Course Specification

(Postgraduate Programs)

Course Title:	**Synthesis and Characterization Techniques**
Course Code:	**PHY 6281**
Program:	**Master of Science in Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**3**
Last Revision Date:	***26/09/2024***

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3				
2. Course type				
A.	☐ University	☐ College	☒ Department	☐ Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: Level 3/Year 2				
4. Course General Description:				
This course introduces the techniques used for the synthesis and the characterization of the nano-systems. Moreover, it provides the development of the nanotechnology and its limitations.				
5. Pre-requirements for this course (if any): None				
6. Pre-requirements for this course (if any): None				
7. Course Main Objective(s):				

At the end of this course, students will be able to:

- **Be familiar with nanoscience techniques for synthesis and characterization.**
- **Use very sophistic techniques for the characterization of advanced materials.**
- **Practice in writing reports from minor experimental research projects;**
- **Gain an understanding of the importance of the development of the nanotechnology and its limitations.**
- **Be adept at the application of physical and mathematical tools to solve real life problems in the considered domain.**
- **Know some important applications in nanotechnology and understand the reason of the researchers interest on this technology.**
- **Understand the emerging science of working and building at near the molecular level.**
- **Be familiar with new strategic materials promising in the near future for nanotechnology.**
- **Explain physical properties when the dimensions of the material are small enough to be comparable to the wavelength of the electrons confined inside. The wave nature of the electrons leads to radically altered electronic properties.**
- **Understand the fundamental concepts and the principles through a broad range of interesting applications in nanotechnology.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	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**	**15**
2.	**Laboratory/Studio**	**30**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)……**	**0**
	Total	**75**

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 the techniques used for the synthesis and the characterization of the nano systems.**	**K1, K2, K3**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Discuss the importance of the development of the nanotechnology and its limitations.**	**K1, K2, K3**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.3	**Interpret the broad range of phenomena in nanophysics and nanotechnology.**	**K1, K2, K3**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.4	**Describe the porosity in the materials: specific surface area, porous volume and pores distribution.**	**K1, K2, K3**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying Synthesis and Characterization Techniques course.**	**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.**	**S3, S4**	• 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.	**Synthesis Techniques:** Synthesis of nanoparticles by sol-gel, ball milling and solve-thermal techniques. Thin film and heterostructure deposition techniques (MBE, PLD, PCVD and sputtering). Nanocomposites by thermal reaction technique.	25
2.	**Structural and Textural Characterizations:** Scanning electron microscopy (SEM). Transmission electron microscopy (TEM). X-ray diffraction (XRD). Atomic force microscopy (AFM). Porosimeter.	25
3.	**Optical, Electric and Magnetic characterization Techniques:** Optical absorption, transmission and reflectance. Photoluminescence and Electroluminescence, Electric and magnetic characterizations: I(V) technique, Impedance at different frequency and temperature. Hall effect measurement. VSM technique.	25
Total		**75**

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**	**20 %**
2.	**Midterm Exam 1**	**6th week**	**20 %**
3.	**Midterm Exam 2**	**12th week**	**20 %**
4.	**Final Exam**	**16thweek**	**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	***C. Binns, Introduction to Nanoscience and Nanotechnology, John Wiley & Sons, 2010.***
Supportive References	***Modern Concepts in Nanoscience, 2nd Edition, Wiley-VCH Verlag GmbH & Co. KGaA, 2006.*** ***C. Binns, Introduction to Nanoscience and Nanotechnology, John Wiley & Sons, 2010.*** ***-G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, 2nd Edition; World Scientific, 2011.***
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	**Multimedia associated with the textbook and the relevant websites.**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- Classrooms - Ball milling, Sol-gel, XRD VSM, SEM/EDAX research Lab
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 student will complete evaluation forms at the end of semester. 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		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Quality Unit-Physics Department
REFERENCE NO.	Department council No. 6
DATE	26/09/2024