COLLEGE PROFILE

Fatima College (Autonomous), Mary Land, Madurai, is a Post Graduate and Research Institution for Women affiliated to Madurai Kamaraj University. It is a Catholic Minority institution established and run by St. Joseph's Society of Madurai (of the Congregation of the Sisters of St. Joseph of Lyons, France). This institution came into existence through the tireless efforts of the missionary sisters of St. Joseph of Lyons and the zeal and heroic sacrifice of Rev. Sr. Rose Benedicta, the Foundress of the College.

The College was started in St. Joseph's Campus Madurai as a Second Grade College with 63 students in 1953. It was upgraded into a Post Graduate College in 1964; Autonomous in 1990 and a Research Institute in 2004. The College now offers 21 Undergraduate Programmes, 13 Postgraduate Programmes, 2 Professional Programme, 5 M.Phil. Programmes and 6 Departments have become Research Centres. It has strength of 4134 Students, 206 Teaching Staff and 100 Non-Teaching Staff.

The comprehensive assessment by NAAC in 1999 placed Fatima College in Five Star Status of merit. The college strives to sustain excellence, quality and relevance while equipping the students to meet the demands of higher education in India. In 2004 UGC conferred on Fatima College the status of College with Potential for Excellence. In 2006 and 2013 NAAC Re-Accredited the College with 'A' Grade. The College was ranked 94th in the All India NIRF Ranking in 2019 by MHRD.

VISION

WOMEN'S EMPOWERMENT THROUGH EDUCATION

The vision of the college is to empower women by developing human capabilities through quality education based on Christian values, making them responsible citizens who can work for the advancement of the society and promote communal harmony in the multi-religious and multi-cultural reality of India eventually evolving into women of communion.

MISSION

- To enhance quality of life through the development of individuals.
- To enable women to become contributors in the economic, social and political development of India.
- To equip the students with 21st century skill-sets with a focus on problem-solving abilities
- To motivate them to work for social justice
- To give preference to the rural economically backward and first-generation learners
- To enable students to be employed in the technology oriented competitive market

VISION OF THE DEPARTMENT

Educate , Empower and Excel

MISSION OF THE DEPARTMENT

- To ignite the young minds and impart quality education in basic Physics
- To promote enthusiasm in the study of physics through innovative and dedicated teaching methodologies
- To discover the budding talents in theoretical and experimental physics and ensure their global competency
- To provide a stimulating environment and strengthen basic and application oriented research aptitude among the students.

FULL TIME DOCTOR OF PHILOSOPHY

PHYSICS - SEMESTER - I

For those who joined in 2020 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
DSPH	**19PHDCWP01**	**NANOSTRUCTURES FOR ENERGY STORAGE APPLICATIONS**	**Core**	**-**	**2**

COURSE DESCRIPTION

This course emphasise the basic concepts of nanomaterials which involves its structure, properties, preparation and its applications in energy storage.

COURSE OBJECTIVES

This course provides detailed information about the magnetic nanostructures and its contribution in energy storage.

UNITS

UNIT –I INTRODUCTION TO PHYSICS OF THE SOLID STATE AND ITS MEASURING PROPERTIES

Structure : Size Dependence of Properties - Crystal Structures - Face-Centered Cubic Nanoparticles - Tetrahedrally Bonded Semiconductor Structures - Lattice Vibrations - Energy Bands : Insulators, Semiconductors, and Conductors - Reciprocal Space - Energy Bonds and Gaps of Semiconductors - Effective Masses - Fermi Surfaces - Localized Particles : Donors, Acceptors, and Deep Traps – Mobility - Excitons - Particle Size

Determination ; Surface Structure ; Microscopy - Transmission Electron Microscopy - Field Ion Microscopy - Scanning Microscopy - Spectroscopy - Infrared and Raman Spectroscopy - Photoemission and X-Ray Spectroscopy- Magnetic Resonance

UNIT –II PROPERTIES OF INDIVIDUAL NANOPARTICLES

Introduction - Metal Nanoclusters : Magic Numbers - Theoretical Modeling of Nanoparticles - Geometric Structure - Electronic Structure - Reactivity - Fluctuations - Magnetic Clusters - Bulk to Nanotransition - Methods of Synthesis : RF Plasma - Chemical Methods - Thermolysis - Pulsed Laser Methods

UNIT –III NANOSTRUCTURED FERROMAGNETISM

Basics of Ferromagnetism - Effect of Bulk Nanostructuring of Magnetic Properties - Dynamics of Nanomagnets - Nanopore Containment of Magnetic Particles - Nanocarbon Ferromagnets - Giant and Colossal Magnetoresistance – Ferrofluids techniques for ME effects in nanocomposites - Layered multiferroic composites : Ferromagnetic–ferroelectric composites - Direct magnetoelectric effects - Converse ME effects - Conclusions - Epitaxial multiferroic heterostructures : Introduction - BiFeO3 systems-related multiferroics - Ferrite-related multiferroics - Summary and prospects- Magnetoelectric characterization techniques : Introduction ; Direct-ME effects - Converse ME effects - Scanning probe microscopy

UNIT –IV SUPERCAPACITORS: FUNDAMENTAL ASPECTS

Introduction ; Electrostatic Capacitor ; Electrolytic Capacitor ;Electrical Double-Layer Capacitor - Technological Aspects of Supercapacitors : Construction – Electrodes – Electrolyte – Separator- Charge Storage Mechanism : Helmholtz Model - Gouy–Chapman Theory - Stern Modification of the Diffuse Double Layer ; Equivalent Model of an EDLC ; Pseudocapacitance- Applications- Advantages and Disadvantages of Supercapacitors

