

Ministry of Higher Education and Scientific research



**Department of Physics**

**College of Science**

**University of Salahaddin**

**Subject: Nanomedicine(I)**

**Course Book –(4<sup>th</sup> Year Nanomedicine)(First Course)**

**Lecturer's name: Dr.Shaida Anwer Kakil**

**Academic Year: 2023/2024**

# Course Book

<b>1. Course name</b>	<b>Nanomedicine</b>												
<b>2. Lecturer in charge</b>	<b>Shaida Anwer Kakil</b>												
<b>3. Department/ College</b>	<b>Physics- Medical/ Science</b>												
<b>4. Contact</b>	<b>e-mail: <a href="mailto:shaida.kakil@su.edu.krd">shaida.kakil@su.edu.krd</a> Tel: 07504303683</b>												
<b>5. Time (in hours) per week</b>	<b>Theory: 2 Practical: 0</b>												
<b>6. Office hours</b>	<b>2</b>												
<b>7. Course code</b>													
<b>8. Teacher's academic profile</b>	<p>My Academic studies starts with the acceptance in the B.Sc. program in 2004-2005 as an undergraduate student in Physics department and extended as I finished the following education degrees</p> <p><b>Education:</b></p> <table border="1"> <tr> <td><b>B.Sc, 2011</b></td> <td><b>Physics- College of Scien</b></td> </tr> <tr> <td><b>M.Sc.2014</b></td> <td><b>Solid state-Optoelectronic</b></td> </tr> <tr> <td><b>Ph.D. 2022</b></td> <td><b>Condensed Matter</b></td> </tr> </table> <p>As I awards my first Academic title in 2011 and later on</p> <p><b>Academic titles attained:</b></p> <table border="1"> <thead> <tr> <th><b>Academic title</b></th> <th><b>Date of attainment</b></th> </tr> </thead> <tbody> <tr> <td><b>Assistant Lecturer</b></td> <td><b>2014-2015</b></td> </tr> <tr> <td><b>Lecturer</b></td> <td><b>2018</b></td> </tr> </tbody> </table> <p>I starts my Academic role as a staff member giving lectures in my specialization through theoretical and practical modules to the students in undergraduate stages having different study areas</p> <p><b>Main Teaching Areas:</b></p> <ul style="list-style-type: none"> <li>* Laser</li> <li>* laser in medicine</li> <li>* Optics (for B.Sc.)</li> <li>* Nuclear physics</li> </ul>	<b>B.Sc, 2011</b>	<b>Physics- College of Scien</b>	<b>M.Sc.2014</b>	<b>Solid state-Optoelectronic</b>	<b>Ph.D. 2022</b>	<b>Condensed Matter</b>	<b>Academic title</b>	<b>Date of attainment</b>	<b>Assistant Lecturer</b>	<b>2014-2015</b>	<b>Lecturer</b>	<b>2018</b>
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	<ul style="list-style-type: none"> <li>* <b>General Physics</b></li> <li>* <b>Nanomedicine</b></li> </ul> <p>Beside my teachings I had different activities implying research performance in my interest areas</p> <p><b>Research Interests:</b></p> <ul style="list-style-type: none"> <li>* <b>Natural Background Nanotechnology</b></li> <li>* <b>Condensed Matter/Computational Quantum Physics</b></li> <li>* <b>Application nanoparticle in medicine</b></li> <li>* <b>Optoelectronic</b></li> </ul> <p>as well as I participate in scientific conferences, work shop, training courses, doing researches and supervising the B.Sc students In my outside university activities I gave consultation</p>
<p>9. Keywords</p>	<p><b>Nanotechnology, Optics, Laser in medicine, Condensed Matter/Computational Quantum Physics</b></p>
<p><b>10. Course overview:</b></p> <p>Nanomedicine is the application of nanotechnology to medicine. It is a rapidly expanding interdisciplinary field that seeks to develop new and improved techniques for the screening, diagnosis, treatment, and prevention of disease. Today, nanomedicines are used globally for patients suffering from a range of disorders including ovarian and breast cancer, kidney disease, fungal infections, elevated cholesterol, menopausal symptoms, multiple sclerosis, chronic pain, asthma and emphysema.</p> <p>The use of nanoscale technologies to design novel drug delivery systems and devices is a rapidly developing area of biomedical research that promises breakthrough advances in therapeutics and diagnostics. Over the last few years, numerous breakthroughs in nanotechnology have made great impact on different fields of scientific research. Out of these many breakthroughs, some of them have proved to be very promising for diagnosis and treatment of diseases. The term “nanomedicine” describes the applications of nanotechnology in medicine for treatment and diagnosis of diseases. There is an unambiguous need for the discovery and development of innovative technologies to improve the delivery of therapeutic and diagnostic agents in the body</p> <p>The present course is a compilation of the application of nanomedicines with a particular focus on their use in the treatment of diseases. Notwithstanding the benefits of nanotherapeutic devices, the healthcare sector has tremendously benefited in terms of reducing the mortality rate beyond the expectations</p> <p>This course, therefore, carries a lot of potential as a repertoire of knowledge and package of information for pharmaceutical scientists, nanoscientists, and nanobiotechnologists to provide holistic information on the subject of interest</p>	

