هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title	**Introduction to Nanophysics**
Course Code:	**PHY 1473**
Program:	**Bachelor of Science in Physics.**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	1
Last Revision Date:	***26/09/2024***

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 7 or 8/ Year 4)					
4. Course General Description:					
Introduction to nanotechnology provides a self-contained introduction to the physical concepts, techniques and applications of nanoscale systems by covering its entire spectrum from the latest examples right up to single-electron and molecular electronics. This course discusses the interdisciplinary nature of nanotechnology and how the different basic sciences merge to create the field and it provides a background of the understanding, motivation, implementation, impact, future, and implications of nanotechnology. The course will also discuss specific applications of nanotechnology in electronic devices, and energy production.					
5. Pre-requirements for this course (if any)**:**					
Atomic Physics, PHY 1362					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Initiate students with new concepts in nanoscience.**
- **Provide the student with a clear and logical presentation of the basic concepts of nanophysics.**
- **Describe, and perform simple calculations involving, the quantization in different dimensions (3D, 2D, 1D and 0D).**
- **Strengthen an understanding of the concepts and principles through a broad range of the interesting applications in nanotechnology.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		60

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Describe and learn basic theoretical concepts of nanophysics allowing working in research and development in nanotechnology.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Outline the rapidly developing field of nanoengineered materials with special focus on their electronic properties**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Recognize the studies of various phenomena in small-size devices.**	**K1, K2**	• Lectures. • Class discussions. Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.4	**State aspects of the electronic properties of**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	materials, as well as fabrication processes.			▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying waves and optical physics.**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	▪ Problem classes and group tutorial. ▪ Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner orally, and using IT for acquiring and analyzing information.**	**S4, S5**	• Lectures. • Class discussions. • Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Exams. ▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. • Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**Generalities on Nanotechnology:** Definitions, Comparison between units, History, Richard Feynman, Norio Taniguchi, Fundamental concepts, Bottom-up and top-down, Importance of nanosystems, Quantification, Specific surface area.	**10**
2.	**Principle Synthesis Techniques of Nanosystems:** Generalities on germination mechanism, Activation energy of nucleation, Critical germ dimension, Stability of the germ, Chemical techniques, Free nanoparticles,	**12**

	Metallic salt reduction, Sol-gel, Solvo-thermal, Physical techniques, Thermal evaporation, Milling, Pulse laser deposition (PLD), Electrical discharge, Sputtering, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD).	
3.	**Quantification:** Free electron and electrons in solid, Gaz of electrons, Description of free electrons in solid, Concept of effective mass, Quantification condition, Born Van Kerman (BVK) conditions, Energy levels of free electron in solid, State densities in different structures 3D, 2D, 1D and 0D, Applications of systems 0D and 1D.	**10**
4.	**Porosity and Texture of Materials:** Divided state, Specific surface area, Generalities on textural characterizations of porous solids, Gurwitsch equation, Porosity.	**10**
5.	**Characterization techniques:** Scanning electron microscopy (SEM), Transmission electron microscopy, Adsorption-desorption characterization methods, Photoluminescence, Electronic characterization, Magnetic characterizations.	**10**
6.	**Some applications:** Quantum effects in opto-electronic devices, Photo catalytic processes, Gaz sensors.	**8**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (class quizzes, homework, solving problems, etc.....)**	**weekly**	**10 %**
2.	**Midterm Exam 1**	**6th week**	**25 %**
3.	**Midterm Exam 2**	**12th week**	**25 %**
4.	**Final Exam**	**16th week**	**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	- Wolf E. L., ***Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience,*** 2nd Edition; Wiley (2006). - Binns C., ***Introduction to Nanoscience and Nanotechnology***, Wiley (2010). Cao G. and Wang Y., ***Nanostructures and Nanomaterials: Synthesis, Properties and Application,*** 2nd Edition, World Scientific (2011).

Supportive References	
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**- Classrooms.** **- Labs.**
Technology equipment (projector, smart board, software)	**- Classroom equipped with a whiteboard and a projector.**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students** **Second examiner**	**Indirect (The students complete the evaluation forms at the end of term. Final exam is evaluated by the second examiner)**
Effectiveness of Students assessment	**Instructors**	**Direct (exams, HW, project, …)**
Quality of learning resources	**Faculty** **Students**	**indirect (surveys)**
The extent to which CLOs have been achieved	**Instructors** **Program Leaders**	**Direct (excel sheet)**
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**Quality Unit-Physics Department**
REFERENCE NO.	**Department council No. 06**
DATE	**26/09/2024**