هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-476
2022

Course Specification

Course Title:	Introduction to Nanoscience and Nanotechnology
Course Code:	PHYS 476
Program:	B.Sc. in Physics
Department:	Department of Physics and astronomy
College:	College of Science
Institution:	King Saud University
Version:	2.0.0
Last Revision Date:	Sep 2023

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A. General information about the course:

Course Identification					
1. Credit hours:	**2(2+0+0)**				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered:	8th level				
4. Course general Description					
Provides an introduction to Nanoscience and Nanotechnology. The student learns the basic, concepts and the main rules of nanoscience in physics and technology.					
5. Pre-requirements for this course (if any):					
6. Co- requirements for this course (if any): PHYS 473					
7. Course Main Objective(s)					
• The student will be able to express on the basic physical knowledge on Nanotechnology, including the effects of quantum confinement on the energy levels and density of states . • The student will understand the available tools for fabrication and characterization of nanostructures. • The student will catch up with developments and applications in this rapidly evolving area.					

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	75	100%
2.	E-learning	0	0
3.	Hybrid • Traditional classroom • E-learning	0	0
4.	Distance learning	0	0

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	30
2.	Laboratory/Studio	0
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0

	Total	30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	demonstrate a knowledge and broad understanding for nanoscience concepts.	K1	• Give extensive examples during lecture. • Give problem sheets to be discussed during lecture..	• Hold Class discussion, tutorial sessions. • Give quizzes, mid-term exam and final exam.
1.2	Understand the observable physics phenomena that are due to quantum size effects in nanoscale materials.	K2		
2.0	Skills			
2.1	Correlate the chemical and physical structure with mechanical, electrical and optical properties of nanomaterials.	S1	• Give extensive examples during lecture • Give problem sheets to be discussed during lecture and labs. • assignments. • Discussions in the classes	• Hold Class discussion, tutorial and lab sessions. • Give quizzes, mid-term exam and final exam.
2.2	Describe the operating principle, and the experimental limitations, of some of the common analytic tools of nanotechnology.	S2		
2.3	Produce scientific reports and present them in writing and oral form for selected topics in nanoscience characterization and fabrication.	S3		
3.0	Values, autonomy, and responsibility			
3.1	Work in a team and acknowledge others' work.	V1	• assignments. • Homework	Hold Class discussion

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction** scaling laws and limits to smallness quantum nature of nano-world	2
2.	**Methods of Measuring Properties** Structure (Atomic Structures, Crystallography, Particle Size Determination, Surface Structure) Microscopy (Transmission Electron Microscopy, Scanning Microscopy) Spectroscopy (Magnetic Resonance, Infrared and Raman Spectroscopy, Photoemission and X-Ray Spectroscopy)	6
3.	**Properties of Individual Nanoparticles** Metal Nanoclusters (Magic Numbers, Geometric Structure, Electronic Structure, Magnetic Clusters)	4
4.	**Carbon Nanostructures** Carbon Molecules (Nature of the Carbon Bond) Carbon Clusters (Small Carbon Clusters, Structure of c60 and Its Crystal, Superconductivity in C60). Carbon Nanotubes (Fabrication, Structure, Electrical Properties, Vibrational Properties, Mechanical Properties) Applications of Carbon Nanotubes (Computers, Fuel Cells, Chemical Sensors, Catalysis)	6
5.	**Nanostructured Ferromagnetism** Basics of Ferromagnetism Effect of Bulk Nano-structuring of Magnetic Properties Dynamics of Nanomagnets	4
6.	**Quantum Wells, Wires, and Dots** Preparation of Quantum Nanostructures Size and Dimensionality Effects Excitons Applications (Infrared Detectors, Quantum Dot Lasers)	6
7.	**Nanomachines and Nanodevices**	4

	Microelectromechanical Systems (MEMSs) Nanoelectromechanical Systems (NEMSs) (Fabrication, Nanodevices and Nanomachines)	
8.	**Nanofabrication Techniques** Microcontact Printing Physical Vapor Deposition Sputtering Metal Evaporation Chemical Vapor Deposition Photolithography	4
Total		36

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	First Midterm examination	Approx. 6	20%
2.	Second Midterm examination	Approx. 12	20%
3.	Quizzes Discussion	Weekly	20%
4.	Final examination	From 16 to 18	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	INTRODUCTION TO NANOTECHNOLOGY Charles P. Poole, Jr. and Frank J. Owens. USA.2003.
Supportive References	Basic Principles of Nanotechnology Wesley C. Sanders. 2019. by Taylor & Francis Group.
Electronic Materials	None
Other Learning Materials	Internet sites relevant to the course

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	A classroom which accommodates 25 students.

Items	Resources
Technology equipment (projector, smart board, software)	Whiteboard and Smart board
Other equipment (depending on the nature of the specialty)	Not applicable

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students\ Peer Reviewer	Indirect \ direct
Effectiveness of students assessment	Students- Faculty	Direct
Quality of learning resources	students	Indirect
The extent to which CLOs have been achieved	Faculty	Indirect
Other	None	None

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	Physics Department's council
REFERENCE NO.	11th meeting (2nd term 1445)
DATE	04/08/1445