SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM- 636 016

Reaccredited with 'B++' Grade by NAAC

Affiliated to Periyar University

PG & RESEARCH
DEPARTMENT OF PHYSICS

OUTCOME BASED SYLLABUS
M.Sc. Physics

For the academic year 2022 – 23

M.Sc. PHYSICS

PROGRAMME OUTCOMES

PO1: To acquire deep knowledge in thrust areas of Physics through exploration and consideration of its complexities.

PO2: To develop knowledge to comprehend, analyse, design and provide solutions for scientific problems suitable to existing requirements.

PO3: To communicate clearly the professional ethics and norms of the scientific and sustainable development using appropriate techniques and tools

PO4: To update knowledge to realize potential for employment in job related requirements.

PO5: To orient students to manage research application projects in multi – disciplinary areas.

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16
PG & RESEARCH DEPARTMENT OF PHYSICS
M.Sc. PHYSICS PROGRAMME STRUCTURE UNDER CBCS
(For the academic year 2022- 23)
Total Credits: 92 + Extra Credits (Maximum 16)

I SEMESTER				
Course	**Course Title**	**Code**	**Hrs/ Week**	**Credits**
Core course – I	Classical and Statistical Mechanics	22PPHC1	6	5
Core course – II	Quantum Mechanics – I	22PPHC2	6	5
Core course – III	Advanced Electronics	22PPHC3	5	5
Core course – IV	Electromagnetic Theory	22PPHC4	5	5
Core course – V	Core Practical – I	22PPHQC1	8	4
	Total		**30**	**24**
Extra Skills	• *Value Education* • *Physical Fitness Practice* • *Life Skills Promotion* • *Productive Preparation for CSIR/SET/JRF- I (21PPHSC1) (Self – study –1 Extra Credit)*			
II SEMESTER				
Course	**Course Title**	**Code**	**Hrs/ Week**	**Credits**
Core Course – VI	Analytical Methods of Physics	22PPHC5	6	5
Core Course –VII	Microprocessor and Microcontroller	22PPHC6	5	5
Core Course VIII	Condensed Matter Physics	22PPHC7	5	5
Elective – I	Energy Physics /Plasma Physics	22PPHEC1	4	4
Core Course – IX	Core Practical – II	22PPHQC2	8	4
Human Rights	Human Rights	22PHRSC	2	2
	Total		**30**	**23+2**
Extra Skills	• *Value Education* 1 Extra Credit • *Physical Fitness Practice – 1 Extra credit* • *Life Skills Promotion– 1 Extra Credit* • *Productive Preparation for CSIR/SET/JRF- II (21PPHSC2) (Self – study –1 Extra Credit)* • *Society Connect Activity – 1 Extra Credit*			

- **Extra Credits are given for extra skills and courses qualified in MOOC/NPTEL**

III SEMESTER				
Course	**Course Title**	**Code**	**Hrs/ Week**	**Credits**
Core Course – X	Quantum Mechanics – II	21PPHC8	5	4
Core Course – XI	Spectroscopy	21PPHC9	5	4
Elective – II	Instrumentation and Characterization Techniques / Crystal Growth Techniques	21PPHEC2 / 21PPHSEC2	4	3
Elective – III	Materials Science / Instrumental Methods of Analysis	21PPHEC3 / 21PPHSEC3	4	3
Core Course –XII	Core Practical – III	21PPHQC3	8	4
Extra Disciplinary Course	Communication Systems	21PPHEDC	4	4
	Total		**30**	**22**
Extra Skills	• *Value Education* • *Physical Fitness Practice* • *Life Skills Promotion* • *Productive Preparation for CSIR/SET/JRF- II (21PPHSC3) (Self – study –1 Extra Credit)*			
• ***Preparation for the Project – 5 Hours per Week (Outside College hours)***				

IV SEMESTER				
Course	**Course Title**	**Code**	**Hrs/ Week**	**Credits**
Core Course – XIII	Nuclear and Particle Physics	21PPHC10	6	5
Elective – IV	Communication Electronics/ Photonics	21PPHEC4 / 21PPHSEC4	5	4
Elective – V	Fibre Optics and Its Applications / Thin Film Physics	21PPHEC5 / 21PPHSEC5	5	4
Core Course – XIV	Core Practical –IV	21PPHQC4	8	4
Core Course – XV	Project and Project viva – voce	21PPHPC	6	4
		Total	**30**	**21**
Extra Skills	• *Value Education –1 Extra Credit* • *Physical Fitness Practice – 1 Extra Credit* • *Life Skills Promotion– 1 Extra Credit* • *Productive Preparation for CSIR/SET/JRF- IV (21PPHSC4) (Self – study –1 Extra Credit)* • *Society Connect Activity - 1 Extra Credit*			
• **Extra Credits are given for extra skills and courses qualified in MOOC/NPTEL**				

Programme Title : M.Sc. Physics

Course Title : CLASSICAL AND STATISTICAL MECHANICS

Course Code : 22PPHC1 **Hours/Week : 6**

Semester : I **Credits: 5**

Course Objectives :

The contents emphasize the advantage of energy representation in dynamics and macroscopic properties. The subject matter has been built up systematically from the fundamental concepts.

SYLLABUS

UNIT - I (Hours: 18) UNIT-I:

LAGRANGIAN FORMULATION

Lagrangian formulation: Coordinate Systems-degrees of freedom and constraints – Holonomic and Non Holonomic constraints-generalized coordinates-force and energy-conservation laws-conservations of linear and angular- momenta-symmetric properties-homogeneity and isotropy -D'Alemberts principle of virtual work - Lagrange's equation of motion from D'Alemberts Principle- Nonholonomic systems- Applications of Lagrange equations of motion: free particle in space-Simple Pendulum-Atwood's machine -Reduction of two body central force problem to the equivalent to one body problem.

UNIT - II (Hours: 18)

HAMILTON'S EQUATION AND CANONICAL TRANSFORMATION

Calculus of variation--principle of least action-Hamilton's principle-Hamilton Principle from D'Alemberts Principle- Lagrange's equation from Hamilton's principle– Modified Hamilton's principle- Hamilton's equations from variation principle-Legendre transformation and Generating functions-Cyclic coordinatesand conservation theorem-Canonical transformations-Hamilton's canonical equations -Poisson brackets and its properties-Lagrange Brackets-Relation between Lagrange Brackets & Poisson brackets.

UNIT - III (Hours: 18)

HAMILTON-JACOBI THEORY AND SMALL OSCILLATIONS

Hamilton-Jacobi equation for Hamilton's principle function-Example: Harmonic oscillator problem-Hamilton's characteristic function -Action-angle variable -application to Kepler problem in action angle variables- Eigen value equation-Normal coordinates-Normal frequencies of vibration-vibrations of linear triatomic molecule

UNIT - IV (Hours: 18)

CONCEPTS OF STATISTICAL MECHANICS

Microstates – Phase – space, Liouville's theorem – Maxwell Boltzmann distribution – The classical perfect gas – Root mean square and most probable velocities – Equipartition of energy – The specific heat of gases.

Bose – Einstein distribution, the perfect gas – The specific heat of solids: The phonon gas.

UNIT V (Hours: 18)

QUANTUM STATISTICS

Fermi Dirac distribution – The Fermi Dirac gas – The electron gas – Pauli Paramagnetism – Thermionic emission.

Third law of thermodynamics – Specific heat and absolute zero – Zero point energy – Liquid Helium

Books for Study:

1. Classical Mechanics- J. C. Upadhaya-Himalaya Publishing House 2017

2. Classical Mechanics-Sathyapraksah, KedarnathRamnath and Co. Publishers, Meerut

3. Statistical Mechanics by Satya Prakash, KedarnathRamnath and Co. Publishers, Meerut

Books for Reference:

1. Classical Mechanics –Goldstien,Narosa Publishing house
2. Thermodynamics, statistical physics and Kinetics – Satyaprakash& T.P. Agarwal, Kedar and Co. Publishers, Meerut.(1989).
3. Statistical Mechanics – Gupta & Kumar, PragatiPrakashan, 9th edition, Meerut (2009).

Web Resources:

1. https://www.physicsforums.com/threads/website–for–classical–mechanics.792083/
2. https://ocw.mit.edu/courses/physics/8–333–statistical–mechanics–i–statistical–mechanics–of–particles

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the basic principles involved in Classical and Statistical mechanics	K1
CO2	**Illustrate** the Lagrangian and Hamiltonian formulations of classical mechanics and **apply** them to simple systems	K2, K3
CO3	**Apply** the concepts of Classical & Statistical Mechanics to various physical phenomena	K3
CO4	**Analyse** the recent intricate theories of rigid body dynamics & small oscillations	K4
CO5	**Solve** the real world problems of classical and statistical mechanics	K6

K6-*Create*; K5-*Evaluate*; K4-*Analyse*; K3-*Apply*; K2-*Understand*; K1-*Recall*

Mapping of COs with POs

CO	PO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	S	S	L	L
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	L	S
CO5	S	S	S	M	S

Programme Title : M.Sc. Physics

Course Title : QUANTUM MECHANICS - I

Course Code : 22PPHC2 **Hours/Week : 6**

Semester : I **Credits: 5**

Course Objectives :

This paper makes the students to understand the various kinetics involved in advanced physics using approximation methods.

SYLLABUS

UNIT - I (Hours: 18)

FOUNDATIONS OF WAVEMECHANICS

Postulates of wave mechanics adjoint and self-adjoint operators-degeneracy-eigen value, eigenfunctions–Hermitian operator-parity-observables-Physical interpretation-expansion coefficients –momentum eigen functions–Uncertainty principle-states with minimum value-commuting observables. Matter waves – Equation of motion-Schrodinger equation for the free particle–physical interpretation of wave function-normalised and orthogonal wave functions-expansion theorem-admissibility conditions-stationary state solution of Schrodinger wave equation – expectation values-probability current density-Ehrenferts theorem.

UNIT - II (Hours: 18)

APPROXIMATION METHODS FOR TIME INDEPENDENT PROBLEMS

Time independent perturbation theory–stationary theory-Non-degenerate case: first and second order-Normal Helium atom– Zeeman effect without electron spin – Stark effect in hydrogen molecule – Degenerate case: Energy correction- Stark effect in hydrogen atom – Variation method – Application to Ground state of Helium atom.

UNIT - III (Hours: 18)

EXACTLY SOLUBLE EIGEN VALUE PROBLEMS

One dimensional linear harmonic oscillator – properties of stationary states- abstract operator method - spherical symmetry systems -Particle in a central potential – radial wave function – Hydrogen atom: solution of the radial equation – stationary state wave functions – bound states-the rigid rotator: with free axis-in affixed plane-3-Dimentional harmonic oscillator.

UNIT-IV (Hours: 18)

MATRIX FORMULATION OF QUANTUM THEORY, EQUATION OF MOTION & ANGULAR MOMENTUM

Quantum state vectors and functions- Hilbert space-Dirac's Bra-Ket notation-matrix theory of Harmonic oscillator–Equation of motions-Schrodinger, Heisenberg and Interaction representation.