## 11. Course objective:

Here are some common objectives that are addressed in such a lecture:

### 1. Introduction to Nanomedicine:

- Define nanomedicine and explain its significance in the field of healthcare.
- Provide historical context and background information on the development of nanomedicine.

### 2. Nanoparticles and Nanoscale Materials:

- Describe the properties and characteristics of nanoparticles and nanoscale materials.
- Explain how nanoscale materials can be engineered and manipulated for medical applications.

### 3. Targeted Drug Delivery:

- Discuss the challenges of traditional drug delivery methods.
- Explain how nanomedicine enables targeted drug delivery to specific cells or tissues.
- Provide examples of nanoparticles used for drug delivery and their advantages.

### 4. Imaging and Diagnostics:

- Explore how nanotechnology is used in medical imaging and diagnostics.
- Discuss the development of contrast agents and nanoparticles for improved imaging techniques.

### 5. Therapeutic Applications:

- Present examples of nanomedicine applications in treating diseases such as cancer, cardiovascular diseases, and neurological disorders.
- Explain the mechanisms by which nanomedicine can enhance treatment efficacy and reduce side effects.

### 6. Safety and Regulatory Considerations:

- Address safety concerns related to the use of nanoscale materials in medicine.
- Discuss the regulatory framework and ethical considerations surrounding nanomedicine.

Overall, the objectives of a nanomedicine lecture are to educate the student about the potential of nanotechnology in revolutionizing healthcare, showcase its applications, and promote discussion on the challenges and opportunities in this rapidly evolving field.

## 12. Student's obligation

The class attendance on time is the first obligation of the student. During to this courses three compulsory written exams will be done beside three or more pop quizzes inside the lectures. As well solving exercises and given problems is the student duties. In addition, in class participation would be an advantage for them to extend their knowledge and understand the module systematically. Also, Students activity like questions, creating posters, presentations and solving the homeworks (i.e. formative assessment) either during

the lecture or outside are very important.

### 13. Forms of teaching

All the lecture outlines are prepared and will be a subject of open discussion inside the lectures. In the beginning of each lecture a brief summary of the previous lecture will be remembered and the headlines of the forward lecture is identified and determined. Forms of teaching During this course, I try to apply 21st century skills in teaching methods and assessment tools like (Group team working, Jigsaw model, PowerPoint presentations, Pen and Board, Simulations, animations, videos, arts, body language and others) that engage the students with lecture and the knowledge transferring become easier. Additionally, make the students to determine the knowledge by themselves and improve their skills based on this knowledge. During the study, the students are divided into small groups to prepare assignments and homework's. Also, if the slide needed a long, explanation and I thought that the students must know all of that, I would distribute the printed-out version of the description on the students to widen their knowledge on the subject.

### 14. Assessment scheme

➤ One examination	25 %
➤ Student activity	5 %
➤ Quizzes, HomeWorks and attendance	6+2+2%
➤ Final examination	60%

Attendance and participation in class will also be averaged into your final mean grade former to the final examination.

