Department of Physics

College of Science

University of Salahaddin

Subject: Analytical instrumentation, ohmic contact and electrocortical etching

Course Book – (Master Degree)

Lecturer's name *Dr. Lary Hana Slewa*

Academic Year: 2023-2024

Course Book

1. Course name	**Nano electronic and Nano biosensor**
2. Lecturer in charge	**Dr. Lary Hana slewa**
3. Department/ College	**Department of Physics College of Science**
4. Contact	**E-mail: lary.slewa@su.edu.krd** **Tel: 07507462485**
5. Time (in hours) per week	**Theory: 3** **Practical: 0**
6. Office hours	**4**
7. Course code	
8. Teacher's academic profile	I studied for an undergraduate degree in Physics science at Salahaddin University-Erbil between the years of 2001- 2005. After graduation in 2005, in the same year, I got a position in Salahaddin University as a laboratory demonstrator (**general physics lab., optics lab. , Electric lab and Electric measurement lab**). I stayed with the job for more than 9 year. In 2014, I obtained MSc in thin film. 3/12/2014 Assistance Lecturer in University of Salahaddin- College of science physics department - Erbil -Iraq **For academic year 2016-2017 I've taught Electronic in Medicine for third year Physics student in** Physic depertment . Finally, I have obtained **PhD. degree** in Solid state (Nanotechnology for biochemical application) from Salahaddin University-Erbil, Kurdistan Region, Iraq, through split site program with Universiti Sains Malaysia. I have published **11 research** papers in scientific journals. I'm interest in nanomaterials fabrication and characterization by using chemical and physical technology, where I have used films in many applications, such as solar cell, gas, optoelectronics, thin film EGFET for pH.
9. Keywords	**Nanoscience, Introduction to Nanoscience and**

	Nanotechnology, Nanomaterials, Concepts And Applications of Nanotechnology

10. Course overview:

Science and technology alone are not going to magically solve all the problems of developing countries but they are critical components of development. Nanotechnology is a relatively new field that will soon be providing radical and relatively inexpensive solutions to critical development problems." Thus, scientists are harnessing nanotechnology to create new, inexpensive materials, devices, and systems with unique properties. Most of current applications of nanotechnology are in electronics, automation, super materials, agriculture, food security systems or life sciences such as pharmaceuticals and medicine.

Nanotechnology is the study, design, creation, synthesis, manipulation, and application of functional materials, devices, and systems through control of matter at the nanometer scale (one nanometer being equal to 1×10^{-9} of a meter), and the exploitation of novel phenomena and properties of matter at that scale.

Nanotechnology is more properly labeled as "molecular nanotechnology (MNT), or "nanoscale engineering Recently, the Foresight Institute has suggested an alternate term to represent the original meaning of nanotechnology: zetta technology.

The study of nanoscale systems promises to lead to fundamentally new advances in science and engineering and in our understanding of biological, environmental, and planetary systems. It also will redirect our scientific approach toward more generic and interdisciplinary research. Nanoscience is at the unexplored frontiers of science and engineering, and it offers one of the most exciting opportunities for innovation in technology.

Nanotechnology will provide the capacity to create affordable products with dramatically improved performance. This will come through a basic understanding of ways to control and manipulate matter at the nanometer scale and through the incorporation of nanostructures and nanoprocesses into technological innovations. It will be a center of intense international competition when it lives up to its promise as a generator of technology.

11. Course objective:

Today we have a much greater understanding than ever before of how and where new technologies may have an effect during a product's life cycle. Increasingly society is carefully considering the impacts a new technology may have, and endeavouring to ensure that any risk can be minimized and managed, while maximizing any benefits. The benefits that nanotechnology promises include: less material consumption; more efficient energy generation methods; greater computing power; new health treatments. There is already some research into the potential risks, and the impact of various particles on organisms and the environment is being examined. Networks of scientists have also been established to discuss and evaluate these results (such as the EU Nano safe Network).

12. Student's obligation

A list of additional useful problems will be given to help the student further sharpen your understanding of the subject and your problem solving skills. The students are required to do these problems, although you may find it useful to do so. Because this subject is One course, so that the

students are required to do at least tow closed exam during this semester besides other assignments and each student must prepare full report at the end of the year. All exams have marks, full report also has marks, the classroom activities count marks and mark for attendance too.

لێرە مامۆستا بەرپرسیارێتی قوتابی خوێندکار ڕووندەکاتەوە سەبارەت بە کۆرسەکە بۆ نموونە ئامادەبوونی قوتابیان لە وانەکاندا، لە تاقیکردنەوەکاندا، ڕاپۆرت و ووتار نووسین... هتد.

13. Forms of teaching

Our lecture is depend directly on showing the strong point in the lecture via data show depending on the power point program… and solve problem on the white board with the students.

