

Maa Shakumbhari University, SAHARANPUR U.P.

माँ शाकुम्भरी विश्वविद्यालय, सहारनपुर



Syllabus

of

Pre Ph.D. Course work

in Physics

(As per guidelines of U.P. Government according to National Education Policy-2020 w.e.f. the session 2023-2024)

Members of the Board of Studies:

S. No.	Name	Signature
1.	Prof. Mukesh Kumar, Dean, Science faculty	
2.	Prof. Mukesh Kumar, Convener	
3.	Prof. Garima Jain, Member	
4.	Prof. Ashok kumar Dimri	
5.	Dr. Sanjay Kumar Singh	
6.	Prof. Beer Pal Singh, External Expert	
7.	Prof. R S Singh, External Expert	

Course No-1

RESEARCH METHODOLOGY AND COMPUTER APPLICATIONS

This course is common for doctoral research students of all the subjects in science faculty the objectives of the course is to acquaint research student with scientific research methods and approaches.

Unit 1: Basic Principles of Research: -

Basic principles of research, objectives of research, importance, types of research basic and applied, selection of a research topic and problem, assessment of current status of topic chosen, literature survey and reference collection, formulation of hypothesis. Research designs, sampling designs, ethics in research, code of ethics, fabrication of data, plagiarism, ***(only for zoology)*** animals, use of animals, animals' ethics and related laws, ***(for life science only)*** bio safety regulations in biology research

Unit 2: Methods of Data Collections: -

Types and sources of data, data collection methods, primary data, secondary data, analysis for specific type of data, tabulation and graphical representation, central tendency, dispersion, skewness, correlation, regression, Chi-square test, t and f tests ANOVA one way and two way, important non parametric tests Sign, Run, Kendall's Coefficient

Unit 3: Report Writing Techniques: -

Significance of report writing, different steps in writing report and research papers, layout of the research report, oral and written presentation of research (abstract/synopsis), mechanics of writing a research report, precautions for writing research report, conclusions, impact factor and citation index

Unit 4 Computer Applications: -

Computer and internet, networking different LAN and WAN connections, connection to a network, web browsers, internet security, web search engine, MS word, Handling Graphics, Tables and charts, converting a word document into various formats like text rich text, word perfect, HTMT, PDF etc. MS Power Point, creating slide show with animations, creating a blank presentation, auto layout, power point screen, screen layout and views, insert a new slide, applying design, template changing slide layout recording and hiding slide show and editing Custom slide.

Data analysis and display facilities in MS Excel for data analysis and display, other data display software, case study origin, software for scientific and statistical analysis case studies SPSS data base creating a database

Educational and research resources on Net Encyclopedia, case study Wikipedia on line tutorials and lectures, java applets, educational applet, virtual tabs, electronic journals, e- books, digital libraries, searching research information using -gate and SCOPUS, science direct

Suggested Books:-

1. Research methodology methods and technique by C.R. Kothan, second revised edition
2. Research methodology a step-by-step guide for beginners by Ranjit Kumar
3. Research methodology methods and statistical by Santosh Gupta Statistical methods
S.P. Gupta
4. Research design, Qualitative, Quantitative and mixed methods approaches by W.
Creswell, third edition
5. Information communication technology by Tim Shorts
6. Handbooks of communication and social interaction skills by John O Green Brant
Raney Burleso

Course No-2

Emerging Trends in Physics

Unit 1: Synthesis of Materials

Vacuum Science & Technology and applications in materials science, Fundamentals of materials synthesis, Film growth, Thin film and thick film synthesis, Physical methods (Vacuum evaporation, sputtering, PLD, MBE, etc.). Chemical methods (Chemical and electrochemical methods, spin coating, etc.); Nano-materials synthesis, Top down and Bottom up approaches, Crystal Growth techniques)

Unit 2: Characterization Techniques

Basics of radiation matter interaction, Basics of, electron matter interaction, Structural and composition characterization; XRD, Electron Microscopic studies, SEM with EDAX, TEM, SPM, STEM, AFM, X-Ray Photoelectron Spectroscopy (XPS), Optical characterization: UV-Vis. Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Photoluminescence, Raman spectroscopy. Magnetic and. dielectric measurements.

Unit 3: Advanced Microelectronic Processing Techniques

Optical Lithography, Photo Masks, Mask Aligners; Photoresist process,, X-ray lithography, Electron beam lithography, Focused ion beam lithography, Etching techniques, MEMS (microelectromechanical systems), Micro-sensors, micro- actuators, NEMS. Qualitative idea only.

Unit 4: Methods of Computational Physics

Numerical methods; Solution of differential equations, Applications to potential-well problem, Understanding of special functions, Generation and Graphs, Random number generators, various test.

Numerical solution of Schrodinger equation for spherically symmetry potentials scattering states, Calculation of phase shifts, Resonance.

References:

1. Vacuum Physics and Techniques by T.A. Delchar.
2. Dielectric Materials and Application by Von Hippel.
3. Electrical Engineering Materials by A.J. Dekker.
4. Thin Film Phenomena by K.L Chopra.
5. Experiments in Modern Physics by H. Mark and N. Thomas Olson.
6. The Science and Engineering of Microelectronic Fabrication, Oxford University Press, by S.A. Campbell.
7. Computational Physics, Cambridge University. Press, by I.M. Thijssen

Course No-3

Electrochemical Energy Storage System

Unit-1: Energy Storage Systems Overview

Scope of energy storage, Needs and opportunities in energy storage, Technology overview and key disciplines, Thermal, Mechanical, Chemical, Electrochemical, Electrical, Efficiency of energy storage systems, Energy storage in power and transportation sector, Importance of energy storage in electric vehicles, Current electric vehicle market.

Unit-2: Batteries

Working principle of battery, Primary and secondary batteries, Battery performance evaluation methods. Li-ion battery & metal hybrid battery vs lead-acid battery.

Unit-3: Supercapacitors

Working Principle of supercapacitor, Types of supercapacitors, Cycling and performance characteristics, Difference between battery and supercapacitors, Introduction to electrochemical capacitors.

Unit-4: Fuel Cells

Operational principle of fuel cells, Types of fuel cells: Alkaline fuel cell, Phosphoric acid fuel cell, Molten carbonate fuel cell, Fuel cell battery and fuel cell supercapacitors. Energy generation technology in fuel cells.

Suggested Readings:

1. Barnes, Frank S. & Levine, Jonah G., "Large Energy Storage Systems Handbook" (Mechanical and Aerospace Engineering Series), CRC press.
2. Zito, R., "Energy Storage: A new approach".
3. Pistonia, Gianfranco & Liaw, Boryann, "Behaviour of Lithium-Ion Batteries in electric vehicles: Battery Health, Performance, Safety and Cost" Springer International Publishing.
4. Huggins, Robert A., "Energy storage", Springer Science & Business Media