



**SCHEME OF EXAMINATION  
&  
DETAILED SYLLABUS**

**MASTER OF PHILOSOPHY  
M.Phil(Physics)**



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<b>COURSE STRUCTURE OF M.PHIL. (PHYSICS)</b>					
<b>Sem</b>	<b>Paper</b>	<b>Marks</b>			<b>Total Marks</b>
		<b>Term End Examination</b>	<b>Internal Assessment (Seminar, Test)</b>	<b>Viva</b>	
I	Theory Paper 1 (Research Methodology) Common To All	80	20	-	100
	Theory Paper 2 (One Subject Specific paper)	80	20	-	100
	Computer Skill	80	-	20	100
II	Dissertation	SCRIPT 150	-	50	200
<b>TOTAL</b>					<b>500</b>

**PAPER I – RESEARCH METHODOLOGY (COMMON TO ALL SUBJECT)**

**PAPER 2 – ONE PAPER FROM THE OPTIONS GIVEN (AS PER SUBJECT)**

**PHYSICS:**

- (A) Advanced Solid State Physics
- (B) Advanced Material Science
- (C) Super Conductivity
- (D) Advanced Condensed Matter Physics

**PAPER 3 – COMPUTER SKILL (COMMON TO ALL)**

**THESIS / DISSERTATION – TO BE PREPARED BY ALL STUDENTS INDIVIDUALLY UNDER A SUPERVISOR.**

**M.PHIL SYLLABUS**  
**COMMON PAPER (APPLY TO ALL)**  
**PAPER I - RESEARCH METHODOLOGY**

**UNIT-I**

Research- Definition, Importance and Meaning of Research, Characteristics of Research, Types of research, Steps in research, Selection and Formulation of research problem, Sources of research problems, criteria / characteristics of a good research problem, errors in selecting a research problem.

**UNIT-II**

Hypotheses- meaning and characteristics of working hypotheses, problem in formulating hypotheses, sources of Hypotheses, Origin of hypotheses, types and significance of Hypotheses.

**UNIT-III**

Research Design- Meaning, Objectives and contents of Research, Types of experimental Research Design, Collection of Primary data-Observation Methods, questionnaire method and schedule methods.

**UNIT-IV**

Case study Methods-Its Characteristics Advantages and limitation, Sampling techniques: Sampling Theory, types of sampling, Steps in sampling, Sampling and Advantages and Limitations of Sampling, Calculation of standard error's T - test and Z – Test, Chi-square tests, ANOVA-One-way / Two- way and analysis of variance.

**UNIT-V**

Research Reports- Types of reports- contents- Format & Styles of reporting- steps in drafting reports-Editing the final draft-Evaluating the final draft. Analysis and Interpretation of Data and Report Writing, References and Bibliography.

**REFERENCE BOOKS:**

- |       |                                |   |               |
|-------|--------------------------------|---|---------------|
| (i)   | Research Methodology           | : | C.R. Kothati  |
| (ii)  | Research Methodology           | : | H.K. Kapil    |
| (iii) | Statistics (Theory & Practice) | : | B. N. Gupta   |
| (iv)  | Social Research & Statistical  | : | R.N. Mukhargi |
| (v)   | Social Research                | : | D.S. Baghel   |
| (vi)  | Statistical Methods            | : | S. P. Gupta   |

## M.PHIL. PAPER II (SUBJECT SPECIFIC)

CHOOSE ANY ONE OPTIONAL PAPERS FROM THE FOLLOWING GIVEN OPTIONS

### ADVANCED SOLID STATE PHYSICS

#### UNIT-I

Atomic Model of Elastic Behavior, The Modulus, Rubber like Elasticity, An elastic behavior, Relaxation Processes, Viscoelastic Behavior; Spring –Dashpot Models, Plastics Deformation. The Tensile Stress –Strain Curve, Plastic Deformation by slip, The Shear Strength of Perfect and Real Crystals. The Stress of move a Dislocation. The Effect of Temperature Multiplication of Dislocations during Deformation, Work Hardening and Dynamic Recovery. The Effect of Grain Size, Solute Atoms, Precipitate Particles on Dislocation motion Mechanism of Creep, Creep Resistant Materials.

Ductile Fracture, Brittle Fracture. Fracture Toughness. The Ductile-Brittle Transition

#### UNIT-II

Energy Conservation, State function and First Law & the Second Law of Thermodynamics, Entropy, Temperature and the Third Law, Free Energies.

The Phase Rule, Unary Diagrams, Two component systems- Solid Solubility, Binary Diagrams, Relative Amount of Phases. Thermal Analysis, Limited Solid Solubility; The Binary Eutectic Diagram, The Peritectic Diagram, Invariant Reactions.

