SRINIVAS UNIVERSITY

# Mukka, Mangaluru–574146

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**[In compliance of University Grants Commission (Minimum Standards and Procedures for Award ofPh.D.Degree)Regulations,2016]**

**COURSEWORK SYLLABUS OF**

**Ph.D. PROGRAMME IN PHYSICS**

**INSTITUTE OF ENGINEERING AND TECHNOLOGY**

# MUKKA, Mangaluru–574 146.

## SRINIVASUNIVERSITY

**INSTITUTE OF ENGINEERING AND TECHNOLOGY**

**Ph.D.PROGRAMME**

## SYLLABUSOFCOURSEWORK

### COURSEWORKPATTERN 400 M

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl.****No.** | **Subjects** | **Exam****(Hours)** | **Credits** | **InternalMarks** | **ExternalMarks** | **Marks** |
| 1 | Research Methodology  | 2 | 4 | 50 | 50 | 100 |
| 2 | Solid State Physics | 2 | 4 | 50 | 50 | 100 |
| 3 | Patent analysis and Presentation | 2 | 4 | 50 | 50 | 100 |
| 4 | Review ofLiterature leading to publish of review paper in journal | 2 | 4 | 50 | 50 | 100 |
| **Total** |  | **16** | **200** | **200** | **400** |

**COURSEWORKSYLLABUS**

**RESEARCH METHODOLOGY (22SPHDRM)**

**COMMON TO ALL ENGINEERING BRANCHES**

**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:**

IPRs- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs) - A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs- Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures.

**Module-5:**

 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

**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 NRHandbook on Intellectual Property Law and Practice Publishing Private Limited.2008S Viswanathan Printers

**SOLID STATE PHYSICS (22SPHDPH01)**

**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>TC (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](https://link.springer.com/book/10.1007/978-3-540-34933-4#author-0-0), [Bernard C. Bailey](https://link.springer.com/book/10.1007/978-3-540-34933-4#author-0-1), ‘Solid State Physics- Introduction to the theory’, Springer, 2007.

**Patent analysis and Presentation (22SPHDPH02)**

Student should submit the review of literature of granted patents in the form of report and presnt the report in front of the committee.Report carries 50 percent weightage and presentation carries 50 percentage weightage.

**Review ofLiterature leading to publish of review paper in journal (22SPHDPH03)**

Student should submit the review of literature of published papersand publish this work in peer reviewed journals. Present the paper in front of the committee. Published paper carries 50 percent weightage and presentation carries 50 percentage weightage.

**Examination patterns**

For Research methodology and Electrochemistry and techniques papers carries 50 percentage for assignments. Students are required to submit the hand written assignment given by the guide and it carries 50 percent weightage.

Examination will be conducted for remaining 50 percentage. Question paper pattern will be as follows

Two question from each module will be asked in the exam. Students are required write any one of the question. Each question will carry 10 marks.

NOTE: One research methodology online course should be completed and students are required to submit the certificate compulsorily.