SRINIVAS UNIVERSITY

Mukka, Mangaluru – 574146

Web : www.srinivasuniversity.ac.in

[In compliance of University Grants Commission (MinimumStandards and Procedures for Award of Ph.D. Degree) Regulations, 2022]

**COURSEWORK SYLLABUS OF
Ph.D. PROGRAMME IN
PHYSICS**

INSTITUTE OF ENGNEERING AND TECHNOLOGY
SRINIVAS UNIVERSITY
Mukka Mangaluru – 574146.

A. COURSE WORK PATTERN   400 M

Sl. No.	Subjects	Credits	Internal Marks	External Marks	Marks
1	Research Methodology (22SPHDRM001)	4	50	50	100
2	Solid State Physics (22SPHDPHS02)	4	50	50	100
3	Analysis And Presentation Of Proposed Research Topic (22SPHDPUB003)	4	50	50	100
4	Review Of Literature (22SPHDPUB004)	4	50	50	100
	Total	**16**	**200**	**200**	**400**

COURSE WORK SYLLABUS

1. RESEARCH METHODOLOGY
(22SPHDRM001)

Module-1
Meaning, Objectives and Characteristics of research - Research methods Vs Methodology - Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research - Developing a research plan. Defining the research problem - Selecting the problem - Necessity of defining the problem -Techniques involved in defining the problem - Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources – Development of working hypothesis.

Module -2
Research design and methods – Research design – Basic Principles- Need of research design – – Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models - Developing a research plan - Exploration, Description, Diagnosis, and Experimentation- Determining experimental and sample designs.

Module -3
Sampling design - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques - Methods of data collection – Collection of primary data - Data collection instruments Testing of hypotheses - Basic concepts - Procedure for hypotheses testing flow diagram for hypotheses testing - Data analysis with Statistical Packages – Correlation and Regression - Important parametric test - Chi-square test - Analysis of variance and Covariance

Module -4
Data Analysis using MS Excel Introduction to Spreadsheets Spreadsheet Functions to Organize Data, Introduction to Filtering, Pivot Tables, and Charts, Advanced Graphing and Charting. Interpretation and report writing - Techniques of interpretation - Structure and components of scientific reports - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis

Module-5

Ethics in Research: Importance, Principles, Developing a code of ethics, Ethics and Respondents, Ethics and Clients, Ethics and research firm. Plagiarism. Patent and Copyrights

REFERENCES:
1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2021. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 2015. Research Methodology: Methods and Techniques. New Age International. 418p. 3. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi
4. Sinha, S.C. and Dhiman, A.K., 2012. Research Methodology, EssEss Publications. 2 volumes. se knowledge base, Atomic Dog Publishing.
5. Trochim, W.M.K., 2015. Research Methods: the conci 270p.
6. Fink, A., 2019. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
7. Intellectual Property Rights in the Global Economy: Keith Eugene Maskus, Institute for International Economics, Washington, DC, 2019
8. Subbarau NR Handbook on Intellectual Property Law and Practice Publishing Private Limited.2008 S Viswanathan Printers
9. Research Methodology, Shashi k Gupta and Praneet Rangi. Kalyani Publishers, 6th edition

SOLID STATE PHYSICS
(22SPHDPHS02)

Module -1:
Crystal structure: Lattice points and space lattice, The basis and crystal structure, Unit cells and lattice parameters, Unit cell versus primitive cell, Crystal systems, Symmetry elements in crystals, Space groups, The Bravais space lattices, Metallic crystal structures, Directions, planes and Miller indices. Atomic packing: packing fraction, Co-ordination number. Examples of simple crystal structures: NaCl, ZnS and diamond. Symmetry operations, point groups and space groups. X-ray diffraction: X-ray diffraction, Bragg's law. Concept of reciprocal lattice, Laue Equations, Brillouin Zones. Experimental diffraction methods: Laue method, Rotating Crystal method and Powder Crystal method.