لێرە مامۆستا ڕێگەی وانە ووتنەوە دەنووسێت، بۆ نموونە: داتاشۆ و پاوەرپۆینت، سەر تەختەڕەش، تەختەی سپی، سمارتبۆرد یان مەلزەمە... هتد

14. Assessment scheme

All exams have 30 marks, full report has 5 marks, the classroom activities count and for attendance 5 Marks. So that the final grade will be based upon the following criteria:

Mid- semester exam: 30%
Classroom participation and assignments: 5%
Report: 5%
Final Exam: 60% .

Breakdown of overall assessment and examination

لێرە مامۆستا جۆری هەڵسەنگاندن (تاقیکردنەوەکان یان ئەزموونەکان) دەنووسێت بۆ نموونە تاقیکردنەوەی مانگانە، کویزەکان، بیرکردنەوەی ڕەخنەگرانە (پریزەنتەیشن)، ڕاپۆرت نووسین، ووتار نووسین یان ئامادەنەبوونی خوێندکار لە پۆلدا...هتد. ئامانە چەند نمرەی لەسەردەبێت و مامۆستا چۆن نمرەکان دابەشدەکات؟

15. Student learning outcome:

Nanotechnology plays a very important role in the Physics field, during the years I teaching Nanotechnology, I have notices that students generally find it easier to learn its underlying ideas than to handle the practical aspects of the formalism. What is true is that the students at the Physics department who were all selected after a stiff entrance examination, and whose ambitions in life were diverse – in science, in industry, in business, in high public office – all had to follow this introductory physics course. As a consequence, the challenge was to try to get them interested in the field whatever their future goals were. Of course, Nanotechnology is an ideal subject because one can be interested in it for a variety of reasons, such as the physics itself, the mathematical structure of the theory, its technological spinoffs, as well as its philosophical or cultural aspects. So the task was basically to think about the pedagogical aspects, in order to satisfy audiences that went up to many students during the last 10 years.

پڕکردنەوەی ئەم خانەیە زۆر گرنگە، مامۆستا دەرئەنجامەکانی فێربوون دەنووسێت. بۆ نموونە: ڕوونی ئامانجە سەرەکیەکانی کۆرسەکە (بابەتەکە) بۆ خوێندکار
گونجاندنی ناوەرۆکی کۆرسەکە بە پێویستی دەرەوە و بازاڕی کار
قوتابی چی نوێ فێردەبێت لە ڕێگەی پێدانی ئەم کۆرسەوە؟

This should not be less than 100 words

16. Course Reading List and References:

Books: *There are many good introductory texts on Nanotechnology, for example:*

1. D.Bimberg, M.Grundman, N.N. Ledenstov : **Quantum Dot Heterostructures**
2. Sharma Ashutosh, Jayesh : Adv. : **In Nano Science & Tech.**
3. Dresselhaus M.S. & Avouris : **CNT Synthesis, Structure, Properties & Application**
4. R. Ueda and J.B. Mullin : **Crystal Growth and Characterisation**
5. Ibach and Luth : **Solid State Physics**
6. Woodruff and Delchar : **Experimental Techniques of Surface Science**
7. Tsakalakos, Ovidko & Vasudevan : :**Nanostructures**
8. Richard Xylen : : **Physics of Amorphous Solids**
9. Gang Moog Chow : **Nanostructured Films & Coatings**

- Key references:
- Useful references:
- Magazines and review (internet):

17. The Topics:	Lecturer's name
Chapter One (Nano science) 1. **Introduction .** 2. **Nanomaterial's** 3. **Classification of Nanomaterials depending on size** 4. **Nano-porous materials** 5. **Types of Nanomaterial's** 6. **Why do nanoparticles behave differently to the bulk material?** 7. **(high surface to volume ratio- Quantum confinement)**	Dr. Lary Hana Slewa ex: (3 hrs) ex: Weeks (One – Three)
Chapter Two (Nanotechnology) 1. **Nanotechnology (Introduction)** 2. **Nanotechnology fabrication methods: (top down and bottom up)** 3. **Classification of fabrication method (physical , chemical method)** 4. **Physical method (Physical vapor deposition :**	Dr. Lary Hana Slewa ex: (3 hrs) ex: Week (Four – Six)

thermal evaporation, laser ablation, sputtering , .. 5. **Chemical method (chemical vapor deposition , hyderothermal , spray pyrolysis ,** 6. **Experimental technology for characterization nanomaterial (XRD, FTIR, FESEM, TEM, Optical and electrical properties)**	
Chapter 3 Biochemical Sensors 1. **introduction** 2. **Electronic device (BJT, FET (MOSFET)** 3. **Type of Nano electronic biosensor (amperoemetric , and potentometeric sensor)** 4. **Amperometeric sensor (for example glucose sensor)** 5. **Potentiometric sensor (ISFET , EGFET (as ion sensore , DNA, ….)**	Dr. Lary Hana Slewa ex: (3 hrs) ex: Weeks (Six & eight)
First Examination	Dr. Lary Hana Slewa ex: (3 hrs)
18. Practical Topics (If there is any)	
None	Lecturer's name ex

