MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI
PG - COURSES – AFFILIATED COLLEGES

Course Structure for M.Sc. Physics

(Choice Based Credit System)

(With effect from the academic year 2017- 2018 onwards)

Sem. (1)	Sub. No. (2)	Subject Status (3)	Subject Title (4)	Contact Hrs./Week (5)	Credits (6)
III	14	Core - 14	Quantum Mechanics I	6	4
	15	Core - 15	Electromagnetic Theory	6	4
	16	Core - 16	Statistical Mechanics	5	4
	17	Core - 17	Research Methodology	5	4
	18	Core - 18 Practical - 5	Advanced Physics Experiments I	4	2
	19	Core - 19 Practical - 6	Microprocessor Experiments	4	2
			Physics **Subtotal**	**30**	**20**
IV	20	Core - 20	Quantum Mechanics II	4	4
	21	Core - 21	Spectroscopy	4	4
	22	Core - 22	Nuclear and Particle Physics	4	4
	23	Core - 23 Practical - 7	Advanced Physics Experiments II	4	2
	24	Core - 24 Practical - 8	C++ Programming	4	2
	25	Elective - 1	Elective / Field Work / Study Tour Elective 1A Renewable Energy Sources (Or) Elective 1B Optoelectronics and Lasers (Or) Elective 1C Materials Science (Or) Elective 1D Charecterization Techniques	3+1*	3
	26	Core - 25	Project	7+9*	8
			Subtotal	**30**	**27**
			Total	**120**	**90**

+ Extra hours for theField Work/Study Tour/ Project

For the Project, flexible credits are b/w 5 – 8 & Hours per week are b/w 10 - 16.

Total number of credits ≥ 90 : 90

Total number of Core Courses : 25 (15 T + 8 P + 1 Prj. + 1 FW.)

Total number of Elective Courses / F.W. / S.T. : 1 Total hours : 120

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.14 / Core-14

Quantum Mechanics I

L T P C
6 0 0 4

Preamble: This course imparts knowledge about wave functions and Schrodinger equations and matrix mechanics, Heisenberg uncertainity 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 $\psi * \psi$ – 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. **(14 L)**

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. **(13 L)**

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. **(11 L)**

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. **(12 L)**

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 system. **(10 L)**

Total (60 L)

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.14 / Core-14

Books for Study:

1. 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)

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.15 / Core-15

Electromagnetic Theory

L T P C
6 0 0 4

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. **(14 L)**

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. **(11 L)**

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. **(12L)**

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. **(13 L)**

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**.** **(10 L)**

Total (60 L)

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.15 / Core-15

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

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.16 / Core-16

Statistical Mechanics

L T P C
5 0 0 4

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. **(11 L)**

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. **(13 L)**

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. **(12 L)**

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. **(14 L)**

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. **(10 L)**

Total (60 L)

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.

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.17 / Core-17

Research Methodology

L T P C
5 0 0 4

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. **(12 L)**

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. **(11 L)**

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. **(10 L)**

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. **(13 L)**

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. **(14 L)**

Total (60 L)

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 (2^{nd} 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.

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Advanced Physics Experiments I

L T P C
0 0 4 2

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

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -III / Ppr.no.19 / Practical - 6

Microprocessor Experiments

L T P C
0 0 4 2

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**
   a) Interfacing ADC with 8085 – ADC chip Block diagram – 8085- ADC interfacing diagram
   b) Conversion of analog input to digital – Resolution – Graph between input and output.

c) Interfacing DAC with 8085 –DAC chip Block diagram – 8085 DAC interfacing diagram.
d) 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

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.20 / Core - 20

Quantum Mechanics II

L T P C
4 0 0 4

Preamble: The course provides knowledge on the theory of angular momentum, various approximation methods, and theory of scattering and relativistic quantum theory. The various aspects studied in the course quantum mechanics I is essential. This course is capable of solving many problems that cannot be exactly solved.

