SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

DEPARTMENT OF PHYSICS

Programme M.Phil

(Under the Choice based Credit Scheme)
Effective from: June-2017-18

Semester I

Name of Course	Course Code	Theory/ Practical	Credit
MS01CPHY21	Research Methodology and Data Analysis in Physics	Theory	3
MS01CPHY22	Advanced Condensed Matter Physics (Growth, Imperfections and Nano-science)	Theory	3
MS01CPHY23	Advanced Crystallography and Biophysics	Theory	2

MS01CPHY21

Research Methodology and Data Analysis in
Physics

Theory

Unit I

Research theory and practice : Research basics, Research theory, Structuring the research project, Research ethics, Finding and reviewing the literature.

Unit II

Uncertainties in Measurements: Measuring Errors, accuracy and Precision, systematic errors, Random errors, Significant figures and Round off, Uncertainties, Parent and Sample Distributions, Mean, median and mode, Standard Deviation of Distributions. Selected applications and examples.

Unit III

Probability Distributions: Binomial Distributions, Poisson Distribution, Gaussian or Normal Error Distribution, Lorentzian Distribution. Selected problems and examples.

Unit IV

Error Analysis: Instrumental and Statistical Uncertainties, Propagation of Errors, Specific Error Formulas withy examples, Application of Error Equations.
Numerical Errors, Conditioning and Stability, Convergence of Iterative Processes.

Books:
1. Research Methods the Basics by Nicholas Walliaman, Taylor and Francis London & NewYork 2011 (ISBN 0-203-83607-3 Master e-book ISBN).
2. Research Methodolgy- Methods and Techniques 2nd ed. By C R Kothari, New Age Int. Publ. 2004 ISBN (13) : 978-81-224-2488-1.
3. Data Reduction and Error Analysis for the Physical Sciences 3rd Ed by Philip R Bevington & D Keith Robinson, McGraw – Hill (2003)
4. Numerical Methods by Balagurusamy, Tata McGraw – Hill (2000)
5. Numerical Analysis, 2nd Ed. by Francis Scheid, McGraw-Hill (2009)
6. Numerical mathematical Analysis, James B Scarboroughs
7. Numerical Methods for Scientists and Engineers, K Sankara Rao, 3rd Ed. PHI

MS01CPHY22
Advanced Condensed Matter Physics
(Growth, Imperfections and Nano-science)

UNIT I
Nucleation, homogeneous nucleation and heterogeneous nucleation, driving force for crystallization, growth on rough faces, growth on perfect singular faces, growth on imperfect singular faces, transport at growth interface, transport in bulk solids, growth rate of a crystal, Bridgman and related methods-basic processes, Czochralski and related methods: Kyropoulos growth, Dendrite method, Stepanov method, edge define film fed growth, high pressure methods, hydrothermal growth.

UNIT II
Chemical vapour transport technique: introduction, some theoretical aspects- concepts of epitaxy, reaction, transport processes, stability condition, closed systems, open systems for bulk crystals, open systems for thin layers.

Defects in crystalline materials – an introduction, concept of slip, dislocations and slip, cross slip, velocity of dislocations, climb, and experimental observations of climb.

UNIT III

Stress field of a dislocation-edge and screw, strain energy of a dislocation, forces on dislocations, forces between dislocations, unit dislocation, partial dislocations- the Shockley partial, Frank partial or Sessile dislocation, Lomer-Cottrell sessile dislocation, Intersections of dislocations, movement of dislocation containing elementary jogs, composite jogs.

UNIT IV

Properties of individual nano-particles: introduction, magic numbers, theoretical modeling of nano-particles, geometric structure, electronic structure, reactivity, magnetic clusters, bulk to nano-transition, semi-conducting nano-particles,-- optical properties, photo-fragmentation, coulombic explosion, Rare gases and Molecular clusters : inert gas clusters, super-fluid clusters, molecular clusters, Method of synthesis : RF plasma, chemical method, thermolysis, pulsed laser methods,Carbon clusters, carbon nano-tubes – fabrication, structure, electrical, vibrational and mechanical properties, applications of carbon nano-tubes.

 BOOKS
1. Crystal growth processes by J.C. Brice (Blackie and sons Ltd.)
2. Crystal growth by Santaraghvan and P. Ramasamy (Kru Publishers)
3. Introduction to dislocation by D. Hull (Pergamon press)
4. Introduction to nanotechnology by Charles P. Poole, Jr., Frank J. Owens.

MS01CPHY23
Advanced Crystallography and Biophysics

Unit:1

X-ray diffraction Technique for single crystal:

X- ray Scattering by unit cell , Structure factor Equations, Expression for integrated intensities, Methods of solving the phase problem : Direct Method, Recording of X-ray Diffraction data: Single crystal Diffractometer, Data collection, Wilson Plot , Structure Refinement, Treatment of results : Bond lengths, bond angles, Torsional angles and standard Deviations, Thermal motion analysis.

Unit:2

X-ray diffraction Technique for poly crystalline materials:

Diffraction principle, Geometry of Bragg - Brentano Diffractometer, Application of Power diffraction, Qualitative and Quantitative phase analysis, Determination of crystal structure, Indexing pattern of cubic and non-cubic crystal, Structure of polycrystalline aggregation - Crystal size, Crystal quality, Texture, pole figure and stress measurement.

Unit:3

 Protein sources, Protein Purification, Principles of Protein Crystallization, Protein crystallization Techniques, Phase Calculations using isomorphism and anomalous dispersion methods, multiple wave length methods,   Ramchandran plot, Protein folding, Application of Synchrotron radiation.

Unit:4

 Basic Transducer principles:

The Transducer and Transduction Principles, Active Transducers, Passive Transducers, Transducers for Biomedical Applications. Sources of Bioelectric potentials; Resting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials   Electrodes , electrodes theory, Bio-potential Electrodes, Bio Chemical

Transducers, The Cardiovascular System; The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sound.

Books:
1. Elements of X-ray diffraction
   (Cullity, S.R.Stock, Prentice Hall, New Jersey)
2. Biomedical Instrumentation and Measurements
   (Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Prentice-Hall of India Pvt. Ltd. New Delhi)
3. Proteins Biochemistry and Biotechnology
   (Gary Walash, John Wiley & sons Inc, New York)