SYLLABUS

MANONMANIAM SUNDARANAR UNIVERISTY, TIRUNELVELI-12

PG - COURSES – AFFILIATED COLLEGES
Course Structure for

M.Sc. Physics

(Choice Based Credit System)
(With effect from the academic year 2017- 2018 onwards)

Semester-III				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
	Core - 14	Quantum Mechanics I	PPHM31	4
	Core - 15	Electromagnetic Theory	PPHM32	4
	Core - 16	Statistical Mechanics	PPHM33	4
	Core - 17	Research Methodology	PPHM34	4
	Core - 18 Practical - 5	Advanced Physics Experiments I	PPHL31	2
	Core - 19 Practical - 6	Microprocessor Experiments	PPHL32	2

QUANTUM MECHANICS I

Preamble:

This course imparts knowledge about wave functions and Schrodinger equations and matrix mechanics, Heisenberg uncertainty principle and different operators and certain solvable systems and various pictures involved in quantum mechanics. Basics of quantum mechanics are essential. Methods of solving some microscopic problems using quantum mechanical ideas are studied.

Unit I:

Schrodinger equation and wave function

Introduction – Construction of Schrodinger equation – Solution of time dependent equation – Physical interpretation of – Conditions on allowed wave functions - Box normalization – Conservation of probability – Expectation value – Ehrenfest's theorem – Verification of Ehrenfest's theorem – Linear harmonic oscillator – particle in an infinite square well potential – Particle in a magnetic field.

Unit II:

Heisenberg Uncertainty Principle and Operators

Classical uncertainty relation –Heisenberg uncertainty relation – Implication of uncertainty relation –Illustration of uncertainty relation – Gamma-Ray microscope – Doppler effect. Operators, Eigen values and Eigen functions: Linear operators, commuting and non-commuting operators – Self-ad joint and Hermitian operator – Discrete and continuous eigen values.

Unit III:

Exactly solvable systems

Bound states – Classical probability distribution – linear harmonic oscillator – Particle in a box – Poschl-Teller potentials – Quantum pendulum – Time dependent harmonic oscillator – Rigid rotator.

Unit IV:

Matrix Mechanics

Linear vector space – Matrix representation of operators and wave functions – Unitary transformation – Schrodinger equation and other quantities in matrix form – Application of matrix mechanics – Dirac's Bra and Ket notations – Properties of bra and ket vectors – Hilbert space.

Unit V:

Various Pictures and Density matrix

Schrodinger picture – Heisenberg picture – Interaction picture – Density matrix for a single system – Density matrix of an ensemble – Time evolution of density operator – A spin ½ systems.

Books for Study:

Quantum Mechanics I: Fundamentals- S. Rajasekar and R. Velusamy (CRC Press, Taylor and Francis group- Boca Raton, London)

Books for Reference:

1. Quantum Mechanics - L. Schiff- Third Edition (Tata Mc-Graw Hill, New Delhi)
2. A Text Book of Quantum Mechanics- P. M. Mathews and K. Venkatesan (Tata McGraw Hill, New Delhi, 1987)
3. Quantum Mechanics - S. Devanarayanan (Sci. Tech. Publications Pvt Ltd, Chennai, 2005)
4. Quantum Mechanics- G. Aruldhas (Prentice Hall of India, New Delhi, 2003)

ELECTROMAGNETIC THEORY

Preamble:

The scope of this course is to impart the knowledge of Maxwell's equation, propagation of electromagnetic waves through various media including waveguides.

Unit I

Electrostatics

Coulomb's law – Gauss law – Poisson's equation and Laplace's equation – work done to move a point charge – energy of a point charge and continuous charge distribution – methods of images – electric field in dielectric materials – induced dipoles and polarizability – connection between polarizability and susceptibility – susceptibility, permittivity and dielectric constant of linear dielectric.

Unit II

Magnetostatics

Lorentz force law – Biot-savart's law and Ampere's law – magnetic vector potential multipole- Expansion of the vector potential – Effects of a magnetic field on atomic orbits – magnetic energy – Dia, Para, Ferro magnetism – magnetic susceptibility and permeability in linear and non linear media.

Unit III

Electrodynamics

Electromagnetic induction – Faraday's law – Maxwell's equation differential and integral form – Boundary conditions on field vectors D, E, Band H – Scalar and vector potentials – Gauge transformations – Lorentz and coulomb gauge – pointing vector and pointing theorem – Maxwell's stress tensor – Conservation of momentum.

Unit IV

Electromagnetic waves

The wave equation for E and B – Monochromatic plane waves – energy and momentum in EM waves in linear media – Reflection and transmission at normal and Oblique incidence – EM waves in conductors wave guides – TE waves in rectangular wave guides – the coaxial transmission line.

Unit V

Electromagnetic radiation

Retarded potential – Lenard – Wiechart potential – Electric dipole radiation – magnetic dipole radiation – power radiated by a point charge – amour formula – Abraham Lorentz formula for the radiation reaction – physical origin of radiation reaction.

Book for Study:

1. Introduction to Electrodynamics, David J Griffiths. Prentice Hall of India. II

Edition, 1989.