Angular momentum-commutation relations of J_Z ,J_+,J_- eigen values and matrix representation of J^2, J_Z , J_+, J_-, Spin angular momentum – spin ½, spin-1- addition of angular momenta - Clebsch – Gordan coefficients.

UNIT- V (Hours: 18)

APPROXIMATION METHODS FOR TIME DEPENDENT PERTURBATION THEORY

Perturbation theory, first and second order transitions under constant perturbation — transition probability: Fermi Golden Rule Application to potential scattering – Harmonic perturbations, Adiabatic and Sudden approximation.

Books for Study:

1. Quantum Mechanics by Satya Prakash and Swathi Saluja, Kedarnath Ramnath, Meerut. (2019).
2. Quantum Mechanics by S.L.Gupta, V.Kumar, H.V.Sharma & R.L.Sharma, Jai Prakashnath and Co,Meerut. (1997).

Books for Reference:

1. Quantum Mechanics by Srivastava, Prakati Publishers.(1990).
2. Quantum Mechanics by Mathews &Venkatesan, Tata McGraw Hill, second edition. (1989).
3. Quantum Mechanics by Pauling &Wilson, McGraw Hill, Kragakusha ltd. (1935).
4. Quantum Mechanics by Ghatak and Loganathan, Macmillan Ltd. (2004).

Web Resources:

1. https://www.springer.com › Home › Physics › Quantum Physics.

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Define** the basic concepts of wave mechanics.	K_1
CO2	**Summarize** the concepts of quantum mechanics	K_2
CO3	**Apply** approximation methods to derive energy of atoms	K_3
CO4	**Analyse** the Eigen values of quantum mechanical operators	K_4
CO5	**Evaluate** Eigen functions for degenerate and non-degenerate systems	K_5

K6-*Create*; K5-*Evaluate*; K4-*Analyse*; K3-*Apply*; K2-*Understand*; K1-*Recall*

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	**S**	**S**	S	M	S
CO 2	S	S	S	M	S
CO 3	S	S	S	M	S
CO 4	S	S	S	M	M
CO 5	S	S	S	M	S

Programme Title : M.Sc. Physics

Course Title : ADVANCED ELECTRONICS

Course Code : 22PPHC3 **Hours/Week : 5**

Semester : I **Credits: 5**

Course Objective

To understand the basic functions of digital circuits, which have wide application in electronic appliances.

SYLLABUS

UNIT - I (Hours: 15)

OPAMP AND ITS APPLICATIONS

Op amp – CMRR – Slew rate – Instrumentation amplifier and its applications – V to I and I to V converter – Op-amp stages- Equivalent circuits - Sample and Hold circuits.Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits – Adder- Subtractor- Differentiator- Integrator- Electronic analog Computation-Solving simultaneous and differential equation – Active AC filters: First order, second order and higher order, Low pass, High pass, Band pass filter and Band reject filters –Logarithmic and Antilog amplifier – Phase locked loop amplifier – Application of PLL 565 – Frequency multiplier.

UNIT - II (Hours: 15)

WAVE FORM GENERATORS

Astable, Monostable multivibrators and Schmitt trigger circuit using IC 555, OP AMP – Astable, Monostable, Bistable multivibrators – Square and Triangular wave generators, Phase shift oscillator, Wein Bridge oscillator – VCO 566 and its applications.

UNIT - III (Hours: 15)

COMBINATION AND SEQUENTIAL LOGIC DIGITAL CIRCUITS

Arithmetic circuits; Half, Full and Binary adders – Half, Full and Binary subtractors – BCD adder (complement method) – Encoder – Decoder – Multiplexer – Demultiplexer– Parity checker – Parity generator.

Asynchronous and Synchronous counters – Up counter – down counter – Shift register – Ring counter – Johnson counter.

UNIT - IV (Hours: 15)

DIGITAL TO ANALOG CONVERSION

Variable resistance network – Binary ladder – D/A converter – Weighted resistor Accuracy and resolution - Sampling theorem-Time division multiplexing – Quantization.

ANALOG TO DIGITAL CONVERSION

Simultaneous (Flash) converter – Counter type – Dual slope – Voltage to frequency converter – Voltage to time converter – Successive approximation Converter Sampling Theorem – Time Divison Multiplexing – Quantisation.

UNIT - V (Hours: 15)

MEMORIES

The read only memory – Implementation of ROMs – Programmable and erasable ROMs – Applications of ROMS – Bipolar – Junction Transistor Random Access – Memory cells – MOS RAMs – Organization of a RAM – Static RAM, Dynamic RAM, Content Addressable Memory – Principle, Block Diagram and Operation. The charge coupled device(CCD) - Principle, Construction, Working and Data transfer mechanism– Storage of charge – Transfer of charge – Input and output arrangement – Magnetic Bubble Memory – Programmable Logic Array(PLA). Classification of Memories & Sequential Memory- Static Shift register and Dynamic shift register - Operation, Internal Architecture.

Books for Study:

1. OP-AMP and Linear integrated circuits – Ramakant A. Gayakwad, IV edition, PHI, (2000)
2. Hand book of Electronics – Gupta and Kumar, Pragati Prakashan (2008).
3. Modern Digital Electronics – R. P. Jain, TMH, (2006).
4. Digital Circuits and Design – S. Salivahanan& S. Arivazhagan – Second Edition (2005).

Books for Reference:

1. Integrated Electronics – Millman &Halkias, TATA Mc GRAW -HILL, (1985).
2. Micro Electronics – Millman and Grabel, TMH, (1987).
3. Digital principles and applications – Malvino and Leach, V edition, TMH,(1996).
4. Digital Fundamentals – Floyd, Pearson Education, (2008).

Web Resources:

1. https://www.elsevier.com/...advanced–electronic...materials.../978–0–12–513745–4

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the basic principles of digital electronics.	K_1
CO2	**Describe** the working of Analog and Digital circuits	K_2
CO3	**Apply** the basic principles of op-amp and 555 to study the amplifies and oscillators circuits	K_3
CO4	**Distinguish** between Analog & Digital circuits.	K_4
CO5	**Analyse** the RAM, ROM, CCD and PLA in programmable logic array.	K_5

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	M	S
CO 2	S	M	S	S	S
CO 3	S	M	S	S	S
CO 4	S	S	S	S	S
CO 5	S	S	S	S	S

Programme Title : M.Sc. Physics

Course Title : ELECTROMAGNETIC THEORY

Course Code : 22PPHC4 **Hours/Week : 5**

Semester : I **Credits: 5**

Course Objective :

To understand the basic concepts of electrical and magnetic properties of electromagnetic waves. To apply vector Maxwell's equations to solve simple electromagnetic problems.Make use of theoretical methods to understand the electrical and magnetic properties of matter and to incorporate the fundamental theory of electromagnetism into the scientific problem.

SYLLABUS

UNIT - I (Hours: 15)

ELECTROSTATICS

Coulomb's law ; the electric field-line, flux and Guass's law in differential form-the electrostatic potential; conductors and insulators; Gauss's law –application of Guass's law-curl of E-Poisson's equation; Laplace's equation-work and energy in electrostatics – energy of a charge distribution-energy of continuous charge distribution-induced charges. Potentials: Laplace equation in one dimensions and two dimensions-dielectrics-induced dipoles-Guass's law in the presence of dielectrics.

UNIT - II (Hours: 15)

MAGNETOSTATICS

Lorentz force-magnetic fields-magnetic forces-currents-Biot-Savart law-divergence and curl of B-Ampere's law-Electromagnetic induction-comparison of magneto statistics and electrostatics-Magnetic vector potentials .Magnetization: effect of magnetic field of atomic orbit-Ampere's law in magnetized field-ferromagnetism.

UNIT - III (Hours: 15)

ELECTROMOTIVEFORCE

Ohm's law-Electromotive force-motional emf-Faraday's law-induced electricfield-inductance- energy in magnetic field-Maxwell's equation in free space and linear isotropic media- continutity equation-Poynting theorem.

Electromagnetic waves invaccum: waves in one dimension-wave equation-sinusoidal waves-reflection and transmission-Polarization.

UNIT - IV (Hours: 15)

ELECTROMAGNETIC POTENTIALS AND ELECTRO DYNAMICS

Electromagneti cvector and scalar potentials–Non uniqueness of electromagnetic potentials–Concept of Gauge–Radiation due an oscillating electric dipole–Poynting vector and radiated power–Electric dipole as an accelerated charge–Radiation due to a small current element

UNIT - V (Hours: 15)

APPLICATIONS OF ELECTROMAGNETIC WAVES

Boundary conditions at the surface of discontinuity–Reflection and Refraction of electromagnetic waves at the interface of non–conducting media–Total internal reflection–Dispersion–Normal and Anomalous–Dispersion in gases–Theory of scattering of electromagnetic waves.

Books for Study:

1. Introduction to electrodynamics – David J. Griffiths (2017)
2. Electromagnetic theory and Electrodynamics – Satyaprakash (2008).

Books for Reference:

1. Fundamentals of Electromagnetic Theory by Prentice Hall India Learning Jan (2011).
2. Electromagnetic Theory by U.A. Bakshi, A.V. Bakshi (2009).
3. Fundamentals of Applied Electromagnetics (7^{th} edition)by Fawwaz T. Ulaby,Umberto Ravaioli (2014).
4. Electromagnetic field Theory and Transmission lines by Pearson Education Ltd-Jan(2013).

Web Resources:

1. http://ocw.mit.edu>resources>textbook
2. https://www.calvin.edu>EMFT Book

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Describe** the basic concepts of electrostatics and magnetostatics.	K2
CO2	**Apply** the principles of electrostatics and magneto statics to solve problems and to **analyse** the propagation of electromagnetic waves in different media	K3,K4
CO3	**Apply** Maxwell's equation for solving the problems	K3
CO4	**Analyse** the role of displacement current, gauge transformations, magnetic scalar and vector potential, Lorentz gauge in Physics.	K4
CO5	**Evaluate** the power radiated from radiating systems.	K5
CO6	**Deduce** the expressions for potential field and force using the principles of electrostatics and magnetostatics	K5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	M	M	M
CO 2	S	S	M	M	S
CO 3	S	S	S	M	M
CO 4	S	S	M	S	S
CO 5	S	M	M	S	S
CO6	S	M	M	M	S

Programme Title : M.Sc. Physics

Course Title : CORE PRACTICAL – I

Course Code : 22PPHQC1 **Hours/Week : 8**

Semester : I **Credits: 4**

Course Objective :

The aim of the course is to develop the practical skills by applying the laws and concepts in physics and electronics experiments.

SYLLABUS

Students are expected to perform at least 12 experiments out of following list

Hours: 120

1. Young's modulus and Poisson's ratio - Cornus Elliptical fringes -
2. F.P. Etalon using Spectrometer.
3. Thermistor - Determination of Band gap energy and temperature co-efficient
4. Charge of an electron – Spectrometer.
5. Mayer's Disc-Determination of Viscosity.
6. Construction of Half adder, full adder and Half Subtractor, Full Subtractor using Ex-OR gates.
7. Op- amp - Square and Triangular wave generators.
8. Modulus Counters using IC 7490.
9. Schmitt trigger using IC 555 and Op-amp.
10. Astable multivibrator using IC 555 & IC741.
11. Hydrogen arc spectrum.
12. Voltage controlled oscillator using IC565.
13. Arithmetic operation using IC 7483.
14. Four Probe Method – Resistivity of a semiconductor.
15. V – I Characteristics of a Solar Cell.

