Form: Course Syllabus		
	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
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	Number of Pages	06

1.	**Course Title**	Properties of Materials
2.	**Course Number**	0302775
3.	**Credit Hours (Theory, Practical)**	(3, 0)
	Contact Hours (Theory, Practical)	(48, 0)
4.	**Prerequisites/ Corequisites**	Non
5.	**Program Title**	Physics
6.	**Program Code**	0302
7.	**School/ Center**	Science
8.	**Department**	Physics
9.	**Course Level**	Graduate Level
10.	**Year of Study and Semester (s)**	Second Year, First Semester
11.	**Other Department(s) Involved in Teaching the Course**	Non
12.	**Main Learning Language**	English
13.	**Learning Types**	☐Face to face learning ☒Blended ☐Fully online
14.	**Online Platforms(s)**	☒Moodle ☒Microsoft Teams
15.	**Issuing Date**	24-12-2024
16.	**Revision Date**	30-12-2024

17. Course Coordinator:

Name: Ahmad S Masadeh Contact hours:

Office number: Phone number: 22023

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18. Other Instructors:

Name: Office number: Phone number: Email: Contact hours:

19. Course Description:

This course provides an understanding of the fundamental properties of materials, including transformations, symmetry elements, thermodynamics, mechanical and thermal properties, and electrical and magnetic phenomena. Students will explore key concepts such as dielectric properties, piezoelectricity, and thermoelectricity, as well as practical applications in material science.

20. Program Intended Learning Outcomes: (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

1. SLO (1): to be able to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the discipline.

2. SLO (2): to be able to formulate or design a scientific system, process, procedure or program to contribute achieving scientific desired needs.

3. SLO (3): to be able to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.

4. SLO (4): to be able to communicate his/her scientific contributions effectively with a range of audiences.

5. SLO (5): to be able to recognize and demonstrate social, ethical and professional responsibilities and the impact of technical and/or scientific solutions in global economic, environmental, and societal contexts.

6. SLO (6): to be able to function effectively independently and on teams for establishing goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

21. Course Intended Learning Outcomes: (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. Explain the fundamental processes of material transformations and their influence on material properties.

2. Identify symmetry elements and point groups and analyze their roles in defining the properties of materials.

3. Evaluate thermodynamic and magnetoelectric effects in materials and their applications in modern technologies.

4. Analyze the mechanical behavior and thermal responses of materials, including thermal expansion, thermal conductivity, and related phenomena.

5. Describe the principles of dielectric, piezoelectric, and pyroelectric effects and their relevance in functional materials.

6. Interpret the relationship between magnetic phenomena, electrical resistivity, and the structure of materials.

7. Investigate diffusion and ionic conductivity in materials, with applications in energy and electronics.

8. Explain galvanomagnetic, thermomagnetic, and thermoelectric effects, and assess their implications in advanced materials and devices.

9. Apply theoretical and practical knowledge to solve real-world problems related to material selection, design, and performance.

10. Develop research skills in materials science and effectively communicate scientific findings in written and oral formats.

Course ILOs	**The learning levels to be achieved**					
	Remembering	**Understanding**	**Applying**	**Analysing**	**evaluating**	**Creating**
1	✓	✓	✓			
2		✓	✓			
3		✓		✓		
4		✓		✓		

5		✓		✓		
6		✓		✓		
7		✓		✓		
8		✓				✓
9		✓	✓			
10		✓			✓	

٢٢. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program ILOs / Course ILOs	ILO (1)	ILO (2)	ILO (3)	ILO (4)	ILO (5)
1	✓	✓			
2	✓	✓	✓		
3	✓	✓			
4	✓	✓		✓	
5	✓	✓			
6	✓	✓			
7	✓	✓	✓		
8	✓	✓		✓	
9	✓	✓			
10		✓			✓