Books for Reference:

1. Classical electrodynamics, J.D.Jackson., Wiley Eastern Publication. Second edition, 1975
2. Foundation of electromagnetic theory, J.R. Reitz, E.J Milford and R.W Christy
3. Electromagnetic fields and waves, P.Lorrain and D.Corson. CBS Publishers and distributors, 1986
4. Electrodynamics, B.P Laud, New Age International Pvt. Ltd. 1987

STATISTICAL MECHANICS

Preamble:

The basic concepts involved in statistical mechanics, classical and quantum statistics, applications of quantum statistics, phase transition in certain physical problems is expected to study. The theory of statistics and quantum ideas are prerequisites. Postulates of quantum mechanics, Maxwell-Boltzmann distribution law, theory and applications of quantum statistics are studied.

Unit I

Basic concepts

Phase space-phase-space diagram of an oscillator-Volume in phase space-Ensembles-Microcanonical ensemble-Canonical ensemble-Grand canonical ensemble-Density of distribution in phase space-Liouvilles theorem-Postulate of equal a priori probability-statistical,mechanical and thermal equilibriums-connection between statistical and thermodynamical quantities.

Unit II

M-B Distribution law

Microstates and macro states-Stirling's approximation-Thermodynamic probability-General statistical distribution law-Classical Maxwell-Boltzmann distribution law-Evaluation of constants in the Maxwell Boltzmann distribution law-Maxwell's law of distribution of velocities-principle of equipartition of energy-Boltzmann entropy relation-Probability of magnetic moment distribution of independent atoms.

Unit III

Quantum statistics

Postulatory foundations of quantum mechanics-Transition from classical statistical mechanics to quantum statistical mechanics-Indistinguishability and quantum statistics-Exchange symmetry of wave functions-Bose-Einstein Statistics-Fermi-Dirac statistics-Maxwell-Boltzmann statistics-Results of three statistics-Thermodynamic interpretation of the parameters α and β-Black body radiation and the Planck radiation law.

Unit IV

Applications of quantum statistics

Specific heat of solids-Dulong and Petit law-Einstein theory of specific heat of solids-Debye theory of specific heat of solids-Criticism of Debye's theory-Ideal Bose Einstein Gas-Energy and pressure of the Gas-Gas degeneracy-Bose-Einstein Condensation-Thermal properties of Bose Einstein Gas-Ideal Fermi Dirac gas- Energy and pressure of the Gas-Thermodynamics functions of degenerate Fermi-Dirac gas-Electron Gas.

Unit V

Phase transitions

Phase transition-Phase transitions of first and second kind-critical exponent-Yang and Lee theory-Phase transitions of second kind: the Ising model-Braggs-Williams approximation-One dimensional Ising model.

Book for Study:

1. Elementary statistical Mechanics Dr.S.L.Gupta & Dr. V.Kumar,Pragati Prakasan,Meerut 22nd Edition 2008

Books for Reference:

1. Fundamentals of statistical mechanics B B Laud New age international Publishers 2005
2. An Introductory course of Statistical Mechanics Palash B.Pal Narosa First reprint 2009
3. Statistical Mechanics by Kerson Huang
4. Statistical Mechnics by Sears and Salinger.

RESEARCH METHODOLOGY

Preamble:

Literature collection, activities involved in the research problem, method of writing the thesis, knowledge about Origin and Latex are expected to learn. Different methods of analysis and computer knowledge are prerequisites. The outcome of the course is how to collect literatures, write the research article and thesis.

Unit I :

Introduction to Research: (BFS – 1)

Objectives of Research – Importance of research – research methods and research methodology – Types of research – Basic research – applied research – Quantitative and Qualitative methods – other types of research – explanatory, exploratory, comparative – various stages of research – Identification of research topic – Literature survey – Reference collection – Hypothesis.

Unit II :

Research Activity: (BFS – 1,2)

Mode of research – Research design – joy in doing research – crucial stage of Ph.D., - actual investigation – doing good research – results and conclusion – preparing the oral report – presenting the oral report in scientific seminar

Planning the assignment – Defining and limiting the problem – time schedule – preparing the working bibliography – taking notes – outline – first draft.

Unit III:

Writing the thesis: (BFS – 2)

Planning the thesis – Writing the thesis / assignment - General format – Page and chapter format – Tables and figures – Referencing – Appendixes.

Unit IV:

Plotting software: Origin: (BFS – 3)

Introduction - Importing your data - Designating Worksheet Columns as Error Bars - Plotting Data - Customizing the Data Plot - Customizing the Graph Axes - Adding Text to the Graph - Exploring Data: Transforming Column Values - Sorting Worksheet Data - Plotting a Range of the Worksheet Data - Masking Data in the Graph - Performing a Linear Fit - Creating Multiple Layer Graphs–Working with Excel in Origin.