Books for Study:

1. Practical Physics and Electronics - C. C. Ouseph, U. J. Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., (2007).
2. Practical Physics, Prof.A. Ponnusamy and B. Amalanathan, Bright Publishers, (1996).

Books for Reference:

1. A text book of Practical Physics – M.N.Srinivasan and others, Sultan Chand and Sons, (2014).

Web Resources:

1. www.practicalphysics.org/

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Determine** various physical quantities like band gap energy, charge of an electron, moduli of elasticity and coefficient of viscosity	K_2
CO2	**Apply** the theory of Op - amp and IC 555 to generate waveforms	K_3
CO3	**Analyse** the concepts involved in electronic devices and circuit systems	K_4
CO4	**Design** simple electronic circuits	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	S	S	S
CO 2	S	S	M	S	M
CO 3	S	S	S	S	S
CO 4	S	S	S	S	S

Programme Title : **M.Sc. Physics**

Course Title : **ANALYTICAL METHODS OF PHYSICS**

Course Code : **22PPHC5** **Hours/Week : 6**

Semester : **II** **Credits: 5**

Course Objective :

Mathematics has become an integral part of physics. This paper aims at providing extensive mathematical formalism for understanding and interpreting various Physical problems.

SYLLABUS

UNIT - I (Hours: 18)

VECTOR FIELD AND TENSORS

Vector fields – Orthogonal Curvilinear Coordinate systems – expression for gradient, divergent, curl and Laplacian – Spherical polar coordinates and differential operators Transformation of coordinates – Summation convention – Contravariant, Covariant and mixed tensor – Rank of a tensor – Kronecker delta symbol – Symmetric and antisymmetric tensor – Invariant tensors.

UNIT - II (Hours: 18)

COMPLEX INTEGRALS

Cauchy's integral theorem and formula – Derivatives of analytic function – Taylor and Laurent's series - Zeroes and Singularities – Residues – The residue theorem – Evaluation of real integrals.

UNIT - III (Hours: 18)

SPECIAL FUNCTIONS

Special functions – Legendre, Bessel, Laguerre's and Hermite differential equations – Generating functions – Orthogonality relations – Rodrigue's formula – Recurrence relations.

UNIT - IV (Hours: 18)

GROUP THEORY

Definition of groups – Subgroups – Conjugate classes – Symmetry elements – The Group multiplication table – The group of symmetry of an Equilateral triangle and a square - Transformation – Matrix representation – Representation of groups – Reducible and Irreducible representation of groups – Schur's Lemma - Orthogonality theorem – Character representation – Character table for C_{2v} and C_{3v} point groups.

UNIT - V (Hours: 18)

DIRAC DELTA FUNCTION AND GREEN'S FUNCTION

Dirac – Delta function – Three dimensional delta functions – Green's function – one dimensional case – Symmetry properties of green function – Green's function for poisson equation – Quantum mechanical scattering problem.

Books for Study:

1. Mathematical Physics – SatyaPrakash, S. Chand & Co, New Delhi, 2014.
2. Mathematical Physics – H.K.Dass, S.Chand& Co, New Delhi, 2010.
3. Group theory applications to molecular vibrations- P.G.Puranik, S. Chand & Co, New Delhi, 1979.
4. Mathematical Physics – B.D.Gupta., Vikas Publishing House Pvt Ltd, New Delhi, 1991.

Books for Reference:

1. Complex Variable – Schaum Series, McGraw Hill Book Company, Singapore, 1998.
2. Functions of Complex Variable – J.N.Sharma, Krishna Prakashan Media pvt ltd, Meerut, 2001.
3. Elements of Group theory for Physicist – A.W.Joshi, New Age International Publishers, New Delhi, 2005.

Web Resources:

1. http://nptel.ac.in/courses/115103036

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Outline** the basic theories and formulae in solving the physical problems	K_2
CO2	**Apply** mathematical methods and theories to solve problems	K_3
CO3	**Analyse** the solutions of problems related to vector field, complex analysis, special functions and greens functions	K_4
CO4	**Deduce** the theorems in analytical methods of physics	K_5
CO5	**Construct** the character tables in group theory	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	M	L	L
CO 2	S	S	S	M	S
CO 3	S	S	S	M	M
CO 4	S	S	S	M	S
CO 5	S	S	S	S	S

Programme Title : M.Sc. Physics

Course Title : MICROPROCESSOR AND MICROCONTROLLER

Course Code : 22PPHC6 **Hours/Week : 5**

Semester : II **Credits: 5**

Course Objective :

To make the students to understand the basic functioning of microprocessor, microcontrollers and interfacing devices which have wide applications in electronic appliances.

SYLLABUS

UNIT - I (Hours: 15)

INTRODUCTION AND INSTRUCTION SET OF 8085

Evolution of Microprocessor – Concept of multiplexing in microprocessor – processor cycles – Machine cycles of 8085 – Instruction format of 8085 – Instruction set – Timing diagram of 8085 instructions. Multiprogramming – Time share and multitasking systems – Distributed processing /multiprocessing.

UNIT - II (Hours: 15)

INTERRUPT STRUCTURE AND INTERFACING WITH 8085

Interrupt and its need – Classification of interrupts – interrupts of 8085 – Software interrupts of 8085 – Hardware interrupts of 8085 – Priorities of Interrupts enabling , Disabling and Masking of 8085 interrupts-Temperature control systems using 8085 – Motor speed control systems using 8085 – Traffic light control using 8085.

Interfacing of I/O and peripheral devices – Keyboard and display interfacing – keyboard and display interface using 8279 – DAC interface – ADC interface.

UNIT - III (Hours: 15)

ASSEMBLY LANGUAGE PROGRAMMING

Levels of programming – Flowchart – Assembler directives – Procedure and Macro – Delay Routine – List and Array – Stack – Examples of 8085 Assembly language programs – Program to subtract two numbers of 16 bit data stored in memory – Program to add two numbers of 8-bit data stored in memory – write an assembly language program to add two numbers of 2-digit(8-bit) BCD data stored in memory, program to multiply two numbers of 8-bit data, program to divide two numbers of 8-bit data, program to add an array of data-program to search the smallest data in an array.

UNIT - IV (Hours: 15)

PERIPHERAL DEVICES

Parallel data transfer schemes –Programmable I/O part and timer – Intel 8155/8156-Programmable Peripheral interface – Intel 8255 – DMA data transfer scheme – Serial data communication interface USART – INTEL 8251A.

UNIT - V (Hours: 15)

INTEL 8086 AND INTRODUCTION TO MICROCONTROLLERS

8086 Microprocessor Internal Architecture – programming the 8086 – Addressing modes of 8086 –History of Microcontrollers and microprocessor-Embedded versus External memory devices-8-bit and 16-bit Microcontrollers (Basic idea).

Books for Study:

1. Microprocessor and its application - A. NagoorKani, RBA publications (2004).
2. Microcontrollers [Theory and applications]- Ajay V. Deshmukh, TMH(2007).

Books for Reference:

1. Microprocessor architecture, Programming and application with 8085 – Ramesh S. Gaonkar, Wiley Eastern. (2000).
2. Microprocessor and interfacing, Doughlas V. Hall, TMH. (2006).

Web Resources:

1. https://simple.wikipedia.org/wiki/Microprocessor
2. http://www.futureelectronics.com/en/Microcontrollers/microcontrollers.aspx

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the basic concepts of Microprocessor and Microcontrollers.	K_1
CO2	**Understand** the functions of multiprogramming, interrupts of 8085 and 8086	K_2
CO3	**Make** use of 8085 microprocessor and the microcontroller for athematic and societal problems.	K_3
CO4	**Analyse** the DAC, ADC and the programmable devices.	K_4
CO5	**Assess** the applications of microprocessors and microcontrollers.	K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	M	M	S
CO 2	S	S	M	S	M
CO 3	S	S	M	S	M
CO 4	S	M	S	M	S
CO 5	S	S	M	S	S

Programme Title : M.Sc. Physics

Course Title : CONDENSED MATTER PHYSICS

Course Code : 22PPHC7 **Hours/Week : 5**

Semester : II **Credits: 5**

Course Objective :

The aim of the course is to provide the basic elements of the physics of solids and to educate basics of Crystallography, Bonding, Lattice vibrations, Band theory of solids, Transport phenomena, and Superconductivity.

SYLLABUS

UNIT - I (Hours: 15)

CRYSTALLOGRAPHY AND BONDING

Reciprocal lattices – Vector development of reciprocal lattice – Properties of the reciprocal lattice – Reciprocal lattice to bcc lattice and fcc lattice – Bragg condition in terms of reciprocal lattice – Crystal diffraction – Neutron and electron diffraction – Brillouin zones.

Binding energy of ionic crystals – Madelung constant – Cohesive energy – Compressibility and Bulk Modulus – Born Haber cycle.

Crystals of inert gases –Vanderwaal's interaction – London interaction – Cohesive energy.

UNIT - II (Hours: 15)

LATTICE VIBRATION

Elastic vibration of continuous media – Group velocity of Harmonic wave trains – Wave motion of one dimensional atomic lattice – Lattice with two atoms per primitive cell – Some facts about diatomic lattice – Number of possible normal modes of vibration in a band – Optical properties in the infrared – Phonons – Momentum of phonons – Inelastic scattering of photons by phonons and neutrons by phonons.

UNIT - III (Hours: 15)

FREE ELECTRON THEORY

Free electron gas - Drude– Lorentz theory of metals – Sommerfeld model- Energy levels and density of orbitals in one dimension –Fermi – Dirac distribution for a free electron gas - Effect of temperature on the F.D. distribution –Free electron gas in three dimension – Heat capacity of a electron gas – Electrical conductivity and Ohm's law – Thermal conductivity of metals – Wiedemann – Franz law – Mathiessen's rule.

UNIT - IV (Hours: 15)

BAND THEORY OF SOLIDS

Early free electron model and origin of energy gap -Bloch wave function – wave equation in a periodic potential - Kronig - penney model – motion of electrons in one dimensional periodic lattice - effective mass of the electron – limitations of K- P model - Free electron approximation – the tight binding approximation – Brillouin zones – reduction of zones – De Hass – Van Alphen effect.

UNIT - V (Hours: 15)

SUPERCONDUCTIVITY

Super conductivity– Critical temperature– Isotope effect– Effect of magnetic field– Meissner effect– Penetration depth– Heat capacity – Energy gap – Theoretical survey – London equation–BCS theory– Cooper pair– Energy gap– Type I and type II Superconductors – Josephson tunnelling – ac Josephson effect and dc Josephson effect – SQUIDS – High TC Superconductors.