Module -2:
Crystal binding: Types of binding. Van der Waals-London interaction, Repulsive interaction. Modelung constant. Born's theory for lattice energy in ionic crystals and comparison with experimental results. Ideas of metallic binding, Hydrogen bonded crystals. Lattice vibrations: Vibrations of monoatomic lattices. First Brillouin zone. Quantization of lattice vibrations - Concept of Phonon, Phonon momentum. Specific heat of lattice (qualitative).

Module -3:
Energy bands in solids: Formation of energy bands. Free electron model: free electrons in one and three dimensional potential wells, electrical conductivity, heat capacity, Fermi-Dirac distribution, density of states, concept of Fermi energy. Kronig-Penny model. Nearly Free Electron Model (qualitative). Tight Binding model (qualitative). Defects in solids: Point defects: Schottky and Frenkel defects and their equilibrium concentrations. Line defects: Dislocations, multiplication of dislocations (Frank-Read mechanism). Plane defects: grain boundary and stacking faults.

Module -4:
Magnetic materials: Classification – paramagnetic, diamagnetic and ferromagnetic materials – Properties and examples. Magnetic susceptibility and magnetic permeability. Variation of susceptibility of paramagnetic materials with temperature. Curie law. Curie temperature. Behaviour of ferromagnetic materials for $T>T_C$ (Curie-Weiss Law). Ferromagnetic domains. Antiferromagnetism, Ferrimagnetism. Hard and soft ferromagnetic materials – applications. Magnetic hysteresis. Superconductors: Superconductivity. Zero resistance. Meissner effect. Critical field. Classification.

Module-5:
Structure of Solids: The crystalline and Non-crystalline states, Covalent solids, Metals and alloys, Ionic solids, The structure of silica and silicates
Crystal growth: Crystal growth from melt: Bridgemann technique, Crystal pulling by Czochralski's method, Growth from solutions, Hydrothermal method, Gel method, Zone refining method of purification.
Crystal imperfections: Point imperfections, Dislocation, Edge and Screw dislocation, Concept of Burger vector and Burger circuit, Surface imperfections, Colour centers in ionic solids.

REFERENCES:
1. M. A. Omar, 'Elementary Solid State Physics', Addison-wesley publishing company, 3rd Edition, 2002.
2. C. Kittel, 'Introduction to Solid State Physics', John Wiley & Sons, Inc, 8th Edition, 2005.
3. A. J. Dekkar, 'Solid State Physics', Macmillan India Limited, 14th Edition, 2008.
4. S.O. Pillai, 'Solid State physics', New age Publishers, 2018 Edition.

5. L. V. Azaroff, 'Introduction to solid', Tata McGraw Hill Publishing Company, Indian Edition, 2017.

6. V. Raghavan, 'Material science and engineering', Prentice Hall of India, 6th Edition, 2015.

7. H. V. Keer, 'Principles of Solid State', New age International Publishers, 2nd Edition, 2017.

8. James D. Patterson, Bernard C. Bailey, 'Solid State Physics- Introduction to the theory', Springer, 2007.

3.ANALYSIS AND PRESENTATION OF PROPOSED RESEARCH TOPIC
(22SPHDPUB003)

The candidates should publish the proposed work in the conference abstract book/ proceedings/ Journal.

Article quality and its presentation carries 50% weightage as internal marks and final end exam carries 50% weightage.

Exam descriptive. Questions will be general. Answers can be in relation to his/her published

4. REVIEW OF LITERATURE
(22SPHDPUB004)

The candidate should publish the review article of his/her proposed work and they should submit the proof of published paper. Review article quality and its presentation carries 50% weightage as internal marks and final end exam carries 50% weightage.
Exam Descriptive. Questions will be General. Answers can be in relation to the published review paper.

NOTE:
IA Components
DDLR completion certificate
One MOOCs/Online certificate on Research methodology
One review paper with ISSN No (Connected to fourth paper of coursework)
One paper presented in conference – Proof (Connected to third paper)
Assignment for Second paper (given by the Guide or Coordinator)
Assignment for first paper (given by the Guide or Coordinator)