Unit I: Theory of angular momentum

Orbital angular momentum – Eigen pairs of L^2 and L_z – Properties of components of L and L^2 – Matrix representation of L^2, L_z and $L_{\pm}$ - spin state of an electron – spin orbit coupling – Addition of angular momenta. **(14 L)**

Unit II:Approximation Methods I

Time Independent Perturbation Theory: Introduction- Theory for non-degenerate case - Application to non-degenerate levels- Theory for degenerate levels- First order Stark effect in Hydrogen atom. **(12 L)**

Unit III:Approximation Methods II

Time Dependent Perturbation Theory:Introduction- Transition probability- constant perturbation-Harmonic perturbation- adiabatic perturbation- sudden approximation- Semi classical theory of radiation- calculation of Einstein coefficients. **(11 L)**

Unit IV: Scattering theory

Classical scattering cross section – Centre of mass and laboratory co-ordinate systems – Scattering amplitude – Green's function approach – Born approximation – Partial wave analysis – Scattering form a square well system. **(13 L)**

Unit V :Relativistic Quantum Theory

Klein – Gordon equation – Dirac equation for a free particle – Spin of a Dirac particle – Particle in a potential – Relativistic particle in a box – Relativistic hydrogen atom – Electron in a field – Spin orbit energy. **(10 L)**

Total (60 L)

Books for Study:

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

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.20 / Core - 20

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)

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Spectroscopy

L T P C
4 0 0 4

Preamble: This course gives detailed knowledge about various types of spectroscopy. The structure of different chemical compounds can be determined by studying these types.

Unit I Microwave Spectroscopy

Classification of molecules based on moment of inertia – rotational spectra of rigid and non-rigid diatomic molecules – Isotopic effect – linear polyatomic molecule - symmetric top molecule – chemical analysis –microwave spectrometer. **(13 L)**

Unit II Infrared Spectroscopy

Vibrating diatomic and poly-21atomic molecules – Simple harmonic oscillator – anhormonicity – Hydrogen bonding – Fermi resonance – rotation vibration spectra of polyatomic molecule – information from IR spectra – IR spectrometer – FTIR. **(14 L)**

Unit III Raman Spectroscopy

Theory of Raman scattering – rotation vibration Raman spectra – mutual exclusion principle – Raman spectrometer – polarization of Raman scattered light – structure determination using Raman spectrum – phase transition – resonance Raman scattering. **(12 L)**

Unit IV Resonance Spectroscopy

Magnetic properties of nuclei – resonance condition – relaxation time – Chemical shift – application to molecular structure – Bloch equation – NMR instrumentation – NMR imaging – ESR theory and hyperfine structure ESR spectra of hydrogen atom and anisotropic systems – crystal defects and biological studies – ESR spectrometer. **(11 L)**

Unit V Surface spectroscopy

Electron Energy Loss Spectroscopy EELS – Reflection – absorption IR spectroscopy RAIRS – Surface Enhanced Raman Scattering SERS – Inelastic Helium Scattering – X-Ray Photoelectron Spectroscopy XEPS. **(10 L)**

Total (60 L)

Book for Study:

1. N.Banwell and E.M.Mc Cash, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill.
2. G.Aruldhas, Molecular Structure and Spectroscopy, Prentice Hall India.

Book for Reference:

1. B.P.Strughan and S.Walker, Spectroscopy, John Wiley.
2. Peter J.Larkin, IR and Raman Spectroscopy Principle and Spectral Interpretation, Elsevier.
3. Gordon M. Barrow, Introduction to Molecular Spectroscopy, McGraw-Hill .

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.22 / Core - 22

Nuclear and Particle Physics

L T P C
4 0 0 4

Preamble: This course imparts knowledge about the elementary particles, nuclear structure, nuclear reactions with the help of various nuclear models.