Books for Study:

1. Solid State Physics – S. L. Gupta & V. Kumar, K. Nath& Co, Meerut, 9th edition 2016 – 2017.
2. Solid State Physics - S.O.Pillai New Age International Publishers, 8th edition 2018.
3. Solid State Physics – K. Elangovan, S. Viswandhan Pvt. Ltd, 2007.

Books for Reference:

1. Fundamentals of Solid State Physics – Saxena Gupta and Saxena, Pragati Prakashan, Meerut, (1989).
2. Solid state Physics – C.Kittel, Wiley Eastern Ltd.(2007).
3. Solid state Physics – Singhal, Kedarnath Ramnath & Co, Meerut.(2007).
4. Solid state Physics – S.O. Pillai, Wiley Eastern, New Age international Ltd.(1994).
5. Elements of Solid state Physics – J. P. Srivastava.

Web Resources:

1. https://www.britannica.com/science/condensed–matter–physics

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the basic elements of the Physics of solids	K_1
CO2	**Explain** the theory of solids	K_2
CO3	**Apply** the concepts of crystallography, bonding, free electron theory and band theory to solids	K_3
CO4	**Distinguish** between insulators, semiconductors, conductors and superconductors	K_4
CO5	**Construct** Brillouin zones on the basis of band theory of solids	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	**S**	**S**	S	M	S
CO 2	S	S	S	M	S
CO 3	S	S	S	S	S
CO 4	S	S	S	M	S
CO 5	S	S	S	M	S

Programme Title : **M.Sc. Physics**

Course Title : **Elective – I: ENERGY PHYSICS**

Course Code : **22PPHEC1** **Hours/Week : 4**

Semester : **II** **Credits: 4**

Course Objective :

The aim of the course is to provide the conventional and non–conventional energy sources in a simple, lucid and precise manner.

SYLLABUS

UNIT - I (Hours: 12)

INTRODUCTION TO ENERGY SOURCES

Energy sources and their availability – Prospects of renewable energy sources.

SOLAR RADIATION AND ITS MEASUREMENTS

Solar constant – Solar radiation at the Earth's surface – Solar radiation – Geometry – Solar radiation measurements using Pyrheliometers, Pyranometers and Sunshine Recorder – Solar radiation data – Estimation of average solar radiation – solar radiation on tilted surfaces.

UNIT - II (Hours: 12)

SOLAR CELLS

Solar Electric power generation: Solar Photovoltaics – Solar cell principle – Semiconductor junctions – Conversion efficiency and power output – Single crystal Silicon solar cell. Polycrystalline solar cell – Cadmium sulphide Solar cell.

UNIT - III (Hours: 12)

APPLICATIONS OF SOLAR ENERGY

Solar water heating –Space heating and space cooling – Agricultural and industrial process heat – Solar distillation – Solar pumping – Solar furnace –Solar cooking – Solar green house.

UNIT - IV (Hours: 12)

WIND ENERGY

Basic principles of wind energy conversion wind data and energy estimation – Basic components of wind energy conversion systems (WECS) –Advantages and Disadvantages of WECS– Types of wind machines – Horizontal axis machine and vertical axis machine– Applications of wind energy – Pumping applications – Direct heat applications – Electric generation applications.

UNIT - V (Hours: 12)

ENERGY FROM BIO MASS

Biomass conversion Technologies – Wet and dry process – Photosynthesis.

BIO GAS GENERATION

Introduction – Basic process and energetics – Advantage – Anaerobic digestion – Factors affecting bio digestion of Generation of gas

CLASSIFICATION OF BIOGAS PLANTS

Continuous and batch type – The dome and drum types of bio gas plants – Different variations in Drum type. Types of Bio gas plants – Janatha biogas plant –Deenbandhu biogas plant–Fuel properties of bio gas and utilization of bio gas.

Books for Study:

1. G.D.Rai, Non–Conventional energy sources, Khauna publication (2005).

Books for Reference:

1. Solar Cells by Charles Cohen Agrotech Press Jaipur New Delhi-2019.
2. Solar Energy Fundamentals and Applications by Brajesh Priyadarshi Ishwar Books – New Delhi-2019.
3. Renewable energy by Robert Ehrlich March 15, 2013.

Web Resources:

1. http://extension.psu.edu>renewable
2. http://www.e–education.psu.edu>node
3. http://www.researchgaate.net>publication

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the various renewable and non-renewable energy resources	K_1
CO2	**Summarize** the energy conversion techniques	K_2
CO3	**Apply** the basic physical concept to develop the conversion technologies like wet process, dry process and photosynthesis	K_3
CO4	**Analyse** the applications of renewable resources.	K_4
CO5	**Distinguish** the principle and performance of different types of solar cells	K_4
CO6	**Construct** solar panels for desired purposes	K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	M	M	S
CO 2	S	S	S	S	S
CO 3	S	M	S	S	S
CO 4	S	S	M	S	S
CO 5	S	S	M	S	S
CO6	S	M	S	S	S

Programme Title : M.Sc. Physics

Course Title : Elective – I: PLASMA PHYSICS

Course Code : 22PPHESEC1 **Hours/Week : 4**

Semester : II **Credits: 4**

Course Objective :

The aim of the course is to know the basics and applications of plasma physics in nature and technology and to understand the problems of fusion research for energy generation.

SYLLABUS

UNIT - I (Hours: 12)

FUNDAMENTAL CONCEPTS ABOUT PLASMA

Kinetic pressure in a partially ionized gas – Mean free path and collision cross section – Mobility of charged particles – Effect of magnetic field on the mobility of ions and electrons – Thermal conductivity – Effect of magnetic field; Dielectric constant of plasma –Quasi neutrality of plasma – Debye shielding distance – Optical properties of plasma.

UNIT - II (Hours: 12)

MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD

Particle description of plasma; Motion of charged particle in an electrostatic field – Motion of charged particle in uniform magnetic field – Motion of charged particles in electric and magnetic fields – Motion of charged particles inhomogeneous magnetic field – Motion of charged particles in a magnetic mirror confinement – Motion of an electron in a time varying electric field – Magneto hydrodynamics – Magneto hydrodynamic equations – Interpretation of the equations – Condition for magneto hydrodynamic behavior.

UNIT - III (Hours: 12)

PLASMA OSCILLATIONS AND WAVES

Introduction: Theory of simple Oscillations – Electron Oscillation in a Plasma – Derivation of plasma Oscillations by Utilising Maxwell's Equation – Ion Oscillations and Waves – Oscillations and waves in a magnetic field – Thermal effects on Plasma Oscillations – Landau damping – Hydromagnetic waves – Oscillations in electron beam.

UNIT - IV (Hours: 12)

PLASMA DIAGNOSTIC TECHNIQUES

Single probe method – Double probe method – Use of probe technique for measurement of plasma parameters in magnetic field – Microwave method – Spectroscopic method –: Laser as a tool for plasma diagnostics – X–ray diagnostics of plasma – Acoustic method – Conclusion.

UNIT - V (Hours: 12)

POSSIBLE APPLICATIONS OF PLASMA PHYSICS

Magneto hydrodynamic generator –Basic theory – Magneto hydrodynamic generator – Principle of working – The fuel in M.H.D – Magnet in M.H.D. generator – Generation of Microwaves utilizing high density plasma – Plasma diode.

Books for Study:

1. Plasma Physics – Plasma State of Matter – S.N. Sen, Pragati Prakashan Meerut –I
2. Introduction to Plasma Physics – FF. Chen.1600 Plenum Press, London.

Books for Reference:

1. Plasma Diagnostic Techniques – RH Huddlestone and SL Leonard, 1600
2. Plasma The fourth state of Matter – D.A. Frank – Kamenetskii –Macmillan Press Ltd, London.

Web Resources:

1. https://www.nature.com/subjects/plasma–physics

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Know** the basic concepts of plasma and it's relevant topics to understand the basic mechanism of single particle motion and it's kinetic theory	K_1
CO2	**Use** the basic mathematical formalism needed for describing the dynamics of plasma media at different levels.	K_2
CO3	**Interpret** basics of plasma parameters and the related fluid equations to analyse the behaviour of electromagnetic waves and electron beam with plasma.	K_2
CO4	**Analyse** the plasma diagnostic techniques as a tool for X-Ray diagnostics of plasma.	K_4
CO5	**Apply** the basics of plasma physics to understand the problems of energy generation from M.H.D. generator and plasma diode.	K_3

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	M	S
CO 2	S	M	S	M	S
CO 3	S	S	S	M	S
CO 4	S	M	S	M	S
CO 5	S	M	S	M	S

Programme Title : M.Sc. Physics

Course Title : CORE PRACTICAL – II

Course Code : 22PPHQC2 **Hours/Week : 8**

Semester : II **Credits: 4**

Course Objective:

The aim of the course is to develop the practical skills by applying the laws and concepts in physics and electronics experiments.

SYLLABUS

Students are expected to perform at least 10 experiments out of the following list.

Hours: 120

1. Cornus Hyperbolic fringes- Young's modulus and Poisson's ratio.
2. Solar spectrum-Rydberg's constant.
3. Polarizability of liquid – Hollow prism –Spectrometer.
4. Microprocessor programs
    1. To find the biggest number and smallest number.
    2. Arranging numbers in ascending and descending order.
5. Microprocessor programs II
    1. Factorial of a given number.
    2. Square root of a given number.
    3. BCD to Binary conversion.
    4. Binary to BCD conversion.
6. Design of NAND/NOR Network to generate the given Sum of Products and Product of Sums.
7. Op –Amp – First order low pass, high pass and band pass filters.
8. ADC using comparators.
9. Analog computer circuit design – Solving the Simultaneous equations.
10. Synchronous and Asynchronous Counters (Up and down counter).
11. Bistable multivibrator using op-amp and IC555.
12. GM Counter.

Books for Study:

1. Practical Physics and Electronics - C.C.Ouseph, U.J.Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., (2007).
2. Practical Physics, Prof.A.Ponnusamy and B.Amalanathan, Bright Publishers, (1996).

Books for Reference:

1. A text book of Practical Physics – M.N.Srinivasan and others, Sultan Chand and Sons, (2014).

Web Resources:

1. www.practicalphysics.org/

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Determine** various physical quantities like polarizability of a liquid, moduli of elasticity, Rydberg's constant and coefficient of viscosity	K_2
CO2	**Apply** logical thinking skills to write the program in 8085 microprocessor and verify the results.	K_3
CO3	**Analyse** the concepts involved in electronic devices and circuit systems	K_4
CO4	**Design** digital and electronic circuits	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	M	S	S
CO 2	S	S	M	S	S
CO 3	S	S	S	S	S
CO 4	S	S	M	S	S

Programme Title : **M.Sc. Physics**

Course Title : **QUANTUM MECHANICS - II**

Course Code : **21PPHC8** **Hours/Week : 5**

Semester : **III** **Credits: 4**

Course Objective :

The aim of the course is to provide an understanding of the advanced concepts and its applications to study the scattering of fundamental particles, relativistic modification in particle behavior, approximations in molecular atomic structure and atom field interaction.