UNIT –V RESEARCH ETHICS

Ethics code of American Psychological Association; Collaboration, cooperation and teamwork; Research outcome; Intellectual property right, Copy-right, patent, 4 4 fundamentals of patent filing; Usage of pirated version of literatures and software; Plagiarism – Case Studies, Web based verification

REFERENCES:

1. INTRODUCTION TO NANOTECHNOLOGY, Charles P. Poole, Jr. ,Frank J. Owens
   Sec 2, Sec 3, Sec 4.1, 4.2, 4.5, Sec 7

2. COMPOSITE MAGNETOELECTRICS: Materials, Structure and Applications, Gopalan Srinivasan, Shanshank Priya, Nian X.sun
   Sec 3, Sec 5.1, 5.2, 5.4, 5.5, Sec 2

3. NANOSTRUCTURED CERAMIC OXIDES FOR SUPERCAPACITOR APPLICATIONS, edited by Avinash Balakrishnan and K. R. V. Subramanian
   Sec 3

4. RESEARCH METHODOLOGY: The Aims, Practices and Ethics of Science, P. Pruzan, Springer, 2016

5. RESEARCH METHODS FOR SCIENCE, M. P. Marder, Cambridge University, 2011.

6. FUNDAMENTALS OF RESEARCH METHODOLOGY AND STATISTICS, Y.K. Singh, New Age, 2006

COURSE OUTCOMES

On the successful completion of the course, students will be able to:

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	understand the structure and properties of nanoparticles	K1, K2	PSO1,PSO2
CO 2	get exposed to various methods of measuring various properties	K1, K2, K3	PSO3,PSO4
CO 3	Gain knowledge about the structure and properties of metal nanoclusters, semiconducting nanomaterials, rare gas and molecular clusters and their methods of preparation	K1, K2	PSO1,PSO3
CO 4	Comprehend the basics of ferromagnetism, multiferroic composites , multiferroic heterostructures and the magnetoelectric characterization techniques.	K2, K2, K3 & K4	PSO4, PSO5
CO 5	apply the basics of supercapacitors, their technical aspects, storage mechanisms towards device fabrication	K1, K2, K3 & k4	PSO3,PSO4& PSO5

COURSE DESIGNER: Dr. M. Ragam

Forwarded By
Dr. A. Sheela Vimala Rani

HoD'S Signature & Name

FULL TIME DOCTOR OF PHILOSOPHY

PHYSICS - SEMESTER - I

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
DSPH	19PHDRMP02	RESEARCH METHODOLOGY	Ph.D Core	-	2

COURSE DESCRIPTION

This is a cross-curricular subject, which may be of interest for those students who are considering undertake a research career, especially in the fields of physics and technologies in physics.

COURSE OBJECTIVES

This paper highlights the various postulates of research problems, research design, writing a thesis and modern statistical methods. This helps to carry out research problem individually in a perfect scientific method.

UNITS

UNIT I: INTRODUCTION TO RESEARCH

Meaning of Research-Objectives of Research-Motivation in Research-Types of Research-Research Approaches-Significance of Research-Research and Scientific Method-Importance of Knowing How Research is Done-Research Process-Criteria of Good Research-Problems Encountered by Research.

UNIT II: SOURCE MATERIAL AND REVEWING OF LITERATURE IN THE AREA OF STUDY

Preparing a list of reading material and reference in the concerning area of specialization and topic of research-Critical evaluation and review of research work carried out so for on the topic-Difficulties with reviews-

Primary and secondary source of materials and methods and technique to be adopted in the collection of primary data.

UNIT III: DESIGN AND PLANNING OF EXPERIMENTS, TIME SCHEDULING

Aims and Objectives-Selecting the problem-Necessity of Defining the problem-Technique involved in Defining a problem-An illustration-Expected outcome-Methodology to be adapted-Planning of experiments for achieving the aims and objectives- Importance of reproducibility of research work.

UNIT IV : THE COMPUTER: IT'S ROLE IN RESEARCH

Introduction-The Computer and Computer Technology-The Computer System-Important Characteristics-Computer Applications-Computers and Researcher-Software Using Origin-Microsoft Office-Matlab-Mathematica etc.

UNIT V :INTERPRETATION AND REPORT WRITING

Meaning of Interpretation-Interpretation-Technique of Interpretation: Precaution in Interpretation-Significance of Report Writing-Different Steps in Writing Report-Layout of the Research Report-Types of Reports-Oral Presentation-Mechanics of Writing Research Report-Precautions for Writing Research Reports-Conclusions.

TEXT BOOK

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006 2. Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047- 0,2006.

BOOKS FOR REFERENCE

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.

2. Fuzzy Logic with Engg Applications, Timothy J.Ross, Wiley Publications, 2nd Ed[d]

3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven& E.H. Aarts[e]

4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg

COURSE OUTCOMES

On the successful completion of the course, students will be able to

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	understand the basics of research and its objectives	K1,K2	PSO1,PSO2
CO 2	gain knowledge about the theoretical research involved	K1, K2	PSO1,PSO2
CO 3	get exposure to planning of experiments and the various methodologies involved	K1 , K2, K3	PSO2, PSO3
CO 4	apply the use software and other computational techniques for data presentation	K1, K2, K3 & K4	PSO4,PSO5
CO 5	understand and analyse the techniques of interpretation involved in written and oral presentations	K1, K2 , K3 & K4	PSO4,PSO5

COURSE DESIGNER Dr. M. Ragam

Signature of the HOD with Seal

Dr. A. SHEELA VIMALA RANI
HEAD & ASSOCIATE PROFESSOR
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