UnitI Nuclear Forces

Ground and excited states of deuteron – magnetic dipole and electric quadrupole moments of deuteron – n-p scattering at low energies – shape independent effective range theory of np scattering – pp scattering at low energies – exchange forces –meson theory of nuclear force.**(14 L)**

Unit II NuclearDecays

Gamow'stheory of alpha decay – lineand Continuous spectrum of β decay-Fermi theory of beta decay – Fermi and Gamow-Teller selection rules – parity violation – Gamma decay – multipole transitions in nuclei – selection rules – internal conversion – nuclear isomerism. **(11 L)**

Unit III Nuclear Models

Liquid drop model – Weizsackers mass formula – nuclear stability – Bohr Wheeler theory of nuclear fission -magic numbers -evidence for magic numbers – shell model – spin orbit coupling – angular momenta and parities of nuclear ground states – magnetic moments - Schmidt line – collective model. **(12 L)**

Unit IV Nuclear Reactions

Types of nuclear reactions – Q-equation – solution of the equation – compound nuclear theory – reciprocity theorem – nuclear cross section – resonance scattering– Breit –Wigner dispersion formula – nuclear chain reaction – four factor formula. **(13 L)**

Unit V Elementary Particles

Classification of elementary particles- fundamental interactions conservations laws – CPT theorem - SU(3) multiplet – meson octet – baryon octet and baryon decouplet – Gellmann-Okubo mass formula - Quark theory. **(10 L)**

Total (60 L)

Books For Study:

1. Nuclear Physics, D. C. Tayal, Himalaya Publications.
2. Elements of Nuclear Physics, M. C. Pandia and R. P. S. Yadav Kedarnath.

Books For Reference:

1. Concepts of Nuclear Physics, Bernard L Cohen, Tata Mc Graw-Hill
2. Nuclear Physics an Introduction, S. B. Patel, Wiley Eastern Ltd.
3. Nuclear Physics, R. R. Roy and B. P. Nigam, New Age International Ltd.

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.23 / Practical -7

Advanced Physics Experiments II

L T P C
0 0 4 2

Preamble: It is expected to provide hands on experience in understanding the advanced physics experiments Hall effect, Hysteresis, Ultrasonic diffraction etc… Basic skills and knowledge about the experiments is required. The theory behind the experiments is also studied.

Any FIVE Experiments

1. Temperature co-efficient and Band Gap

Determination of Temperature co-efficient and band gap of a given Semiconductor Thermistor using Carey-Foster Bridge.

2. Hall Effect

a. Definition of Hall effect and its application

Determination of

b. Hall voltage
c. Hall coefficient
d. Carrier density
e. Mobility of charge carriers
f. Resistivity

3. Four Probe

a) Four Probe principle
b) Measurement of Resistivity and Energy band gap of a given semiconductor material
c) Measurement of Resistivity of a large sample using Four Probe mapping.

4. Ultrasonic Diffraction

Formation of acoustic grating in a given liquid using a crystal to determine the velocity of ultrasonic wave in the liquid and compressibility of the liquid.

Repeat for another liquid and hence find the ratio of compressibility and velocity.

5. LCR circuit

a) Determination of dielectric constant of a liquid using LCR circuit
b) Determination of dielectric constant of a given crystal using LCR meter.

6. Hysteresis

Formation and tracing of magnetic hysteresis loop for the given specimen to determine

a) Coercivity
b) Retentivity and
c) Energy loss per unit volume per cycle of the specimen

7. Two Probe

Determination of resistivity of the given samples

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.24 / Practical -8

L T P C
0 0 4 2

Preamble: The course provides knowledge about the C++ programming and the course is able to solve many tedious physical problems numerically.

Any FIVE programs Algorithm and Flow chart

1. Curve Fitting – Fitting a straight line.

a) Principle of least Square and fitting a straight line.
b) Principle of linear interpolation
c) C++ program to fit a straight line using the data obtained from Cauchy's Constant Experiment and Interpolation using the fitted equation

2. Solution of simultaneous equations - Gauss Elimination method.

a) Procedure to solve Simultaneous equations using Gauss Elimination Method
b) Solving unknown branch currents in Wheatstone's bridge using GE method manually.
c) C++ program to solve the equations.