19. Examinations:

1. ANSWER ALL THE FOLLOWING **2X10=20marks**

a) Define NANO TECHNOLOGY?
b) Give any two salient points addressed by Feynman?
c) Define nano structured material? Classify nanostructured materials?
d) Define nanocomposite and Classify nanocomposites?
e) What is the diameter of a bucky ball? How many pentagons and hexagons are there in a bucky ball?
f) What for MEMS stands for? What are the types of MEMS?
g) What do you mean by characterization related with materials? Give any four tools for characterization of materials?
h) What is the difference between SEM & TEM?
i) Why C-60 molecules are called as bucky balls? Give reasons?
j) What is the name of Pentium-IV processor launched by INTEL in 2004, based on 90nm technology?

ANSWER ANY FOUR OF THE FOLLOWING **4X10=40marks**

2) What are the salient points addressed by Feynman in his lecture “there is plenty of room at the bottom”?
3) a) Briefly narrate the history of nanomaterials?

b) Give some present and future applications of nanomaterials?

4) With a neat skech, explain mechanical milling process for synthesis of nano particles? List advantages and disadvantages also?

5) Explain the working of scanning electron microscopy with a neat sketch?

6) a) Define carbon nanotube? What are the types of carbon nanotubes? Highlight the properties of carbon nanotubes?

b) List the the methods for producing carbon nanotubes and explain any one of the method with a neat sketch?

7) a) Write a short note on microfabrication?

b) Define MEMS? What are the types and applications of MEMS?

8) Explain photolithography (optical lithography) with a neat sketch?

BIG QUESTIONS

1) a) "Nanotechnology is new, but research on nanometer scale is not new at all." Write a short paragraph supporting this statement?

b) What are the mile stones in the evolution of nanotechnology?

2) "One nanometer is a magical point on the dimension scale." Why? Explain?

3) what are the salient points addressed by Feynman in his lecture " there is plenty of room at the bottom"?

4) a) What is the difference between nanotechnology & nanoscience?

b) Give Moore's first law & second law?

5) a) What are the challenges faced by researchers in nanotechnology?

b) Why [surface area/volume] ratio is very large for nanoparticles compared to bulk materials? Explain with a simple example? Highlight any two problems associated with increase in surface area?

6) Explain the role of bottom up & top down approaches in nanotechnology?

7) What are the causes of interest in nanomaterial's? Explain?

8) a) Briefly narrate the history of nanomaterials?

b) Give some present and future applications of nanomaterials?

9) a) Define nanomaterial? Give classification of nanomaterials?

b) What are the fundamental and future issues to be considered for the development of nanomaterials?

10) a) What are the advantages and disadvantages in mechanical synthesis of nanopowders?

b) What are the characteristics of nanoparticles that should posses by any fabrication technique?

11) With a neat skech, explain mechanical milling process for synthesis of nano particles? List advantages and disadvantages also?

12) list any four bottom up approaches for synthesis of nanopowders and explain any one of them in detail?

13) Explain gas condensation process for synthesis of nanopowders with a neat sketch?

14) Explain vapor condensation process for synthesis of nanopowders with a neat sketch?

15) Explain laser ablation process for synthesis of nanopowders with a neat sketch?

16) a) What are the differences between top down approach and bottom up approach in synthesis of nanopowders?

b) What are the differences between gas condensation process and vapor condensation process employed for synthesis of nanopowders?

17) Explain SOL-GEL synthesis for producing nanomaterials? Explain with the help of a neat sketch?

18) a) Define carbon nanotube? What are the types of carbon nanotubes? Highlight the properties of carbon nanotubes?

b) List the the methods for producing carbon nanotubes and explain any of the method with a neat sketch?

19) Explain the working of scanning electron microscopy (SEM) with a neat sketch?

20) How do you characterize a material with transmission electron microscope (TEM) with a neat sketch?

21) Explain the working of scanning tunneling microscopy (STM) with a neat sketch?

22) Explain the working of atomic force microscopy (AFM) with a neat sketch?

23) Explain the working of scanning probe microscopy (SPM) with a neat sketch?

24) Explain XRD technique for material characterization?

25) a) Define a bucky ball? What are the methods for producing bucky balls?

b) Explain the more popular method for producing bucky balls with a neat sketch?

26) a) Define nanocomposite? Classify nanocomposites?

b) Write a brief note over the preparation of nanocomposites?

27) a) Highlight the properties of bucky balls? Give applications of bucky balls?

b) Explain the synthesis of polymer nanocomposites?

20. Extra notes:

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

21. Peer review پێداچوونەوەی هاوەڵ

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).

ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەڕۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەڕۆکی کۆرسەکە و واژووی لەسەر بکات.

هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.