Jordan University of Science and Technology

Faculty of Institute Of Nanotechnology

Nanotechnology And Engineering Department

NANO703 Nanofabrication And Characterization - JNQF Level: 9

Second Semester 2023-2024

Course Catalog
3 Credit Hours. This course gives a comprehensive overview of nanomaterials synthesis and characterization. Methods for creating nanostructured materials, such as sol-gel methods, chemical vapor deposition, atomic layer deposition, physical vapor deposition, metal-induced crystallization and thermal treatments are discussed. Synthesis of one-dimensional nanostructures (nanotubes, nanorods, nanowires), nanoporous materials, and nanostructured bulk materials are discussed. Processes used to synthesis two-dimensional structures, thin films and self-assembled monolayers, and lift-off lithography are presented. Top-down and bottom-up approaches are also discussed. Characterization of nanomaterials in terms of chemical, mechanical, optical, structural and morphological properties are introduced.
Teaching Method: On Campus

Text Book	
Title	Nanomaterials and Nanocomposites Synthesis, Properties, Characterization Techniques, and Applications
Author(s)	Rajendra Kumar Goyal
Edition	1st Edition
Short Name	Synthesis and characterization
Other Information	

Instructor	
Name	**Prof. Rami Oweis**
Office Location	Institute of Nanotechnology, First Floor.
Office Hours	
Email	oweis@just.edu.jo

Class Schedule & Room

Section 1:
Lecture Time: Tue : 10:30 - 13:30
Room: NANO 1

Tentative List of Topics Covered		
Weeks	**Topic**	**References**
Week 1	Introduction to the course, syllabus presentation, discussion on course evaluation tools. Review of the fundamentals of Nanomaterials and Nanotechnology.	From **Synthesis and characterization**
Week 2	Synthesis of nanomaterials and nanostructures: Top-down approach and Bottom-up approach	From **Synthesis and characterization**
Week 3	Top-down approach: 1. Mechanical alloying 2. Severe plastic deformation 3. Lithography	From **Synthesis and characterization**
Week 4	Bottom-up approach: 1. Physical vapor deposition 2. Molecular beam epitaxy 3. Chemical vapor deposition	From **Synthesis and characterization**
Week 5	4. Colloidal or wet chemical route 5. Reverse micelle rout 6. Green chemistry route	From **Synthesis and characterization**
Week 6	7. Sol-gel method 8. Combustion synthesis 9. Atomic layer deposition	From **Synthesis and characterization**
Week 7	Characterization of Nanomaterials: 1. X-Ray Diffraction 2. Optical Spectroscopy: 1. Raman Spectroscopy 2. UV?vis Spectroscopy	From **Synthesis and characterization**
Week 8	Characterization of Nanomaterials: Optical Spectroscopy: 3. Photoluminescence Spectroscopy 4. Fourier Transform Infrared Spectroscopy	From **Synthesis and characterization**
Week 9	Characterization of Nanomaterials: Surface Area Analysis (BET Method), Light Scattering Method, Electron Microscopy: 1. Scanning Electron Microscopy	From **Synthesis and characterization**
Week 10	Characterization of Nanomaterials: Electron Microscopy: 2. Transmission Electron Microscopy. Scanning Probe Microscopy: Atomic Force Microscopy	From **Synthesis and characterization**
Week 11	Characterization of Nanomaterials: X-ray Photoelectron Spectroscopy, Thermal Analyzer, and Zeta Potential	From **Synthesis and characterization**
Week 12	Synthesis of Nanowires.	From **Synthesis and characterization**
Week 13	Synthesis of Carbon Nanotubes.	From **Synthesis and characterization**
	Synthesis of Graphene	From **Synthesis and characterization**
Week 15	Processing of Polymer Nanocomposites	From **Synthesis and characterization**
Week 16	Synthesis of Polymeric Nanofibers	From **Synthesis and characterization**

Mapping of Course Outcomes to Program Outcomes and NQF Outcomes	Course Outcome Weight (Out of 100%)	Assessment method
Develop relations between disciplinary, interdisciplinary, and nanotechnology aspects to improve practical knowledge in the fabrication and characterization of nanomaterials. [15L9K1, 10L9K2, 10L9K3, 15L9S2, 10L9C1, 10L9C2, 5L9C3, 10L9C4, 5L9C5]	10%	
Utilize a variety of bottom-up and top-down methods to synthesize nanomaterials. [30L9K1, 10L9K2, 20L9K3, 20L9S2, 10L9C1, 10L9C4]	10%	
Elucidate the operation of an individual nanofabrication tool or processes and assess the performance constraints critically. [15L9K1, 10L9K2, 15L9K3, 30L9S1, 10L9S2, 10L9C2, 20L9C4]	10%	
Critique the employed tools and processes for nanofabrication. [20L9K2, 20L9S1, 20L9S2, 20L9C2, 20L9C4]	10%	
Analyze the nanofabrication products through nanofabrication tools and processes. [20L9K2, 20L9S1, 20L9S2, 20L9C2, 20L9C4]	10%	
Produce nanostructures independently. [20L9K2, 20L9K3, 20L9S1, 20L9S2, 20L9C2]	10%	
Utilize a variety of morphological approaches by selecting the correct tools for their future research. [15L9K1, 15L9K2, 15L9S1, 1L9S2, 15L9C2, 10L9C3, 20L9C4, 10L9C5]	10%	
Showcase a range of spectroscopic methods. [20L9K1, 20L9K2, 20L9S1, 20L9S2, 20L9C4]	10%	
Select scanning probe techniques for nanomaterial characterization. [20L9K1, 20L9K2, 20L9S1, 20L9S2, 20L9C4]	10%	
Investigate sophisticated methods for microscopic characterization. [20L9K1, 20L9K2, 20L9K3, 20L9S1, 20L9C4]	5%	
Use appropriate techniques to prepare, characterize, and analyze the samples. [20L9K1, 20L9K2, 20L9S1, 20L9S2, 20L9C4]	5%	

Relationship to NQF Outcomes (Out of 100%)									
L9K1	L9K2	L9K3	L9S1	L9S2	L9C1	L9C2	L9C3	L9C4	L9C5
13.52	16.51	7.47	16.21	15.67	2.11	9.51	1.55	15.91	1.55

Evaluation	
Assessment Tool	**Weight**
Midterm Exam written Part	15%
Term Project	20%
Final Exam written part	25%
Final Exam Take-home part	25%
Midterm Exam Take-home part	15%

Policy	
Course Policy	Attendance: Every class will have an attendance record, and students who miss more than 20% of them will be automatically dismissed (no excuses allowed). It is the student's responsibility to compensate for any missed class. Exams: During the exam students are not permitted to use books or notes. Multiple choice questions may be included in exams and quizzes, but problem solving, analysis, and design are the most common. Makeups: Exam makeup requires online application within two days of the exam date, pending formal approval, makeups are arranged typically one week after the exams period end. Cheating: Copying assignments and cheating in exams will result in severe penalties.

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