3. Numerical Differentiation.

a) Derivation of Exponential law of Radioactive decay.
b) RK 4^{th} order method of solving a given 1^{st} order differential equation.
c) Analytical computation of the mass of the given radioactive sample after a specified period (Given: activity or half life period).
d) C++ program using RK method to solve radio-active problem – Compare output with the analytical result.

4. Area under the Curve

a) Numerical integration – derivation of Simpson's rule
b) C++ programs for Simpson $1/3^{rd}$ rule, Simpson 3/8 rule and Montecarlo integration.
c) Comparison of the program output with direct integration.

5. Eigen Value and Eigen Vector.

a) Explanation of Eigen Values and Eigen Vectors.
b) Calculation of Eigen Values and Eigen Vectors using analytical method.
c) C++ program to calculate Eigen values and Eigen vectors of a give matrix – Comparison with analytical result.

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6. Matrix Multiplication

a) Multiplication of given matrices
b) Rotation matrix definition.
c) C++ program to rotate the given point about the origin using rotation matrix by the given angle.

7. Numerical Differentiation

a) Numerical differentiation – related to any physical problem
b) Derivation of Newton's law of cooling – equation
c) C++ program to verify the Newton's law of cooling from the given experimental data.

8. Solution of Algebraic and Transcendental equations.

a) Solution of the given equations using Newton Raphson Method – manual calculation.
b) C++ program to find the solution using N-R method and verification.

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.25 / Elective – 1(a)

Renewable Energy Sources

L	T	P	C
3+1*	0	0	3

***Extra hours for the Elective**

Preamble: This course gives a brief knowledge about the types of various non-conventional energy sources. The societal application of these energy sources is studied.

Unit I Introduction

Primary and secondary energy – Commercial and non commercial energy – renewable and non – renewable resources and their importance – World energy use – reserves of energy resources – energy cycle of earth – Indian energy scenario – Long term energy scenario for India – environmental aspects of utilization. **(14 L)**

Unit II Solar Energy

Introduction – extra terrestrial solar radiation – radiation at ground level - collectors – Solar cells – application of solar energy – Biomass energy – bihomass conversion – bio gas production – ethanol production – pyrolysis and gasification – direct combustion – application. **(13 L)**

Unit III Geothermal and Tidal Energy

Introduction – basic theory – types of turbines – applications geothermal energy – Introduction – geothermal resources types – resource base – application for heating and electricity generation – Tidal energy – Introduction – origin of tides – Power generation scheme. **(12 L)**

Unit IV Other Renewable Energy Sources

Hydropower – introduction – basic concept – site selection – types of turbine – small scale hydropower – magneto hydrodynamics (MHD), Thermoelectric and Thermionic energy resources – basic principles – power generation – nuclear energy – basic principle – power generation (basic ideas only). **(11 L)**

Unit V Chemical Energy Sources

Introduction – fuel cells – design and principle – classification – types – advantages and disadvantages – applications – Batteries – Introduction – Theory – Different types of batteries arrangements – classification of batteries – advantages of batteries for bulk storage. **(10 L)**

Total (60 L)

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.25 / Elective – 1(a)

Books for Study:

1. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, New delhi, 1984

Books for Reference:

1. Solar Energies of thermal processe, A.Duffie and W.A. Beckmann, john – wiley, 1980.
2. Principle of Solar Engineering, F.Kreith and J.F.Kreider, McGraw-Hill,1978
3. Alternate Energy Sources, T.N. Veziroglu, Vol.5 and 6, Mc Graw - Hill, 1978.
4. Solar energy – principle of thermal collection and storage S P Sukhatme and j K Nayak, Tata Mc Graw Hill, Tata, 2008

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Optoelectronics and Lasers

L	T	P	C
3+1*	0	0	3

***Extra hours for the Elective**

Preamble: This course provides the fundamentals of light waves, integrated wave guides, optic fiber wave guides. The applications of Laser and Holography are also studied.

