC

	- FCC and HCP structures - Atomic packing factor.
Week 3	**Imperfections in crystals** - Point defects - Dislocations and grain boundaries - Solidification of metals and alloys
Week 4	**- Structure of ingots chilled** - Columnar and central equi-axed grains - Dendritic segregation.
Week 5	**Thermal equilibrium diagrams** - Solubility in the solid state - Phases - Solid solutions, compounds and mechanical mixtures.
Week 6	**Lever rule** - Eutectic, Eutectoid and Peritectic reactions. **Applications on binary phase diagrams** -Components completely soluble, completely insoluble or partially soluble in the solid state.
Week 7	**Mechanical properties of metals** - Specifications and standards - Normal stress and shear stress - Strain - Tensile and compression tests - Stress-strain diagram.
Week 8	**Application on mechanical testing and properties** - Determination of Young's modulus - Yield stress - Proof stress - Ultimate tensile strength - Fracture stress, ductility - Hardness and impact toughness
Week 9	- **Iron and Steel** - Fe-Fe_3C phase diagram - Allotropy - Microstructure of carbon steels - Effect of carbon content on microstructure & mechanical properties of carbon steel. **-Heat treatment of steel** - Non-equilibrium cooling - TTT diagrams - Annealing, normalizing, hardening and tempering of steel.
Week 10	**Carbon steel** - Types, Properties and uses of carbon steel - Low, medium, and high carbon steel - Tool carbon steel. **Cast Iron** - Types, properties and uses of cast iron - White, grey, nodular and malleable cast iron
Week 11	**Non- destructive inspection** - Liquid penetrant - Magnetic particle

	- X-rays - Ultrasonic.
Week 12	**Nano materials** - Characterization of nano particles and nano structures - Classification - Applications of nano materials in technology and medicine.
Week 13	**Plastics** - Introduction to plastics technology - Microstructure and polymerization - Structure of plastics materials. - Classification, properties and uses of plastics
Week 14	**Ceramics and glass** - Structure, defects, properties and uses of ceramics. - Structure, properties and uses of glasses.
Week 15	**Composite Materials** - Classification: metal matrix, ceramic matrix and polymer matrix composites - Reinforcing phase: fibers, flakes, and particles. - Composites structure and volume fraction - Properties and uses of composites.
Week 16	**Preparatory week before the final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	E I G H T H E D I T I O N Materials Science and Engineering An Introduction [William D. Callister, Jr. and David G. Rethwisch]	No
Recommended Texts	Essentials of Materials Science and Engineering Second Edition, SI	No
Websites	https://youtube.com/@WkhalifaMr	

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.