٢٣. Topic Outline and Schedule:

Week	Lecture	Topic	ILO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully	Platform Used	Synchronous / Asynchronous Lecturing	Evaluation Methods	Learning Resources
1	1.1	Transformations	Understand transformations in materials	Face to Face	Classroom/LMS	Synchronous	Short quizzes, participation	Lecture slides, textbooks, examples
	1.2	Tensors	Explain tensor applications	Blended	Teams	Asynchronous	Problem-solving assignments	Online tutorials, recorded lecture videos
	1.3	Applications of Tensors	Apply tensor models to real-world cases	Fully Online	LMS	Asynchronous	Discussion forum	Case studies, research papers, Heckmann diagrams
2	2.1	Symmetry Elements	Identify symmetry in materials	Face to Face	Classroom	Synchronous	Visual models, diagrams quiz	3D models, symmetry analysis tools
	2.2	Point Groups	Classify materials based on symmetry	Blended	Teams	Asynchronous	Peer discussions	Lecture notes, problem sets
	2.3	Symmetry in Properties	Relate symmetry to material properties using Heckmann diagrams	Fully Online	LMS	Asynchronous	Assignment submission	Journals, simulation videos, Heckmann diagrams

3	3.1	Thermodynamics	Describe thermodynamics principles	Face to Face	Classroom	Synchronous	In-class problem-solving	Thermodynamics textbooks, examples
	3.2	Thermodynamic Properties	Explain thermal properties of materials	Blended	LMS	Asynchronous	Problem-solving quiz	Lecture notes, diagrams
	3.3	Magnetoelectric Effect	Analyze magneto electric coupling with Heckmann diagrams	Fully Online	Teams	Synchronous	Research report	Online papers, Heckmann diagrams
4	4.1	Pyroelectricity	Explain pyroelectric principles using Heckmann diagrams	Face to Face	Classroom	Synchronous	Case-based exam	Lecture slides, application-based problems
	4.2	Dielectric Properties	Analyze dielectric responses	Blended	LMS	Asynchronous	Short quizzes, problem sets	Research articles, videos
	4.3	Relation: Pyro/Dielectric	Compare dielectric & pyroelectricity with Heckmann diagrams	Fully Online	LMS	Asynchronous	Written assignment	Simulation tools, lecture slides, Heckmann diagrams
5	5.1	Elastic and Plastic Behavior	Differentiate elastic/plastic responses	Face to Face	Classroom	Synchronous	Stress-strain lab	Lab manual, material property data sheets

	5.2	Hardness and Toughness	Assess hardness and toughness	Blended	LMS	Asynchronous	Data analysis assignment	Case studies, online experiments
	5.3	Advanced Mechanical Behavior	Discuss advanced mechanical behaviors	Fully Online	LMS	Asynchronous	Group presentations	Review papers, video tutorials
6	6.1	Thermal Expansion	Understand thermal expansion and its implications	Face to Face	Classroom	Synchronous	Conceptual quiz	Textbooks, simulations, Heckmann diagrams
	6.2	Thermal Conductivity	Explain heat transfer in different materials using Heckmann diagrams	Blended	LMS	Asynchronous	Problem-solving exercises	Video tutorials, research papers
	6.3	Thermal Properties of Composites	Analyze thermal expansion/conductivity in composites	Fully Online	LMS	Asynchronous	Case-based problem-solving	Journals, material property databases
7	7.1	Piezoelectric Effect	Explain fundamentals of piezoelectric materials using Heckmann diagrams	Face to Face	Classroom	Synchronous	Oral quiz	Lecture slides, research papers

	7.2	Applications of Piezoelectric Materials	Explore applications in sensors and devices	Blended	LMS	Asynchronous	Assignment submission	Case studies, video demonstrations
	7.3	Piezoelectric Device Design	Analyze the design of piezoelectric devices	Fully Online	LMS	Asynchronous	Project-based evaluation	Design tools, research papers, Heckmann diagrams
8	8.1	Basics of Magnetism	Explain types of magnetic behavior	Face to Face	Classroom	Synchronous	In-class discussion	Magnetic materials textbooks
	8.2	Magnetic Materials	Explore applications of magnetic materials	Blended	LMS	Asynchronous	Quiz	Online examples, material catalogs
	8.3	Advanced Magnetic Phenomena	Analyze advanced magnetic effects (e.g., spintronics)	Fully Online	Teams	Synchronous	Report submission	Journals, videos, Heckmann diagrams
9	9.1	Electrical Resistivity	Discuss factors affecting resistivity	Face to Face	Classroom	Synchronous	Problem-solving quiz	Textbooks, online examples
	9.2	Temperature Dependence of Resistivity	Analyze resistivity-temperature relationship	Blended	LMS	Asynchronous	Data interpretation assignment	Research papers, graphs
	9.3	Conductors vs. Semiconductors	Compare electrical properties of materials	Fully Online	LMS	Asynchronous	Quiz	Simulation tools, material data, Heckmann diagrams