### 15. Student learning outcome:

The use of nanotechnology in medicine offers some exciting possibilities. Some techniques are only imagined, while others are at various stages of testing, or actually being used today.

Nanotechnology in medicine involves applications of nanoparticles currently under development, as well as longer range research that involves the use of manufactured nano-robots to make repairs at the cellular level (sometimes referred to as *nanomedicine*).

Whatever you call it, the use of nanotechnology in the field of medicine could revolutionize the way we detect and treat damage to the human body and disease in the future, and many techniques only imagined a few years ago are making remarkable progress towards becoming realities.

After completion of the course the student should be able to: - Qualitatively describe how the nanoparticle size can affect the morphology, crystal structure, reactivity, and electrical properties. - Describe several synthesis methods for fabrication of inorganic nanoparticles, one-dimensional nanostructures (nanotubes, nanorods, nanowires), thin films, nanoporous materials, and nanostructured bulk materials, and also could describe how different lithography methods can be used for making nanostructures.

- **Understand the following terminologies: nanomaterial, nanotechnology, nanomedicine and Quantum confinement .**
- **Understand the fabrication, characterization, and manipulation of nanomaterials**
- **Explain :Where Physical and Biological Sciences Meet**
- **Understand Size and shape of nanomaterials effect on Drug delivery system**
- **Understand The bottom-up approach used in nanofabrication is more advantageous than the top-down approach approaches**

- Understand Nanomaterials used in medicine have many unique characteristics compared to conventional micron-size materials. First, they have a high ratio of surface area to volume, which enables high loading of drugs on nanomaterial carriers. Hollow polymeric nanomaterials can even encapsulate hundreds of drug molecules inside a single vehicle and control the release of drugs. In addition, size-dependent properties such as quantum confinement in semiconductor particles (e.g., quantum dots) and superparamagnetism in magnetic materials (e.g., iron oxide nanoparticles) lead to important improvements in medical imaging techniques. Nanomaterials can be engineered to have different sizes, shapes, chemistries and surface characteristics so that they exhibit tunable optical, electronic, magnetic and biologic properties
- Explain and discuss advantages and challenges with nanomaterials in medical and pharmaceutical applications
- Describe transport mechanisms as well as passive and active targeting that control uptake of nano-based drug delivery systems via different administration routes
- Describe and critically evaluate different types of nanovehicles and nanocarriers as well as their use in nanomedicine for disease diagnosis and therapy
- Nanotechnology has the potential to radically change how we diagnose and treat cancer

## 16. Course Reading List and References:

1-B.S. Murty.....Textbook of Nanoscience and Nanotechnology, springer, 2013



2-by B.S. Murty (Author), P. Shankar (Author), Baldev Raj (Author), B B Rath (Author), James Murday Nanomedicine: Design and Applications of Magnetic Nanomaterials, Nanosensors and Nanosystems 1st , Wily, 2008



3- Thomas J. Webster Nanomedicine: Technologies and Applications, Woodhead Publishing; 1st edition (November 2, 2012)



4-Alexandru Mihai Grumezescu, Nanomaterials for Drug Delivery and Therapy, Elsevier Science, Publication date: 03/18/2019