Non-equilibrium Phase Transformations. Coring and Surrounding during Solidification, Invariant Transformations Induced by Non- Equilibrium cooling, Super- saturation and Precipitation, Inhibited Solid state Invariant Transformations, Isothermal Transformation Diagrams, Non-equilibrium Tran formations and the Heat Treatment of Alloys.

#### UNIT-III

Fick's Law of Diffusion, Solution to Fick's Second Law, Application based Law Solution. The Kirkendall Effect, The Atomic Model of Diffusion, Other Diffusion Processes.

The Nucleation Kinetics. The Growth and the Overall Transformation Kinetics. Applications Transformations in Steel, Precipitation Processes. Solidification and Crystallization the Glass Transaction, Recovery, Recrystallization and Grain Growth Epitaxy.

#### UNIT-IV

Ceramics- Nature, Morphology, Crystal Structures. Imperfection. Phase Diagram Glass Carbon Products, Cemented Carbides for Structural Applications, Ceramic for Wear-Applications, Ceramic for Environment Applications, Advanced Ceramics.

Composites- Large Particle and Dispersion Strengthened Composites. Fiber Reinforced Composites. The Influence of Fiber- length, Orientation and Concentration, Polymer Matrix, Metal Matrix and Ceramics Matrix Composites.

#### BOOKED RECOMMENDED:

- |                                      |   |                       |
|--------------------------------------|---|-----------------------|
| 1. Materials Science and Engineering | - | William Callister     |
| 2. Strength of Materials             | - | A. Pytel. F. L.Singer |
| 3. Engineering Metallurgy            | - | R.A. Higgins          |
| 4. Engineering Materials             | - | K.G.Budinski          |

## **ADVANCE MATERIALS SCIENCE (COMPULSORY PAPER)**

### **UNIT-I**

Preliminary Concepts: Molecular velocities, Pressure, Impingement, gas Flow Regimes Conductance and Pumping Speed, Vacuum spectrum and Applications.

Vacuum Pumps: Rotary, Roots, Turbomolecular Diffusion Cryo, Sorption, Vacuum Materials Adsorption. Out gassing, Permeation of Vacuum Materials vacuum measurements: Pirani and Penning Gauges.

### **UNIT-II**

Vacuum Evaporation thermodynamics Concepts – Equilibrium Vapor Pressure, Clausius Elaperon Equation. Evaporation Theory- Evaporation Rates, Mechanism and Directionality vapor sources- Wire. Foil Sublimation, Credible Sources. Electron Bombardment Heated sources.

### **UNIT-III**

Physical Sputtering – Basic Concepts: The Phenomenon and Applications, Methods of Sputtering Yields and Thresholds, Sputter deposition-Self Sustained Glow discharge Thermionically and Magnetically Supported Glow Discharge Growth of film in Sputtering Environment, Sputtering equipment and deposition parameters, Sputtering RI sputtering.

### **UNIT-IV**

Properties of Thin Films: film Thickness – measurement of Optical Interference Techniques.

Elipsometry, Magnetic Electrical. Mechanic and Radiation methods. Film Composition Compositional analysis by Microchemical. Emmision and Mass Spectroscopy.

### **BOOKED RECOMMENDED:**

- |  |   |                   |
|--|---|-------------------|
| 1. Hand Book of thin Film Technology   | - | Maissel and Giang |
| 2. The Materials Science of Thin Films | - | M. Ohring         |
| 3. Modern Vacuum Practice              | - | Nigel Harris      |

## **ONE PAPER TO BE ELECTED WITH PROJECT SUPER CONDUCTIVITY**

### **UNIT-I**

Superconductivity, Characteristics features, Critical temperature, Critical current, Persistent current and Meissner effect, Critical magnetic fields, Magnetic susceptibility Permeability, Penetration depth, Measurement of Magnetic Properties, Magnetization of superconductor, Flux quantization, Entropy Thermoelectric effect, Specific heat, thermal conductivity, Isotope effect, Optical energy gap. Structure, Type I and II superconductivity.

### **UNIT-II**

Mechanism of Superconductor: London theory, Limitation of London theory , ginzburg-London theory, Edge effect, Microscopic theory, BCS theory, electron- Phonon interaction, Cooper pairs Application of BCS theory, Superconducting ground state, Properties of BCs ground state, Hubbard model, Resonant valence bond model.

### **UNIT-III**

High superconductors, Ceramic superconductors. copper free superconductors, Organic superconductors Crystal graphic structure granularity, oxygen deficiency, magnetic susceptibility, resistivity, thermoelectric power, thermal conductivity, specific heat of Cuprate superconductors, effect of substitution, pressure and oxygen stoichiometry.