Unit I Light wave fundamentals

Electromagnetic waves – dispersion – Pulse distortion – and information rate – polarisation – resonant cavities at plane boundary – critical angle – reflections. **(10 L)**

Unit II Integrated wave guides

Dielectric slab guide – modes in the symmetric slab guide – modes in the asymmetric slab wave guide – coupling to the wave guide – integrated optical network. **(11 L)**

Unit III Optic fibre wave guides

Step index fibre – graded index fibre – attenuation in fibres – modes in step index fibre – modes in graded index fibre pulse distortion and information rate in optic fibres – construction of optical fibres. **(12 L)**

Unit IV Lasers

Population inversion – threshold conditions – Laser losses – line shape functions – population inversion and pumping threshold conditions– classes of laser – doped insulator laser – semiconductor laser – gas lasers – liquid gas lasers – single mode operation – frequency stabilization – mode locking – active mode – passive mode locking method. **(14 L)**

Unit V Holography

Image formation of holographic process – Gabor hologram – limitations –hologram – recording the hologram – minimum reference angle – holography of three dimension – types of holograms – Fresnel – Fraunhofer – transmission – reflection – rainbow multiplex – embossed and thick holograms. **(13 L)**

Total (60 L)

Books for Study:

1. Fibre optic communications, Joseph C. Palais, Prentice Hall Publications. IV Edition (Unit 1-3)
2. Optoelectronics, J.Wilson and J.F.B.Hawkes, Prentice Hall Publications, 1989

3. Intoduction to Fourier optics , Joseph W.Goodman , McGraw Hill, Person Education II Edition, 1996. (Unit 5)

Books for Reference:

1. Photonic Optical Electronics in modern communications, Amnn yariv and pochi yeh, Oxford University Press, VI Edition, 2006
2. Optical Fibres and fiber optic Communication system, Subir kumar sarkar, S. Chand & Co
3. Introduction to Fibre Optics, Ajoy Ghatak and K.Thyagarajan, TataMcGraw Hill

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.25 / Elective – 1(c)

Materials Science

L T P C
3+1* 0 0 3
***Extra hours for the Elective**

Preamble: The course details about the temperature effect, elastic behavior of materials, solid structure, imperfections in the crystal, the various deformation of materials.

Unit I Phase diagram

Phase rule-Single component systems-Binary Phase diagrams-Micro structural changes during cooling-The lever rule-Some typical phase diagrams-other applications of phase diagrams-Phase transformations-Time scale for phase changes-Nucleation and growth-The growth and the overall Transformation kinetics-applications. **(14 L)**

Unit II Elastic behaviour

Atomic model for elastic behaviour-The Modulus as a parameter in Design-Rubber like elasticity-Anelastic behaviour-Relaxation behaviours-Viscoelastic behaviour-Spring-Dashpot models. **(11 L)**

Unit III Structure of solids

The crystalline and non-crystalline states-Covalent solids-Metals and alloys-Ionic solids-The structure of silica and silicate-polymers-classification of polymers-Structure of long chain polymers-Crystallinity of long chain polymers. **(13 L)**

Unit IV Imperfections

Crystal imperfections-Point imperfections-The geometry of dislocations-other properties of dislocations-Surface imperfections. **(10 L)**

Unit V Oxidation, corrosion and other deformation of materials

Mechanisms of Oxidation-Oxidation resistant materials-the principles of corrosion-protection against corrosion-Plastic deformation-The tensile stress-strain curve-Plastic deformation by slip-Creep-Mechanisms of creep-Creep resistant materials-Ductile fracture-brittle fracture-methods of protection against fracture. **(12 L)**

Total (60 L)

Book for Study:

1. Materials Science and Engineering-A First Course V.Raghavan Fifth Edition Prentice Hall of India,New Delhi,2011.

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Books for Reference:

1. A text book of Material Science and metallurgy O P Khanna Dhanpat Rai Publications 2013
2. Rudiments of Materials science S O Pillai Sivagami Pillai New age international Publishers 2005
3. Callister's Materials Science and Engineering Adapted by R.Balasubramaniam Wiley-India 2010
4. Materials Science P K Palanisamy

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Characterization Techniques

L	T	P	C
3+1*	0	0	3

***Extra hours for the Elective**

Preamble: The principle behind the characterizations such as structural, thermal, microscopy, electrical and spectroscopy are studied.