Unit : V :

Typesetting Software : Latex (BFS – 4)

Introduction to LaTeX – TeX and LaTeX – A typical LaTeX input file – Characters and control sequences - Producing Simple Documents using LaTeX – LaTeX input file – producing ordinary text using LaTeX – Section headings in LaTeX – changing fonts in text mode – Active characters and special symbols in text -

Producing Mathematical Formulae using LaTeX– Mathematics mode – characters in mathematics mode – superscripts and subscripts – Greek letters – mathematical symbols – standard functions – fraction and roots –Ellipsis – accents in mathematics mode - Matrices and other arrays in LaTeX - Derivatives, Limits, Sums and Integrals – Lists – tables - Defining your own Control Sequences in LaTeX.

Books for study (BFS):

1. Research methodology – Dr. S. Rajasekar, Dr. P. Philominathan, Dr. V. Chinnathambi https://arxiv.org/pdf/physics/0601009.pdf
2. Thesis and Assignment writing – Janathan Anderson, Berry H. Durston, Millicent Poole - Wiley Eastern University Edition, Wiley Eastern Ltd.
3. http://www.physics.rutgers.edu/~eandrei/389/Origin6_Tutorial.pdf
4. http://www.maths.tcd.ie/~dwilkins/LaTeXPrimer/

Books for further references:

1. Research Methodology – Methods and techniques (2nd edition) – C.R.Kothari – New Age International Publishers, NewDelhi (2005).
2. A Guide to LaTeX – Document preparation for beginners and advanced users – Helmut Kopka and Patrick W. Daly – Addison Wesley Publishing company.

ADVANCED PHYSICS EXPERIMENTS I

Preamble:

It is expected to provide hands on experience in understanding the advanced physics experiments Gouy's method, elliptical fringes, Hall probe into Gauss meter, and Phototransistor characteristics. Basic skills and knowledge about the experiments is required. Experiments in magnetism, electricity, and the theory behind the experiments are also studied.

Any FIVE Experiments

1. **Gouy's Method**
   Determination of Magnetic Susceptibility (Volume and Mass) of the given sample. (use a specimen in the form of a long rod or tube filled with powder or liquid)
2. **Elliptical Fringes**
   Determination of Young's modulus, Bulk modulus, Rigidity modulus, Poisson's ratio and compressibility of the given material by forming Elliptical fringes.
3. **Equipotential lines**
   a) Formation of equipotential lines for a) parallel plates b) circular plates c) plates of irregular shape.
   b) Determination of Electric field between the equipotential lines.
   c) Mapping of Electric field vector between the plates.
4. **Temperature co-efficient of a forward biased diode**
   Measure the resistance of a forward biased diode at three different temperature and hence find the temperature co-efficient. Also plot variation of I with respect to T.
5. **Phototransistor Characteristics**
   Characteristic Study of Phototransistor using
   a) Light sources of different wave length b) light sources of different intensities
   Plots for a) Spectral response b) Sensitivity c) Linearity
6. **Calibration of Hall Probe into Gauss meter**
   a) Calibration of Hall probe into Gauss meter using a Search coil and
   b) Determination of calibration curve for a two axis Hall probe in radial mode

MICROPROCESSOR EXPERIMENTS

Preamble:

Provide hands on experience on microprocessor experiments. Learners are expected to give a detailed knowledge of arithmetic operation, data manipulation, interfacing experiments, ADC & DAC conversion etc…

Any FIVE programs with Algorithm and Flow chart

1. **Arithmetic Operations**
   a) Addition of two 8 bit and two 16 bit numbers
   b) Subtraction of two 8 bit and 16 bit numbers
   c) Multiplication of two 8 bit numbers – 16 bit result.
   d) Division of 16 bit by an 8 bit number.

2. **Data Manipulation**
   a) Arrange the given data items in Ascending or Descending order
   b) Finding the Minimum and Maximum value in the given data set.
   c) Search of a given character/number in the given data set.

3. **System Call and Counters**
   a) Display a character/number on the 7 segment display of the Kit using Monitor Call.
   b) Calculation of Time delay for a given interval.
   c) Up-Counter to count from 00 upto 'nn' with 1 sec time interval.
   d) Down counter to count from 'nn' to 00 with specified counting interval.

4. **Block Move and Series Generation**
   a) Moving a block of data from memory xxxx to yyyy.
   b) Fibonacci series generation
   c) Tribonacci series generation

5. **System Call and Rolling character**
   a) Calculation of time delay for a given interval.
   b) Display a Character on the 7 segment display of the Kit using Monitor Call.
   c) Roll a given character from Left to Right / Right to Left on the 7 segment displays with the specified time interval.

6. **ADC and DAC conversion**
   1) Interfacing ADC with 8085 – ADC chip Block diagram – 8085- ADC interfacing diagram
   2) Conversion of analog input to digital – Resolution – Graph between input and output.
   3) Interfacing DAC with 8085 –DAC chip Block diagram – 8085 DAC interfacing diagram.

4) Conversion of digital input to analog – Resolution – Graph between input and output.Generation

7. **DAC interfacing and Wave form generation**.
   Interfacing DAC with 8085 – DDC Chip Block diagram – 8085- DAC-8085 interfacing diagram and Wave Form using DAC
   a) Square wave with the specified period
   b) Rectangular wave with the specified period
   c) Ramp Wave with the specified period
   d) Triangular Wave