

**University of Puerto Rico  
Rio Piedras Campus  
Natural Science Faculty  
Physics Department,  
San Juan, PR 00925-2537**

**Course Title: Research Seminar**

FISI 6995 -052 Katiyar (Science & Technology of Nanoceramics for Multifunctional Applications)

No. Hours / Credits: 3-4 hours per week / 1-2 credits per semester

Prerequisites Co-requisites and Other Requirements: FISI4032 (Methods of Mathematical Physics) or equivalent and permission of the investigator in laboratory or the Director of the Department.

**Course Description:**

Advanced studies and training in specialized topics of synthesis and characterization of functional nanomaterials and their applications. The focus of the course is on studying physical properties of materials and their applications in nano-devices.

**Goals:**

At the end of the course, each student will have demonstrated an ability to determine:

- Research skills in synthesizing nanomaterials and thin film fabrications
- Crystallography of the materials
- Optical and spectroscopic properties
- Electrical, dielectric, ferroelectric, and magnetic properties
- Raman and infrared spectroscopy of materials
- Develop critical thinking skills about concepts of physics in the context of above physical properties and their correlations,
- Integrate fundamental concepts of physics in a particular area of research
- Critically analyze any existing scientific literature
- Make a value judgment of scientific research for possible applications in devices.

Content Outline and Time Distribution: Weeks	No. Hours	Topics
weeks 1-6	18	The first step will consist of 6 weeks of course related to basic concepts of spectroscopy and crystal physics in relation to structural and physical properties of materials
weeks 7-10	12	In this period, the students will learn about the materials synthesis and fabrication of nanoparticles and their characterization by various

		microscopic techniques. These materials can be oxide ferroelectrics, resistive switching oxides, and/or cathode materials for Li-ion/Li-S batteries
weeks 11-15	15	In this period, the focus of the course will be on the study of ferroelectric, magnetic, dielectric, vibrational spectroscopic properties, and electrochemical properties of the multifunctional nanomaterials and their applications for energy, sensor and/or memory devices.

**Instructional Strategies:**

The instructional method of the seminar is based on the discussion of frontier functional material research and their multifunctional applications in energy related research. The discussions will often involve recent review articles on the subject.

**Minimum resources available:**

Audiovisual and conference room projectors, and SPECLAB research facilities.

**Evaluation Strategies:**

Attendance and active participation of students in the discussion are essential (25%). Each student makes a presentation of the results of research in which it participates and discusses the relevant scientific literature (50%). the increase in the level of proficiency in the particular area of research in physics (25%) is evaluated.

**Rating system:**

approved or not approved.

**Suggested Textbooks:**

Physical Properties of Materials by Nye; Elementary Crystallography by M.J. Buerger, Raman and Infrared spectroscopy by G. Turrell; Chemical Applications of group theory by F.A. Cotton; Thin Film Growth:

**REGULATION ON DISCRIMINATION BY SEX AND GENDER IN THE FORM OF SEXUAL VIOLENCE:**

"The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, must turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or a formal complaint. "

**REASONABLE ACCOMMODATION:**

The University of Puerto Rico complies with all state and federal laws and regulations related to discrimination, including "The American Disabilities Act" (ADA law) and Law #51 from the Puerto Rico Commonwealth (Estado Libre Asociado de Puerto Rico). Every student has the right to request and receive reasonable accommodation and Vocational Rehabilitation Services (VRS). Those students with special needs that require some type of particular assistance or accommodation shall explicitly communicate it directly to the professor. Students who are receiving VRS services shall communicate it to the professor at the beginning of the semester so that appropriate planning and the necessary equipment may be requested according to the Disabilities Persons Affairs Office (Oficina de Servicios a Estudiantes con Impedimentos –OSEI) from the Students' Deanship office. Any other student requiring assistance or special accommodation shall also communicate directly with the professor. Reasonable accommodations requests or services DO NOT exempt the student from complying and fulfilling academic and course related requirements and responsibilities.

**ACADEMIC INTEGRITY:**

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws.

To ensure user data integrity and security, hybrid and distance education courses are offered through the institutional learning management system, which employs secure connection and authentication protocols. The system authenticates the users' identity with the username and password of their institutional accounts. Users are responsible for keeping their password secure and not sharing with others.