UNIT I: Structural characterization

X-ray powder diffraction: Bragg's law - x-ray diffractometer essentials - estimation of x-ray diffraction intensity - structure, polarization, multiplicity, Lorentz, absorption and temperature factors - intensity formula - crystal structure determination of cubic systems - determination of lattice parameter, crystallite size and lattice strain - problems. **(13 L)**

UNIT II: Thermal characterization

Heat, Energy and Temperature. Resistance temperature transducers - thermocouples - Furnace and its control - automatic control systems. Differential Thermal Analysis: instrument design - introduction to DTA applications - Thermodynamic data from DTA - calibration - melting, boiling, decomposition and phase equilibria. **(12 L)**

UNIT III: Microscopy characterization

Magnification - Resolution. Electron Microscopy: electrons - generation of electron beams - magnetic lense. Scanning Electron Microscope; working method - obtaining a signal – detection of secondary and backscattered electrons - optics of SEM - pixel - depth of field –ultimate resolution. Transmission Electron Microscope; electron gun -- condenser system – specimen hamber - objective and intermediate lenses - projection of image - specimen preparation - electro, chemical and mechanical polishing - FIB. **(14 L)**

UNIT IV: Electrical characteri/ation

Impedance spectroscopy: importance of interface - impedance related functions - physical models for equivalent circuit -single RC circuit -single impedance arcs -dielectric relaxation - conductivity and diffusion in electrolytes - mixed electronic-ionic conductors. Automated impedance analyzer: impedance measurement - audio frequency bridge - automated frequency response and impedance analyzer - measurements using 2, 3 or 4 terminals. **(11 L)**

UNIT V: Spectroscopy characterization

UV-Vis spectrophotometer: Introduction - principle - qualitative analysis - quantitative analysis - instrumentation - experimental parameters -application. Infrared spectroscopy: introduction -principle - instrumentation - sample preparation and accessories - qualitative analysis –

quantitative analysis - application. Raman spectroscopy: introduction - Raman Effect - experimental consideration -analysis of bulk materials. **(10 L)**

Total (60 L)

Books for_study_:

1. X-ray diffraction crystallography, Yoshio Waseda, Biichiro Matsubara and Kozo Shinoda, Spinger-Verlag, Berlin Heidelberg (201 1)
2. Thermal analysis of Materials, Robert F. Speyer, Marcel Dekker Inc., New York (1994). [Unit II]
3. Electron Microscopy and Analysis, Peter J. Goodhew, John Humphreys and Richard Beanland, Taylor & Francis, London (2001). [Unit- III]
4. Impedance Spectroscopy Theory, Experiment and Applications, Bvgenij Barsoukov and J. Ross Macdonald, John-Wiley & Sons, new'Jersey (2005). [Unit - IVJ
5. Materials Characterization, Ruth E. Whan, ASM Handbook Volume 10 (1998). [Unit VJ.

PROJECT

L	T	P	C
7+9*	0	0	8

***Extra hours for the Project**

GUIDELINES FOR PROJECT WORK

Format for Preparation of Project Report for M.Sc., Physics

1. **Arrangement of Contents:**

   The sequence in which the project report material should be arranged and bound should be as follows:

   Cover Page & Title Page
   Bonafide Certificate
   Abstract
   Table of Contents
   List of Tables
   List of Figures
   List of Symbols, Abbreviations and Nomenclature
   Chapters
   Appendices
   References

2. **Page Dimension and Binding Specifications:**

   The dimension of the project report should be in A4 size. The project report should be bound using flexible cover of the thick white art paper. The cover should be **printed in black letters** and the text for printing should be identical.

   Total number of Pages should not exceed 70.