SYLLABUS

UNIT - I (Hours: 15)

IDENTICAL PARTICLES AND SCATTERING THEORY

Indistinguishability of identical particles – Symmetric and anti-Symmetric wave function –Distinguishability of identical particles – Bosons and Fermions – Pauli's Exclusion principles- Symmetric and Anti symmetric wave function of hydrogen molecule.

The scattering problem - Formulation – The method of partial waves- - Scattering amplitude – Phase shifts - Low energy scattering- Green's function – Born approximation and its validity – scattering by Yukawa potential – Coulomb Scattering – Screened coulomb potentials-– Scattering length and effective range.

UNIT - II (Hours: 15)

EMISSION AND ABSORPTION OF RADIATION

The Einstein coefficient – atom field interaction – Spontaneous and induced emission of radiation from semi – Classical theory – Electric dipole transition - Selection rules and polarizability – Transition probabilities for stimulated emission and absorption and spontaneous emission of radiation –Quantization of radiation field - Radiation field as an assembly of oscillators– Interaction with atoms and absorption rates.

UNIT - III (Hours: 15)

ATOMIC AND MOLECULAR STRUCTURE

Approximations in atomic structure – Central field approximation – Thomas Fermi Statistical model – HartreeFock Equation – The method of self consistent field – Residual electrostatic and spin orbit interaction – Alkali atoms – Doublet separation – Coupling schemes – Hydrogen molecule – Covalent bond.

UNIT - IV (Hours: 15)

RELATIVISTIC WAVE EQUATION

The Klein – Gordon Equation – Charge and current densities in four vector – KG equation in electromagnetic field – The Dirac relativistic equation : The Dirac matrices – Free particle solutions – Meaning of negative energy states - Electromagnetic potential – magnetic dipole moment – Existence of electron spin - Spin orbit energy.

UNIT - V (Hours: 15)

QUANTUM FIELD THEORY

Quantization of Wave Fields - Classical Lagrangian Equation –Classical Hamiltonian Equation - Field Quantization of the Non-Relativistic Schrodinger Equation - Creation,

Destruction and Number Operators – Anti-Commutation Relations – Quantization of Electromagnetic Field Energy and Momentum.

Books for Study:

1. Quantum Mechanics -Satyaprakash, KedarNath Ram Nath, 2012.
2. Quantum Mechanics - Ajay Ghatak and S.Loganathan, Macmillan India Ltd, 2011.
3. Quantum Mechanics -P.M. Mathews and K. Venkatesan, Tata McGraw Hill Education Pvt. Ltd., 2013.
4. Quantum Mechanics -Leonard I.Schiff, Tata McGraw Hill Education Pvt. Ltd., 2010.
5. Quantum Chemistry -R.K. Prasad, New Age International Pvt. Ltd., 2010.

Books for Reference:

1. Quantum Mechanics - Gupta, Kumar, Sharma, Jai Prakash Nath& Co., 2004.
2. Quantum Mechanics - B. N. Srivastava, PragatiPrakashan, 1990.
3. Advanced Quantum Theory and Fields - S. L. Gupta & I. D. Gupta, S. Chand & Company, Pvt Ltd., 1986.
4. Advanced Quantum Mechanics - B. S. Rajput, PragatiPrakashan, 2009.
5. Quantum Mechanics - Chatwal Anand, Himalaya Publication House, 1991.
6. Quantum Mechanics - Powell Crasemann, Addison Wesley Publication Company, 1988.
7. Quantum Chemistry - Henry Eyring, The Late John Walter &n George E.Kimball, John
   Wiley & Sons INC, 1994.
8. Introductory Quantum Mechanics - Waghmare, S. Chand & Company, Pvt, Ltd., 1990.

Web Resources:

1. http://bookboon.com/Introduction to Quantum Mechanics, Intermediate Quantum Mechanics, Chemistry: Quantum Mechanics and Spectroscopy I , Chemistry: Quantum Mechanics and Spectroscopy II
2. https://swayam.gov.in/courses/3485-quantum-chemistry
3. http://freevideolectures.com/Course/2876/Fundamentals-of-Physics-III/19
4. http://www.freebookcentre.netNuclear physics books

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recognise** the role of approximation and mathematical approaches in quantum mechanics	K_1
CO2	**Describe and interpret** phenomena of scattering, interactions of different types of single and many particle systems, their behavior under relativistic phenomenon	K_2
CO3	**Apply** the concepts of quantum mechanics quantitatively to predict the behaviour of particles and atom field interactions.	K_3
CO4	**Analyse** the differences, implications and descriptions of the different methodologies applied in the study of scattering, field theory, atom field interactions and relativistic behavior of particles.	K_4
CO5	**Evaluate** total scattering cross - section and transition probabilities by using integral / residual approach Calculate the rate of transition using time dependent perturbation theory	K_5
CO6	**Construct** symmetrised and self consistent wave functions for a system of particles	K_6
CO7	**Develop** skill with necessary intricacies to attempt and compete in the Competitive Examinations	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	S	L	M
CO 2	S	S	S	L	M
CO 3	S	S	S	L	M
CO 4	S	S	S	M	M
CO 5	S	S	S	M	S
CO6	S	S	S	M	S
CO7	S	S	S	S	S

Programme Title : M.Sc. Physics

Course Title : SPECTROSCOPY

Course Code : 21PPHC9 **Hours/Week : 5**

Semester : III **Credits: 4**

Course Objective :

The aim of the course is to study and interpret the most popular technique for structure determination and analysis. This syllabus deals with IR, Raman, NMR, NQR, ESR, Mossbauer and Electronic spectroscopy along with an introduction to the subject and spectroscopic solution of structural properties.

SYLLABUS

UNIT - I (Hours: 15)

MICROWAVE SPECTROSCOPY

Molecular energies-Interaction of radiation with matter-Rotation of diatomic molecules – Classification of molecules – Rigid and non-rigid rotator– Spectra of linear polyatomic and top molecules–Stark effect–Inversion spectrum of Ammonia– Quadrupole hyperfine interaction Microwave Spectrometer.

UNIT - II (Hours: 15)

IR AND RAMAN SPECTROSCOPY

Vibrating diatomic molecule as a harmonic oscillator – Molecule as anharmonic oscillator – Vibrational Spectra of Polyatomic molecules–Number of fundamental vibrations-Linear polyatomic molecule–Symmetric top molecules–Experimental aspects of IR–Fourier transform spectroscopy.

RAMAN SPECTROSCOPY

Classical and Quantum mechanical theories–Pure rotational Raman spectra - Vibrational raman spectra–Raman activity–Polarization of Raman scattered Light - Mutual exclusion principle–Vibrational rotational raman spectra–Resonance Raman scattering - Structure determination from Raman and IR spectroscopy–Laser Raman spectrometer.

UNIT - III (Hours: 15)

ELECTRONIC SPECTRA OF MOLECULES

Born Oppenheimer approximation–Vibrational structure of electronic transitions – Intensity of vibrational electronic spectra – Frank – Condon principle –Rotational structure of electronic vibrational transition – the Fortrat diagram – Pre dissociation–Molecular orbital theory–The shapes of some molecular orbitals–classification of states– Chemical analysis by electronic spectroscopy

UNIT - IV (Hours: 15)

NMR SPECTROSCOPY

Theory of NMR – Quantum mechanical theory – Classical theory – Bloch equation –Steady state solution–Relaxation processes– Spin–spin relaxation–spin– lattice relaxation– Experimental method – Continuous wave spectrometer, FT–NMR– Chemical shift – spin–

spin coupling–Coupling constant

ESR SPECTROSCOPY

Quantum mechanical theory of ESR – 'g' factor – Experimental method –Multiplet structures-Fine structure-Hyperfine structure– Applications– Free radicals.

UNIT - V (Hours: 15)

NQR SPECTROSCOPY

Theory of NQR - Quadrupole Hamiltonian – Energy levels for Half integral spin and integral spins of nuclei – Experimental method – Continuous wave oscillator – Application –Hydrogen bonding.

MOSSBAUER SPECTROSCOPY

Theory of recoilless emission and absorption–Experimental methods – Chemical isomer shift – Magnetic hyperfine interactions – Zeeman Splitting –Electric Quadrupole interactions.

Books for Study:

1. Fundamentals of Molecular Spectroscopy – C. N. Banwell, Tata McGraw–Hill Publishing company Ltd.(1996).
2. Atomic and molecular Spectroscopy –Gurdeep R. Chatwal and Shem K. Anand – Himalaya Publishing house (2004).
3. Spectroscopy Volume 1 & 2 – B. P. Straughan and S. Walker, John Wiley & Sons Inc.,NewYork(1976).
4. SpectroscopyVolume1–S.Walker and H.Straw, Macmillan(1962).
5. Molecular Structure and Spectroscopy– G.Aruldhas, Prentice Hall of India Pvt Ltd.,(2001)
6. Molecular Spectroscopy-G.M.Barrow- McGraw – Hill International editions, Singapore(1986)

Books for Reference:

1. Basic principles of spectroscopy – R. Chang, Tata McGraw – Hill Publishing Company Ltd.,(1971).
2. Spectra of Diatomic molecules Infrared and Raman Spectra of polyatomic molecules - G.Herzberg, Volume–I– Molecular spectra and Molecular Structure.(1966)
3. VibrationalSpectroscopy–D.N.Sathyanarayanan,NewageinternationalPvt.Ltd.(1996)
4. Spectroscopy of Organic compounds -P.S.Kalsi- New age International Publishers (2004).
5. Molecular Spectroscopy– Jack D. Graybeal –Hill International editions, 1988.
6. Vibrational Spectroscopy- D.N.Sathyanarayana- New age International Publishers (2004).
7. Spectroscopy–Pavia, Lampman, Kriz, vyvyan – India edition (2007).
8. Organic spectroscopy– William kemp–Indian edition (2009).

9. Organic spectroscopy- L.D.S. Yadav- Anamaya Publishers(2005)

Web Resources:

1. www.anadolu.edu.tr
2. www.swinburne.edu.au
3. http://www.ifpan.edu.pl ›

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the different types of spectroscopy and its importance	K_1
CO2	**Comprehend** the theory of spectroscopy and its techniques	K_2
CO3	**Apply** the concept of quantum mechanics to solve the molecular problems	K_3
CO4	**Analyse** the structure of molecules based on the theoretical concepts of spectroscopy	K_4
CO5	**Determine** the properties of molecules using spectra	K_5
CO6	**Predict** the structure of new molecules using IR & NMR Spectroscopy	K_6

Mapping of COs with POs

CO	PO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO 1	S	S	S	S	S
CO 2	S	S	S	S	M
CO 3	S	S	S	S	S
CO 4	S	S	S	S	M
CO 5	S	S	S	S	S
CO6	S	S	S	S	S

Programme Title : M.Sc. Physics
Course Title : Elective – II: INSTRUMENTATION AND CHARACTERIZATION TECHNIQUES
Course Code : 21PPHEC2 **Hours/Week : 4**
Semester : III **Credits: 3**
Course Objective :

Instrumental methods of analyses plays important role in day to day life. This paper presents different types of instrumental methods of analyses available and their working.