### **UNIT-IV**

Synthesis and characterization:

Bulk material synthesis techniques – Solid-state reaction, Matrix reaction, Sol gel, methods. Thin film Preparation – Sputtering, Laser ablation . RT measurement, XRD, Susceptibility, SEM for ceramic superconductors.

### **BOOKED RECOMMENDED:**

- |                                       |   |                               |
|---------------------------------------|---|-------------------------------|
| 1. Introduction to Superconductivity  | - | A.C. Rose & I Rhodrich        |
| 2. High Temperature Superconductors   | - | J.C.Philips                   |
| 3. High Temperature Superconductivity | - | J.N.Lynn                      |
| 4. Superconductivity today-           | - | T.V. Ramakrishna & C.N.R. Rao |

## ADVANCED CONDENSED MATTER PHYSICS

### UNIT-I

Lattice vibration in one and three dimension, dispersion relation, Application to Metallic and Ionic solids, distribution function, Root Sampling and Moment trace methods, quantization's of lattice vibration, quantum Theory of Lattice vibrations, quantum Theory of Lattice specific Heat, General Theory of Neutron scattering.

### UNIT-II

Elastic Energy Density, Elastic Stiffness constants of cubic crystals, Experimental determination of Elastic constants. Transport Properties, Electro – Phonon interaction. High Pressure Measurement Techniques Order-Disorder Transitions. Thermodynamic classification of Phase transitions, Hysteresis in Phase transitions.

### UNIT-III

Classification of Solids, Cohesive energy electron levels in a periodic potential, General Properties, The Tight Binding Method. Other for calculating band structure, Measuring the Fermi Surface. ab initio calculations, pseudo potentials.

### UNIT-IV

Carbon Nano- Tube: Structure of single wall nano –tubes, Classification, Symmetry, Unit cell and Brillouin zone Electron structure. One Electron dispersion relation, Phonon dispersion relation for Nano-tube.

### BOOKED RECOMMENDED:

- |  |   |                    |
|--|---|--------------------|
| 1. Lattice Dynamics                    | - | Ghatak and Kothari |
| 2. Introduction to Solis State Physics | - | C. Kittel          |
| 3. Solid State Physics                 | - | Neil W. Ashcroft   |

## **PAPER III – COMPUTER SKILL (PRACTICAL)**

**(COMMERCE, MATHS, CHEMISTRY, PHYSICS, EDUCATION, PHYSICAL EDUCATION, ZOOLOGY, BOTANY, MICROBIOLOGY, LIBRARY SCIENCE)**

### **UNIT – I**

#### **WINDOWS OPERATING SYSTEM**

Introduction to Windows, Various Versions of Windows, Working with Windows O.S., Managing Files and Folders, Managing Windows and Desktop, Installing and Using Windows Applications.

### **UNIT – II**

#### **WORD PROCESSING USING MS WORD**

Word Processing – Concepts and Using, Using MS Word for Windows, Inserting & Editing text, Formatting Texts & Paragraphs, Page Layout, Refining a document, Print a Document. Working with Columns and Tables, Using Images in Word Document, Mail-Merge, Desktop Publishing with Word.

### **UNIT – III**

#### **MS-EXCEL**

Introduction to Spreadsheet, Spreadsheets & Worksheets, Working with MS Excel, Gathering data for simple calculations, Formatting data, Using Numbers, and Texts, Formulas and Functions in MS-Excel, Creating Charts & Graphs.

### **UNIT - IV**

#### **MS-POWER POINT**

Introduction to Multimedia, Using MS-Power Point, Creating Presentation with MS-PowerPoint, Insert Graphics, Images, Charts and Tables in PowerPoint, Add Special effects and animation in PowerPoint, Print Slides and Handouts.

### **UNIT - V**

#### **INTRODUCTION TO STATISTICAL PACKAGES**

Usage of to Statistical Packages for analysis in research - Lotus and Excel, SPSS; SYSTEM.



## **THESIS / DISSERTATION**

To be prepared by all students individually under a supervisor. A synopsis should be submitted and approved by the DRC of the concerned department.

## DISSERTATION

Students individually will carry out a detail study on a topic and implement a related system. The study must include literature survey, methodology and proposed work, experimental details and results, modifications to be included and future directions, applications etc. A report is to be prepared and submitted under the guidance of a supervisor. The report should contain design, implementation and experimental details. The topics involved in the work should be related to the courses undertaken by the student till this portion of progression under the programme and have contemporary relevance. It can involve research and development oriented works and be carried out with an eye on the needs of the industry. The work must be defended through a presentation in front of a panel constituted by selected experts. The quality of the work should be reflected by at least one publication in conference proceedings/ journals etc.