3. **Preparation Format**

   Cover Page & Title Page – A specimen copy of the Cover page & Title page of the project report are given in **Appendix 1.**

Bonafide Certificate – The Bonafide Certificate shall be in double line spacing using Font Style Times New Roman and Font Size 14**.**

The Certificate shall carry the supervisor's signature and shall be followed by the supervisor's name, academic designation (not any other responsibilities of administrative nature), department and full address of the institution where the supervisor has guided the student. The term **'SUPERVISOR'** must be typed in capital letters between the supervisor's name and academic designation.

Preface – Preface should be one page synopsis of the project report typed double line spacing, Font Style Times New Roman and Font Size 14.

Table of Contents – The table of contents should list all material following it as well as any material which precedes it. The title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents but the page numbers of which are in lower case Roman letters. One and a half spacing should be adopted for typing the matter under this head.

List of Tables – The list should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head. The tables shall be introduced in the appropriate places in the text.

List of Figures – The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head. The figures shall be introduced in the appropriate places in the text.

List of Symbols, Abbreviations and Nomenclature – One and a half spacing should be adopted or typing the matter under this head. Standard symbols, abbreviations etc., should be used.

Chapters – The Chapters may be broadly divided into 5 parts

1. Introduction to Project
2. Literature Survey
3. Methods and methodology/Working / Experimental Techniques
4. Result Analysis
5. Conclusion

1. The main text will be divided into several chapters and each chapter may be further divided into several divisions and sub-divisions.
2. Each chapter should be given an appropriate title.
3. Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
4. Footnotes should be used sparingly. They should be typed single space and placed directly underneath in the very same page, which refers to the material they annotate.

Appendices – Appendices are provided to give supplementary information, which is included in the main text may serve as a distraction and cloud the central theme.

1. Appendices should be numbered using numerals, e.g. Appendix 1, Appendix 2, etc.
2. Appendices, Tables and References appearing in appendices should be numbered and referred to at appropriate places just as in the case of chapters.

3. Appendices shall carry the title of the work reported and the same title shall be made in the contents page also.

List of References –The listing of references should be typed 4 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. The reference material should be listed in the alphabetical order of the first author. The name of the author/authors should be immediately followed by the year and other details.
A typical illustrative list given below relates to the citation example quoted above.

References

1. Ariponnammal, S. and Natarajan, S. (1994) „Transport Phonomena of Sm Sel – X Asx", Pramana – Journal of Physics Vol.42, No.1, pp.421-425.
2. Barnard, R.W. and Kellogg, C. (1980) „Applications of Convolution Operators to Problems in Univalent Function Theory", Michigan Mach, J., Vol.27, pp.81–94.
3. Shin, K.G. and Mckay, N.D. (1984) „Open Loop Minimum Time Control of Mechanical Manipulations and its Applications", Proc.Amer.Contr.Conf., San Diego, CA, pp. 12311236.

Table and figures - By the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non-verbal materials used in the body of the project work and appendices such as charts, graphs, maps, photographs and diagrams may be designated as figures.

4. **Typing Instructions**

The impression on the typed copies should be black in colour. One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style „Times New Roman" and Font size 14.

MSU / 2017-18 / PG –Colleges / M.Sc.(Physics) / Semester -IV / Ppr.no.26 / Project

APPENDIX I
(A typical Specimen of Cover Page & Title Page)
<Font Style Times New Roman – Bold>
TITLE OF PROJECT REPORT
<Font Size 18><1.5 line spacing>

A PROJECT REPORT
<Font Size 14>

Submitted by
<Font Size 14><Italic>

NAME OF THE CANDIDATE(S)
<Font Size 16>

in partial fulfilment for the award of the degree
of
<Font Size 14><1.5 line spacing><Italic>

NAME OF THE DEGREE
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IN

BRANCH OF STUDY
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NAME OF THE COLLEGE
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MANONMANIAM SUNDARARANAR UNIVERSITY
TIRUNELVELI- 627 012
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MONTH & YEAR
<Font Size 14>