SYLLABUS

UNIT - I (Hours: 12)

TRANSDUCERS AND SENSORS

Definitions for Transducer and sensors - Classification – Strain gauge – gauge factor – resistance - Strain gauge theory – Construction of electrical resistance strain gauge – Bridge circuit for strain measurements – measurement of Displacement – LVDT – Construction – advantages – disadvantages – uses- Capacitive transducers – Capacitance equation – Measurements of angular displacements – Differential capacitive Displacement transducer – Advantages , disadvantages, uses – Measurement of non-electrical quantities – Thermistor –Characteristics – Measurement of force using strain gauge – Sensor Systems Performance and terminology - Potentiometer sensors -body temperature measurements using sensors.

UNIT - II (Hours: 12)

DIGITAL AND ANALYTICAL INSTRUMENTATION

Principle – block diagram and working of digital frequency counter, digital multimeter, digital pH meter, digital conductivity meter, digital storage oscilloscope.

Elements of analytical instrument – absorption spectrometry – Absorption instrument – Essential components – prism Monochromator – grating monochromator – Photo voltaic cell – Photo emissive cell – Photo multiplier tube (PMT) -Principle, block diagram, description - working and applications of UV-VIS spectrometer-Flame emission spectrometer- ICP-AES Spectrometer – Basic concepts of chromatography.

UNIT - III (Hours: 12)

BIOMEDICAL INSTRUMENTATION

Introduction to Biomedical instruments - Resting and action potentials – Bio potential - Electrodes – Electrode theory – Classification – Physiological transducers to measure blood pressure -Biomedical Recorders -EEG-Principle and Working -Output Measurements – ECG Principle and Working - Patients Monitoring system - Blood Flow Measure ment and Cardiac - Biomedical Telemetry - Telemedicine Technology - Clinical Laboratory Instruments- Blood Gas Analyzers - Blood cell Counters.

UNIT - IV (Hours: 12)

STRUCTRAL AND ELEMENTAL ANALYSIS

XRD Instrumentation and its application for analysis of crystalline structure of thin films – NMR Instrumentation- Analytical Applications of NMR- HNMR: Chemical structure

identification of solids and liquids containing Hydrogen - C-NMR: Chemical structure identification of compounds and mixtures in solids and liquids containing Carbon.

Elemental analysis: CHN-identification of composition of C, H and N in an organic compound -Electron Spin Resonance Spectroscopy instrumentation and applications– EDAX Instrumentation and applied to analyse the elemental composition of materials-XPS: Measurement of composition, chemical and electronic states of materials.

UNIT - V (Hours: 12)

THERMALAND SURFACE ANALYSIS

Thermal Analyzer for Identification of the stages of thermal decomposition of materials by TG and DTG - Examination of phase changes and melting point of materials by DTA and DSC.

Surface Analysis by SEM: Analysis of surface defects in single crystal and morphology and size of micro particles - Identification of morphology of nano materials by TEM - Determination of crystalline structure of nano materials HR-TEM - Examine the surface of single crystals by etching using optical microscopy.

Books for Study:

1. Electrical and electronics measurement and instrumentation - A. K. Sawhney, Dhanpat & sons, 2000.
2. Instrumentation – V.Ramasamy, Sowmi Publications,2005.
3. Nanotechnology - S. Shanmugam, MJP publishers, 2010
4. Biomedical Instrumentation - Dr.R.S. KhandpurTMH Publication, New Delhi, 1992.

Books for Reference:

1. Electronic measurements and instrumentation - Dr.Rajendra Prasad, Khanna publications, 2003.
2. Electronics measurements and instrumentations-S. M. Dhir, Khanna publications, 2002.
3. Electronics measurements and Instrumentation - S. Ramachandran, Khanna publishers, 2002.
4. Nanotechnology - S. Shanmugam, MJP publishers, 2010.
5. Biomedical instrumentation - M. Arumugam, Anuradha agencies, Kumbakonam, 2000.
6. Instrumental method of analysis -.Hobart H.Willard, Lynne L. Merritt, John A. Dean, Frank A. Settle – 6th edition- CBS publisher, New Delhi

Web Resources:

1. http://www.kelm.ftn.uns.ac.rs/literatura/si/pdf
2. https://www.britannica.com/technology/microscope
3. https://www.accessengineeringlibrary.com/browse/handbook–of–biomedical–Instrumentation–third–edition
4. https://www.sciencedirect.com/book/9780080523606/encyclopedia-of-materials-characterization#book-info
5. https://onlinelibrary.wiley.com/doi/book/10.1002/97804706977

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Describe** the basic theories of Transducers, sensors and chromatography.	K_2
CO2	**Explain** the working of digital, analytical and biomedical instrumentations.	K_4
CO3	**Apply** the knowledge of spectrometers for various applications.	K_3
CO4	**Demonstrate** the principles of analytical instruments to **examine** the various types of materials.	K_2,K_5
CO5	**Compare** and contrast the DTA and DSC instrumentation.	K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	M	M	S
CO 2	S	S	M	S	M
CO 3	M	S	M	S	S
CO 4	S	M	S	M	M
CO 5	S	S	M	S	S

Programme Title : M.Sc. Physics

Course Title : Elective – II: CRYSTAL GROWTH TECHNIQUES

Course Code : 21PPHESC2 **Hours/Week : 4**

Semester : III **Credits: 3**

Course Objective :

The aim of the course is to describe the fundamentals of Crystal growth, different methods of growing crystals, characterization of crystals and its applications

SYLLABUS

UNIT - I (Hours: 12)

CRYSTAL GROWTH PHENOMENA

Introduction – Nucleation – Theories of Nucleation – Classical theory of nucleation – Gibbs Thomson equation for vapour – modified Thomson's equation for melt – Gibbs Thomson equation for solution – energy of formation of a nucleus – spherical nucleus – Cylindrical nucleus – Heterogeneous nucleation – cap shaped nucleus – Disc shaped nucleus.

UNIT - II (Hours: 12)

KINETICS OF CRYSTAL GROWTH

Introduction – Singular and rough faces – models on surface roughness – The Kossel , Stranski, Volemr (KSV) Theory – The Burton, Cabera and Frank (BCF) theory – Periodic Bond Chain theory.

UNIT - III (Hours: 12)

SOLUTION GROWTH

Slow Evaporation Technique

Low temperature solution growth: Solution , Solubility and super solubility – Expression of Super saturation – methods of crystallization – crystallization by slow cooling of solutions – crystallization by solvent evaporation – Temperature gradient method – Crystal Growth system : Constant temperature bath – Crystallizer – filtration assembly – seed, seed mount platform and crystal revolution unit – Seed preparation mounting and reasoning: Solution preparation and reasoning – Initial growth and cooling rate.

Gel Growth

Introduction – principle of gel growth various types of gel – structure of gel – Growth of crystals in gels – Importance of gel technique.

UNIT - IV (Hours: 12)

CRYSTAL GROWTH TECHNIQUE AT HIGH TEMPERATURE

Crystal Growth from the melt

Bridgeman Technique – Czochralski Technique Verneuil Technique – Zone melting technique.

Vapour Growth

Physical Vapour deposition – Chemical Vapour deposition – MOCVD – Advantages of CVD – Disadvantages of CVD.

UNIT - V (Hours: 12)

CHARACTERIZATION OF CRYSTALS

UV–VIS–NIR–FTIR–FT Raman – TGA – DTA – DSC – X–ray Spectrograph – EDAX – NLO studies.

Application

UV, VIS, IR filters –optical and thermal sensors– Modulation in fibre optics

Books for Study:

1. Crystal growth processes and methods – Dr.P.Santhana Raghavan, Dr.P.Ramasamy – KRV Publications.
2. Elementary crystal Growth – K. Sangwal, Saan Publisher, UK (1994).
3. Crystal Growth Process – J.C. Brice, John Wiley Publications, New York (1996).

Books for Reference:

1. Modern Crystallography – III – Crystal Growth in Solid State – A.A. Chernov, Springer series, New York, 1984.
2. Progress in crystal Growth Characterisation – B.R. Pamplin, Pergamon Press Ltd, UK.

Web Resources:

1. https://en.wikipedia.org/wiki/Crystal_growth
2. https://link.springer.com/chapter/10.1007/978–3–540–74761–1_1

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the concepts of thermodynamics and kinetics to nucleation, crystal growth and epitaxy.	K_1
CO2	**Analyse** the relation between growth parameters and the quality and properties of the grown material.	K_4
CO3	**Understand** the recent intricate theories of rigid body dynamics ,small oscillations and statistical mechanics	K_2
CO4	**Apply** the concepts of Statistical Mechanics to various physical phenomena.	K_3
CO5	**Evaluate** the various characterization techniques of crystals and applications of crystals in day to day life.	K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	S	S
CO 2	S	S	M	S	S
CO 3	S	S	S	S	S
CO 4	S	S	S	S	S
CO 5	S	S	M	S	S

Programme Title : M.Sc. Physics

Course Title : Elective – III: MATERIALS SCIENCE

Course Code : 21PPHEC3 **Hours/Week : 4**

Semester : III **Credits: 3**

Course Objective :

To enhance the knowledge about the physics of new materials and describe the properties of condensed systems.

SYLLABUS

UNIT - I (Hours: 12)

IMPERFECTIONS IN CRYSTALS

Classification of imperfections – Point defects – Lattice Vacancies and interstitial atoms (Schottky defect) – Frenkel defect – Equilibrium concentration of point defect – Colour centres – F – centres, F' centres – Line defects – definition of dislocation – Edge and Screw dislocation – Burger's Circuit – Dislocation motion – Strain due to dislocation motion - Stress fields around dislocation – Plane defects – Grain boundaries dislocation.

UNIT - II (Hours: 12)

MAGNETISM

Introduction- Review of Basic Concept and Formulae- Paramagnetism – Quantum Theory –Quenching of Orbital Angular Momentum– Ferromagnetism-Classical Theory of Ferromagnetism - Spontaneous Magnetization – Weiss Theory – Temperature Dependence of Spontaneous Magnetization – Heisenberg Interpretation of Weiss Field – Ferromagnetic Domains – Evidence – Origin of Domains – Bloch Wall - Thickness and Energy.

UNIT - III (Hours: 12)

ANTIFERRO, FERRIMAGNETIC AND FERROELECTRICS MATERIALS

Anti Ferromagnetism

Molecular Field Theory - Anti Ferromagnetic susceptibility above Neel Temperature- Neel Temperature- Anti Ferromagnetic susceptibility below Neel Temperature.

Ferrimagnetic Materials:

Introduction-Structure of Ferrites- The Saturation Magnetism- Curie Temperature and Susceptibility of Ferrimagnets.

Ferroelectrics Materials

Ferro electricity – General properties -Dipole Theory of Ferroelectricity – Classification of Ferroelectric materials- Ant ferroelectricity - Ferroelectric domains – Piezoelectricity.