			using Heckmann diagrams					
10	10.1	Heat Capacity of Materials	Relate heat capacity to material properties	Face to Face	Classroom	Synchronous	Conceptual quiz	Lecture notes, research papers
	10.2	Thermal Stresses	Understand material failure due to thermal stress	Blended	LMS	Asynchronous	Case study assignment	Journals, problem sets, Heckmann diagrams
	10.3	Nanomaterials' Thermal Properties	Discuss unique thermal behaviors of nanomaterials	Fully Online	Teams	Synchronous	Report submission	Research papers, recorded lectures
11	11.1	Review of Mechanical Properties	Integrate knowledge of mechanical testing and properties	Face to Face	Classroom	Synchronous	Group quiz	Summaries, videos
	11.2	Advanced Dielectric Phenomena	Explore polarization mechanisms	Blended	LMS	Asynchronous	Peer-reviewed reports	Journals, video explanations
	11.3	Coupling: Mechanical/Thermal/Dielectric	Case studies on multifunctional materials	Fully Online	LMS	Asynchronous	Problem-solving exercises	Review papers, simulations, Heckmann diagrams

			using Heckmann diagrams					
12	12.1	Interrelation of Properties	Connect mechanical, dielectric, and piezoelectric properties	Face to Face	Classroom	Synchronous	Group presentations	Lecture slides, application-focused articles
	12.2	Emerging Applications	Analyze emerging trends and applications of material properties	Blended	LMS	Asynchronous	Individual reports	Cutting-edge research articles
	12.3	Summary and Future Trends	Summarize and discuss future directions	Fully Online	Teams	Synchronous	Course evaluation	Journals, recorded lectures, Heckmann diagrams
13	13.1	Transformations	Understand transformations in materials	Face to Face	Classroom/LMS	Synchronous	Short quizzes, participation	Lecture slides, textbooks, examples
	13.2	Tensors	Explain tensor applications	Blended	Teams	Asynchronous	Problem-solving assignments	Online tutorials, recorded lecture videos
	13.3	Applications of Tensors	Apply tensor models to real-world cases	Fully Online	LMS	Asynchronous	Discussion forum	Case studies, research papers, Heckmann diagrams
14	14.1	Project (paper term)						

	14.2	Project (paper term)						
	14.3	Project (paper term)						
15	15.1	Project (paper term)						
	15.2	Project (paper term)						
	15.3	Project (paper term)						

٢٤. Evaluation Methods:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	ILO/s Linked to the Evaluation activity	Period (Week)	Platform
Midterm Exam	30	transformations, symmetry elements, mechanical and thermal properties	1 ,2	Week 7	
Assignments	30	All Covered topics	1,3	Throughout	
Final	40	All Covered topics	1, 2, 3	Week 14	

٢٥. Course Requirements:

White board and overhead projector.

٢٦. Course Policies:

A- Attendance policies:

Regular attendance according to the rules of the host institution

B- Absences from exams and handing in assignments on time:

Based on the rules of the host institution.

C- Health and safety procedures:

Based on the rules of the host institution

D- Honesty policy regarding cheating, plagiarism, misbehavior:

According the rules of the host institution

E- Grading policy:

Grading the exam based on a key solution.

F- Available university services that support achievement in the course:

e-learning.

2٧. References:

A- Required book(s), assigned reading and audio-visuals:

1) Properties of Materials: Anisotropy, Symmetry, Structure" by Robert E. Newnham

B- Recommended books, materials, and media:

1) Structure of Materials: An Introduction to Crystallography, Diffraction, and Symmetry , by Marc De Graef and Michael E. McHenry

2٨. Additional information:

Name of the Instructor or the Course Coordinator: Ahmad S Masadeh	Signature: Ahmad Masadeh	Date: 30-12-2024…
Name of the Head of Quality Assurance Committee/ Department	Signature:	Date:
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Name of the Head of Department	Signature:	Date:
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Name of the Head of Quality Assurance Committee/ School or Center	Signature:	Date:

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Name of the Dean or the Director	Signature:	Date:
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