17. The Topics:	Lecturer's name
<p><b>1-Nanomedicine: An Introduction</b></p> <p>1.1 Properties Unique to Nanomaterials                      1.2 Nanomaterial Syntheses                      1.3 Bottom-Up Approach                      1.4 TOP-DOWN Approach                      1.5 Physical and chemical properties of nanomaterials</p>	<p><b>Shaida Anwer Kakil</b>                      ex: (6 hrs)                      ex: 06/10/2018                      weeks (1 ,2 and 3)</p>
<p><b>2-Nanomedicine in Drug Delivery</b></p> <p>2.1 Nanoparticulate Drug-Delivery Systems: An Overview                      2.2 TARGETED DRUG DELIVERY                      2.3 Mechanism for the NanoBased Drug Delivery System                      2.4 Liposomes as a novel drug delivery system                      2.5 Targeted Drug Delivery in Cancer Therapy</p>	<p><b>Shaida Anwer Kakil</b>                      ex: (4 hrs)                      weeks (4+ 5)</p>
<p><b>3. Nanobiotechnology for Antibacterial Therapy and Diagnosis</b></p> <p>3.1 NTRODUCTION                      3.2 ANTIBACTERIAL THERAPEUTICS                      3.3 Carbon Nanotubes and Fullerenes                      3.4 Antibacterial Therapeutics with Diagnostic Potential-pluronic Block Copolymers as Micellar Nanocarriers                      3.5 Multifunctional Nanoplatfoms</p>	<p><b>Shaida Anwer Kakil</b>                      ex: (4 hrs)                      weeks (5 + 6)</p>
<p><b>4.Viral Biology and Nanotechnology</b></p> <p>4.1 Viral Biology and Nanotechnology :Introduction                      4.2 Background Assembly of Nanoparticles and Viruses into Multicomponent Systems                      4.3 NPs Coupled to the Outer Surface of Viruses                      4.4 NPs Packaged Inside Viruses                      4.5 Applications of Nanotechnology and Viral Biology                      4.6 Understanding Basic Biology • Antipathogen Agents • Nanofi Itration • Detection and Diagnosis.</p>	<p><b>Shaida Anwer Kakil</b>                      ex: (4 hrs)                      weeks (5 + 6)</p>
<p><b>5-Biomedical Applications of Magnetic Nanoparticles</b></p> <p>5.1 Introduction                      5.2 Diagnostic Applications                      5.3 Enhancement of Magnetic Resonance Imaging                      5.4 Magnetic Labeling                      5.5 Spatially Resolved Magnetorelaxometry</p>	<p><b>Shaida Anwer Kakil</b>                      ex: (4 hrs)                      weeks (7 + 8)</p>

<p>5.6 Magnetic Separation and Purification 5.7 Biological Assay System 5.8 Biosensors</p>	
<p><b>6-Nanomedicine in Brain Diseases</b> 6.1 Introduction: Nanomedicine in the Brain . 6.2 The Strategies of Nanomaterials for Traversing Blood-Brain Barrier 6.3 BBB Structure and Passage Mechanism 6.4 Different Strategies for Targeting of Drugs to the Brain 6.5 Convection-Enhanced Delivery (CED) 6.6 Different Types of Nanoparticles Employed to Cross BBB</p>	<p><b>Shaida Anwer Kakil</b> ex: (6 hrs) weeks (9+10+)</p>
<p><b>7- Porous Silicon Nanoparticles</b> 7.1 Introduction 7.2 Physicochemical Attributes of PSi 7.3 Loading and Release of Drugs from PSiNPs 7.4 Covalent Attachment , Oxidation, Surface Adsorption</p>	<p><b>Shaida Anwer Kakil</b> ex: (6 hrs) weeks (11)</p>
<p><b>7-Nanoparticles for Medical Imaging</b> 7.1 Enhancement for X-Ray and Tomography Imaging. 7.2 Enhancements with MRI Imaging. 7.3 Nanodots and Quantum Resonant Nanoparticles. 7.4 Nanoparticles in the Enhancement of IR, Visible,</p>	<p><b>Shaida Anwer Kakil</b> ex: (4 hrs) weeks (12 + 13)</p>
<p><b>8- Nanotechnology for tissue engineering</b></p>	<p><b>Shaida Anwer Kakil</b> ex: (2 hrs) weeks (14)</p>
<p><b>20. Extra notes:</b> 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.</p>	
<p><b>21. Peer review</b> <span style="float: right;"><b>پیداچوونہودی ھاوہل</b></span> 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 كۆرسىۋوكە دەبىت لەلايەن ھاوہلئىكى ئەكادىمىيە سەپىر بىكرىت و ناوہرۆكى بابەتەكانى كۆرسەكە پەسەند بىكات و جەند ووشەپەك بنوسىت لەسەر شىاوى ناوہرۆكى كۆرسەكە و واژووى لەسەر بىكات. ھاوہل ئەو كەسەپە كە زانىارى ھەبىت لەسەر كۆرسەكە و دەبىت پلەي زانستى لە مامۇستا كەمتر نەبىت.</p>	