UNIT - IV (Hours: 12)

THERMAL PROPERTIES OF SOLIDS

Introduction- Specific Heat: Classical Theory (Dulong And Petit Law)- Einstein Theory-Debye's Theory-Density of Vibrational Modes-Debye Approximation- Heat Capacity of an Array of N Identical Atoms- Modification of Debye's Theory – Anharmonic Crystals Interaction – The Gruneisen Relation- Lattice Thermal Conductivity of Solids.

UNIT - V (Hours: 12)

NANOMATERIALS

Introduction –Generation of Nanoscience and Nano Technology-Quantum confinement-surface to volume ratio - Classification of Nanomaterials – 1D, 2D and 3D nanostructures-Quantum dots – Properties :Electrical, Mechanical , Magnetic and Optical Properties - Synthesis of nanostructure and materials: Top down and Bottom up approach-Photolithography- Particle confinement - Chemical vapor deposition (CVD - Size quantization effects – Charge transfer processes –-Application of Nanomaterials: medical-chemical-energy conservation-information and communication-industry.

Books for Study:

1. Solid State Physics – S.L.Gupta & Dr.V.Kumar, K.Nath & Co., Meerut (2017-2018).
2. Solid State Physics –S.O.Pillai- New AGE international publications (2018).
3. Essentials in Nanoscience and Nanotechnology- Narendra Kumar, Sunita Kumbghat, John Wiley & Sons, 2016.
4. Charles P. Poole and Frank J. Owens, "Introduction to Nanotechnology", John Wiley and Sons, New Delhi, 2003

Books for Reference:

1. Fundamentals of Solid State Physics - Saxena Gupta and Saxena, Pragati Prakashan,Meerut,2003.
2. Solid State Physics -R.L.Singhal, Kedar Nath Ram Nath, 2019.
3. Introduction to Solid State Physics -Charles, Kittle 7th edition.

Web Resources:

1. https://swayam.gov.in/nd1_noc19_mm20/preview
2. https://nptel.ac.in/courses/115/104/115104109/
3. https://nptel.ac.in/courses/118/104/118104008/

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the basic elements of physics of solids	K_1
CO2	**Describe** the concepts of crystal defects and the properties of magnetic, nanomaterials	K_2
CO3	**Solve** the problems based on the concepts of materials science	K_3
CO4	**Classify** the materials based on their properties like magnetic, thermal and ferroelectric.	K_4
CO5	**Assess** various theories of materials.	K_5
CO6	**Synthesize** new materials for next generation applications using nanotechnology and characterize	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO1	S	S	S	S	S
CO 2	S	S	S	M	S
CO 3	S	S	S	S	S
CO 4	S	S	S	S	S
CO 5	S	S	S	M	S
CO6	S	S	S	S	S

Programme Title : M.Sc. Physics
Course Title : Elective – III: INSTRUMENTAL METHODS OF ANALYSIS
Course Code : 21PPHSEC3 **Hours/Week : 4**
Semester : III **Credits: 3**
Course Objective :

Instrumental methods of analyses plays important role in day to day life. This paper presents different types of instrumental methods of analyses available and their working.

SYLLABUS

UNIT - I (Hours: 12)

ERRORS AND ANALYSIS OF EXPERIMENTAL DATA

Types of errors – Mean, Variance and standard deviation, standard deviation of standard deviation – Sampling techniques – Chi square test.

EXPERIMENTAL STRESS ANALYSIS

Stress analysis by strain gauging – High temperature strain gauge techniques – Photo elasticity and holography.

UNIT - II (Hours: 12)

THERMAL ANALYSIS

Introduction – Thermo gravimetric analysis – Instrumentation of weight loss and decomposition products – Differential scanning calorimetric – Instrumentation – Specific heat capacity measurements – Determination of thermo chemical parameters – Differential thermal analysis – Basic principles – Melting point determination and analysis.

UNIT - III (Hours: 12)

X–RAY ANALYSIS

Single Crystal and Powder diffraction – Diffractometer – Interpretation of diffraction patterns – Indexing – Unknown and phase identification – Double and four crystal Diffractometer for epitaxial characterization – Lattice mismatch – Tetragonal distortion – Thin film characterization – X–ray fluorescence spectroscopy – Uses.

UNIT - IV (Hours: 12)

OPTICAL METHODS AND ELECTRON MICROSCOPY

Photoluminescence – Light – Electroluminescence – Instrumentation – Photo reflectance – Electronic transitions – Behaviour of electronic transitions as a function of electric field. Principles of SEM. TEM, EDAX,AFM,EPMA – Instrumentation – Sample preparation – Analysis of materials – Study of dislocations – Ion implantation – Uses – Nanolithography.

UNIT - V (Hours: 12)

ELECTRICAL METHODS

Hall Effect – Carrier density – Resistivity – Two probe and four probe methods – Scattering mechanism – Vander pauw method – CV characteristics – Schottky barrier capacitance – Impurity concentration – Electrochemical CV profiling – Limitations.

Books for Study:

1. Willard. M, Steve.D, Instrumental Methods of Analysis, CBS Publishers, New Delhi(1986).

2. Strading, R.A, Electron microscopy and microanalysis of crystalline materials, Applied Science Publishers, London (1979).

Books for Reference:

1. Belk. J.A, Electron microscopy and microanalysis of crystalline materials, Applied Science publishers, London (1979).
2. Philips V.A, Modern metallographic techniques and their applications, Wiley Interscience (1971 hill (1).

Web Resources:

1. http://www.researchgate.net>topic>ins.,
2. http://global.oup.com>product>instru...

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Relate** types of errors in analysis and their evaluation	K_2
CO2	**Summarize** the basic principle, working and instrumentation of various analytical tools	K_2
CO3	**Apply** various analytical methods to study the structural, electrical, optical and thermal properties of materials	K_3
CO4	**Analyse** the data obtained from various analytical tools.	K_4
CO5	**Interpret** and communicate an analytical result	K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	M	M	M
CO 2	S	S	S	S	S
CO 3	S	S	S	S	S
CO 4	S	S	S	S	S
CO 5	S	S	S	S	S

Programme Title : M.Sc. Physics

Course Title : CORE PRACTICAL – III

Course Code : 21PPHQC3 **Hours/Week : 8**

Semester : III **Credits: 4**

Course Objective :

The aim of the course is to

- Give exposure to experimental techniques in Electronics, Micro Processor and Micro Controller and Interfacing Devices so that they can verify some of the things read in theory here or in earlier classes and develop confidence to handle sophisticated equipment.
- Impart the broad knowledge of experimental methods and measurement techniques.

SYLLABUS

Students are expected to perform at least 13 experiments out of the following list.

Hours: 120

1. CDS – Copper and Iron arc spectrum.
2. Laser diffraction at a straight edge and circular aperture.
3. Velocity and Compressibility of the given liquids using Ultrasonic Interferometer
4. Multiplexer and Demultiplexer using ICs
5. Studies of Shift register, Ring and Johnson counters using IC 7473
6. Four bit binary adder, Subtractor and BCD adder.
7. C Programs
    1. to check the LCR circuit and to find the frequency of oscillation
    2. to accept initial Velocity (u) acceleration (a)& time (t) and print the final velocity (v) and the distance (s)travelled
8. C programs
    1. Numerical Differentiation by Fourth order Runge Kutta method
    2. Numerical integration by Simpson 1/3 Rule and Trapezoidal Rule
9. Microprocessor Interfacing– Analog to digital & Digital to Analog conversion
10. Microprocessor Interfacing -Waveform generation
    (Square wave, triangular wave and rectangular wave)
11. Microcontroller Programs – Arithmetic operations.
12. Microcontroller Programs
    1. To find the biggest number and smallest number
    2. To arrange numbers in Ascending and Descending order
13. Microprocessor-Traffic control Interface
14. Microprocessor-Seven Segment LED display interface
15. Determination of Hall co-efficient, carrier mobility, carrier density of the given crystal
16. Determination of Band Gap Energy of a given material - UV-Visible Spectrophotometer
17. Flip Flops –JK, Master- Slave, and T flip Flops
18. Determination of thickness of wire using laser

Books for Study:

1. Practical Physics and Electronics- C.C.Ouseph, U.J.Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., 2007.
2. Programming in Ansi C - E.Balagurusamy, Tata McGraw Hill, 2008.
3. Advanced Practical Physics- Ghosh, New Central Book Agency, 1997.
4. Microprocessor Architecture, Programming and Application with 8085-Ramesh S.Gaonkar, Wiley Eastern,2000.
5. Fundamentals of Microprocessor and Microcontroller-B.Ram, 2011.

Books for Reference:

1. Microprocessor and its Application- A.Nagoor Kani, RBA Publications, 2004.
2. Microprocessor- Gillmore, TMH Editions, 1997.
3. Microprocessor and interfacing-DoughlasV.Hall, TMH, 2006.
4. Microcontrollers (Theory and Applications)-Ajay V. Deshmuk, TMH, 2007.

Web Resources:

1. http://iitg.ac.in/subhasht/ph511%20July-Dec-2015/Manual%20PH511.pdf
2. http://dusty.physics.uiowa.edu/~goree/teaching/29_128_manual_01_07_v2.pdf

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Make measurements, analyse and interpret** the experimental data with techniques of advanced general experiments.	K_3, K_4
CO2	**Use** the 8085 microprocessor for interfacing devices.	K_3
CO3	**Design** electronics circuits.	K_5
CO4	**Apply C** language to **solve** problems in Physics.	K_3, K_5
CO5	**Perform** scientific experiments as well as accurately record and **analyse** the results of the performed experiments.	K_4

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	M	M
CO 2	S	S	S	M	M
CO 3	S	S	S	M	M
CO 4	S	S	S	M	M
CO 5	S	S	S	M	M

Programme Title : M.A. / M.Sc.

Course Title : EDC: COMMUNICATION SYSTEMS

Course Code : 21PPHEDC Hours/ Week : 4

Semester : III Credits: 4

Course Objective :

The aim of the course is to describe communication system that enable transfer of information from one source to another and also to understand the prevailing nature of communication media.

SYLLABUS

UNIT - I (Hours: 12)

COMMUNICATION FUNDAMENTALS (BLOCK DIAGRAMS ONLY)

Communication – Communication systems – Electromagnetic spectrum – Radio broadcasting – Radio transmitter – Modulation – Need for modulation – Types of modulation - Amplitude modulation (AM) – Frequency modulation (FM) and Phase modulation (PM) – Explanation with waveforms only – Advantages of FM over AM – Demodulation – Radio receiver – Super heterodyne receiver.

UNIT - II (Hours: 12)

RADAR (BLOCK DIAGRAMS ONLY)

Basic principles of Radar – Transmission and reception - Automatic tracking Radars

TELEVISION (BLOCK DIAGRAMS ONLY)

Elementary concepts of TV transmitter and receiver – Camera tube (Iconoscope) – Scanning Synchronization TV channels - Colour mixing principle (additive and subtractive) – transmission and reception of colour signals – Picture tube – Delta gun colour picture tube.

UNIT - III (Hours: 12)

MOBILE COMMUNICATION

Need for Mobile communication – Requirements of mobile communication – History of mobile communication – Properties of wireless medium – Radio propagation – Reflection, scattering and diffraction in propagation – Propagation coverage calculations – Cellular structure – Frequency reuse – System architecture – Authentication centre - Home location register – Visiting location register – Equipment identify register – Base station system - Advantages And disadvantages of using cellular mobile system.

