

Maa Shakumbhari University, SAHARANPUR U.P.



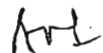
माँ शाकुम्भरी विश्वविद्यालय, सहारनपुर, उत्तर प्रदेश



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. Garima Jain, Dean, Science faculty |  |
| 2. | Prof. Garima Jain, Convener |  |
| 3. | Prof. Ashok Kumar Dimri |  |
| 4. | Dr. Sanjay Kumar Singh | |
| 5. | Prof. Beer Pal Singh, External Expert | |
| 6. | Prof. R S Singh, External Expert | |

Post Graduate in Diploma in Research (PGDR) in Physics as per

NEP 2020 (Revised)/ Pre. Ph. D. course works in Physics

Guidelines (Effective from 2024-2025)

| Year | Semester | Course Code | Course Title | Core Compulsory/ Elective/Value Added | Theory/ Practical/ Project | Credits | Internal Marks | External Marks (Min Marks) | Total Marks | Minimum Marks (Int+Ext) | Teaching Hours |
|---------------------------------|--|-------------|---|---------------------------------------|----------------------------|---------|----------------|----------------------------|---------------------|-------------------------|----------------|
| Year-6 as per NEP 2020/ year -I | Semester-XI as per NEP 2020 / Semester-I | 1120101 | Research methodology and Computer Application | Core Compulsory | Theory | 4 | 25 | 75 (25) | 100 | 55 | 60 |
| | | 1120102 | Emerging Trends in Physics | Core Compulsory | Theory | 2 | 25 | 75 (25) | 100 | 55 | 30 |
| | | 1120103 | Computational and Numerical physics | Core Compulsory | Theory | 2 | 25 | 75 (25) | 100 | 55 | 30 |
| | | 1120104 | Electrochemical Energy Storage System | Core Compulsory | Theory | 2 | 25 | 75 (25) | 100 | 55 | 30 |
| | | 1120105 | Specialized Areas in Physics Research | Core Compulsory | Theory | 2 | 25 | 75 (25) | 100 | 55 | 30 |
| | | 1120165 | Research Project | Core Compulsory | Project | 4 | - | - | 75 + 25 (Res. Pub.) | 55 | - |

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Code: - 1120601

Course No-1

Credits:-4

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, HTML, 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

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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.

Suggested Books: -

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

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Computational and Numerical Physics

Unit 1: 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.

Unit 2: Quantum computing

Introduction, Overview of binary number system and logic gates, Turing machine, Qubits Entanglement, Quantum logic gates, Quantum computation, Brain computer interface.

Suggested Books: -

- 1 Computational Physics, Cambridge University. Press, by I.M. Thijssen
- 2 Principles of Quantum Mechanics, by Ishwar Singh Tyagi,
3. An Introduction of Quantum Computing by Phillip Kaye, Ramond Laflamme and Michele Mosca
4. Computational Quantum Mechanics by Joshua Izaac and Jingbo Wang

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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 and Supercapacitors

Working principle of battery, Primary and secondary batteries, Battery performance evaluation methods. Li-ion battery & metal hybrid battery vs lead-acid battery. Working Principle of supercapacitor, Types of supercapacitors, Cycling and performance characteristics, Difference between battery and supercapacitors, Introduction to electrochemical capacitors.

Suggested Books: -

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

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Code: - 1120605

Course No-5

Credits: -2

Specialized Areas in Physics Research

Unit-1: Radiation Physics

Introduction to Radiation Physics, Radioactive sources, Quantifying Radiation, Interaction with charged Particles and Photon, Radioactive gases, Detectors, Dosimetry, Micro Dosimetry, Radiation effects, Radiation Protectors, Current trends in radiation research

Unit-2: Liquid Crystals

Historical overview of liquid Crystals, Classification: Thermotropic and Isotropic liquid crystal, Different Phases of Liquid crystals, Physical properties: optical, dielectric and elastic behaviour, Parameters determining liquid crystalline structure, Current trends in liquid crystal technology.

Suggested Books: -

1. A Primer in Applied Radiation Physics, by F. A. Smith, World Scientific Publication.
2. Introduction to Radiological Physics and Radiation Dosimetry. By Franck Herbert Attix
3. Introduction to Liquid Crystal: Chemistry and Physics, by Peter J. Cooling and M. Hird, Taylor and Francis (1997)
4. The Physics of Liquid Crystal by P. G. De. Gennes, Oxford University Press (1993)

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