UNIT - IV (Hours: 12)

SATELLITE COMMUNICATION

Evolution and Growth of communication satellites – The satellite orbit – Geostationary orbit – Linkages – Assignable satellite frequencies – Satellite construction or equipment on satellite – Special purpose satellites – Indian space centres and the Indian satellite systems.

UNIT - V (Hours: 12)

FIBRE OPTIC COMMUNICATION

Introduction – Structure of optical fibres – Light propagation through fibres – Classification of optical fibres – Fabrication of optical fibres – Optical couplers, splicers and fibre sensors – Advantages of optical fibres – Application of fibre optic communications – Fibre optic communication systems.

Books for Study:

1. Electronic communication Systems 3rd edition - George Kennedy, Tata Mc GRAW HILL Publishing company,1991
2. Hand book of Electronics - Gupta & Kumar, PragatiPrakashan, 2008.
3. Electronics fundamentals and applications - D. Chattopadhyay and P. C. Rakshit, New Age International, 2008.
4. Basic Electronics Solid state - B. L. Theraja, S. Chand & Co., 2006.
5. Wireless and mobile communication – T. G. Palanivelu, PHI Learning Pvt. Ltd, 2011.
6. Principles of Electronics – V.K. Mehta, S.Chand & Co, 11th edition, 2008.
7. Applied Electronics – A. Subramaniyam, National Publishing House, 2nd edition, 2003.
8. Monochrome and Colour Television- R.R. Gulati, New Age International Pvt Ltd, 2002.

Books for Reference:

1. Electronic Communication 4th edition - Dennis Roddy and John Coolen, Prentice Hall of India, 2009.
2. Communication Electronics - N. D. Deshpande, D. A. Deshpande and P. K. Rangole, TMH, 2001.

Web Resources:

1. NPTEL Electronics And Communication Engineering Video Lecture... https://www.btechguru.com/courses--nptel--electronics-and-communication-engineering

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the concepts of various communication systems	K_1
CO2	**Outline** the basic theories behind television, radar, satellite, mobile and fibre optic communication	K_2
CO3	**Demonstrate** the working of communication systems	K_3
CO4	**Analyse** the problems and limitations related to communication systems	K_4

Programme Title : **M.Sc. Physics**

Course Title : **NUCLEAR AND PARTICLE PHYSICS**

Course Code : **21PPHC10** **Hours/Week : 6**

Semester : **IV** **Credits: 5**

Course Objective :

The aim of the course is to provide better understanding of the structure and properties of the nucleus, nuclear interaction, radioactive decay, nuclear models and the interaction of nuclear radiation with matter; and develop an insight into the building block of matter along with the fundamental interactions of nature.

SYLLABUS

UNIT - I (Hours: 18)

NUCLEAR PROPERTIES AND INTERACTION

Determination of Nuclear radius – Electrical radius method:mesonicX-rays-Electron Scattering–Coulomb energies of mirror nuclei–Nuclear matter methods: Rutherford's theory of α-scattering-Isotopic shift in line spectra– Ground state of deuteron –Wave Mechanical theory- square well potential– range-depth– excited states of deuteron – p-p & n-p scattering at low energy (partial wave analysis)– Spin dependence - scattering from molecular hydrogen and determination of singlet and triplet scattering lengths –Non-central forces-Saturation of Nuclear forces: Exchange forces.

UNIT - II (Hours: 18)

NUCLEAR DECAY

α-decay: Geiger-Nuttal law – α-particle Spectra-Gamow's theory ofα-decay – β-decay: Neutrino hypotheses-direct and indirect method of measuring neutrino energy-Fermi's theory of β-decay– Fermi –kurie plot –Fifthpower law-Kurieplot–Fermi & GT-Selection rules – Allowed and forbidden decays-violationof parity conservation in β decay–γ-decay: internal conversion – Nuclear isomerism–Angular correlation in gamma emission.

UNIT - III (Hours: 18)

NUCLEAR REACTION AND MODELS

Compound Nucleus – energy level – level width and de excitation – Breit and Wigner single level formula – Nuclear models: Liquid drop model – Shell model- Evidence for magic number –extreme Single Particle Model: square well potential of infinite depth –Harmonic oscillator potential–spin orbit potential– predictions of shell model.

UNIT - IV (Hours: 18)

NUCLEAR ENERGY

Fission:

Energy released in fission–Energy and Mass distribution–Emission of neutrons-Fissile and fissionable nuclides –Test of fissionability– Bohr-Wheeler's theory of nuclear fission- Fission chain reaction (Four Factor Formula)-Controlled fission: General aspects of reactor design – Reactor theory and critical size

Fusion:

Source of stellar energy– Basic fusion processes– Controlled thermonuclear reactions –Plasma confinement.

Nuclear reactors:

Research reactors in India **(**Apsara, Cirus, Purnima**)** – Production reactors – Power reactors in India(RAPS.MAPS.NAPSKAPS,KAIGA,TAPS etc.)-Nuclear energy and social development.

UNIT - V (Hours: 18)

ELEMENTARY PARTICLES

Elementary particles – conservation laws –Isospin– strangeness – Hyper charge– charge conjugations – parity invariance – combined inversion CP – Time reversal – combined inversion of CPT – Violation of parity conservation in weak interaction – symmetry multiples of Hadrons – SU(2) – SU(3) multiplets — Gell– mann Okubo mass formula for SU(3) multiplets– Quarks –Quark Gluon model –classification of isotopic multiplets on Quark model.

Books for Study:

1. Nuclear physics by D.C.Tayal, Himalaya Publishing House, 2009.
2. Elements of Nuclear Physics by M.L.Pandya and R.P.S.Yadav, Kedarnath Ramnath Publishing, 2009.
3. Nuclear Physics by R.R.Roy and B.P.Nigam, Wiley Eastern Ltd.,1993.
4. Nuclear Physics byR.C.Sharma, KedarnathRamnath& Co., 1992.
5. Basic Nuclear Physics by Dr.B.N.Srivastawa, Pragatiprakashan, 1990.

Books for Reference:

1. V. Devanathan, Narosa publishing House,2006.

Web Resources:

1. http://www.freebookcentre.net/Physics/Nuclear-Physics-Books.html
2. https://www.pdfdrive.net/introduction-to-nuclear-and-particle-physics-34369147.html
3. https://nptel.ac.in/courses/115/104/115104043

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recollect** higher level concepts of nuclear and particle physics	K_1
CO2	**Comprehend and interpret** all aspects of the nuclear decay, nuclear models, fission, fusion and wide variety of reactor concepts.	K_2
CO3	**Solve** conceptual questions and problems by applying the theory of nuclear models and conservations laws.	K_3
CO4	**Analyse** nuclear structure , nuclear reactions, nuclear decays, symmetry properties and Quark model of elementary particles, nuclear models and its limitations	K_4
CO5	**Determine** transmission probability and reaction cross sections.	K_5
CO6	**Pave** a way for the global energy and environmental needs and research in nuclear physics	K_6

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	S	L	M
CO 2	S	S	S	M	M
CO 3	S	S	S	M	M
CO 4	S	S	S	M	M
CO 5	S	S	S	M	S
CO6	S	S	S	M	S

Programme Title : M.Sc. Physics

Course Title : Elective – IV: COMMUNICATION ELECTRONICS

Course Code : 21PPHEC4 **Hours/Week : 5**

Semester : IV **Credits: 4**

Course Objective :

The aim of the course is to understand about different types of communication systems available and their working in day to day life.

SYLLABUS

UNIT - I (Hours: 15)

ANTENNAS AND WAVE PROPAGATION

Short dipole antenna – Radiation resistance-power radiated by the antenna-Effect of ground on antennas- grounded $\lambda/4$ antenna-Ungrounded $\lambda/2$ antenna - Antenna arrays: Broad side and end fire arrays – Types of wave propagation - ionosphere and its layers – Eccles Larmor theory – Critical frequency - Maximum usable frequency – Skip distance - Expression for skip distance and maximum usable frequency.

UNIT - II (Hours: 15)

MICROWAVE GENERATION (PRINCIPLE AND OPERATION ONLY)

Multi cavity Klystron-Reflex Klystron- Magnetron- Travelling wave tube - MASER-Gunn Diode.

RADAR

RADAR Fundamentals – Range equation- Doppler effect-CW Doppler radar- FMCW radar.

TELEVISION

Colour TV transmitter and receiver – Colour transmission and reception – Colour picture tubes - delta gun picture tube.

UNIT - III (Hours: 15)

DIGITAL COMMUNICATION

Advantages and disadvantages of digital communication – Simple delta modulation-Companded delta modulation - Continuous, variable slope delta modulation-Pulse code modulation technique - Binary coding – Regeneration process - PCM receptors and noise-advantages of PCM-CODECS**.**

DIGITAL DATA TRANSMISSION

Representation of data signal- Parallel and serial data transmission – MODEMS-Repeaters - Digital modulation systems- Amplitude shift keying – Frequency shift keying-Phase shift keying.

UNIT - IV (Hours: 15)

BROAD BAND COMMUNICATION SYSTEMS

Multiplexing - frequency division - time division - Short and medium Haul systems: Coaxial cables- Fibre optic link- Microwave link – Tropospheric Scatter links - Submarine cables.

SATELLITE COMMUNICATION

Satellite orbits and inclination - Geostationary orbit – Attitude control – Satellite station keeping - Uplink power budget calculations – Down link budget calculations - Multiple access methods – Different domestic satellites.

UNIT - V (Hours: 15)

CELLULAR TELEPHONE

Introduction – Mobile telephone service – Evolution of cellular telephone – Cellular Telephone – Frequency reuse – Interference – Cell splitting, sectoring, segmentation and dualization – Cellular system topology – Roaming and handoffs – Cellular telephone network components – Cellular telephone call processing.

MOBILE COMMUNICATION

Need for mobile communication – Requirements of mobile communication – History of mobile communication – Properties of wireless medium – Radio propagation – Reflection, scattering and diffraction in propagation – System architecture.

Books for Study:

1. Hand book of Electronics- Gupta & Kumar, PragatiPrakashan, 2008.
2. Antenna and Wave Propagation -K.D. Prasad, Satya Prakashan, 2007.
3. Electronic Communication Systems - George Kennedy, Bernard Davis, TMH, 1991.
4. Microwave Engineering – Sanjeeva Gupta & others, Khanna Publishers, 6th edition, 2017.
5. Modern Electronic Communication Theory and systems- Ashok Raj, Umesh publications, 1995.
6. Electronics communication – Dennis Roddy, John Coolen, Prentice Hall of India, 2009.
7. Applied Electronics – A. Subramaniyam, National Publishing House, 2nd edition, 2003.
8. Monochrome and Colour Television – R.R.Gulati, New Age International Publishing Company, 2002.
9. Communication Electronics – N.D.Despande, D.A.Despande and P.K.Rangole, TMH, 2001.
10. Wireless and mobile communication – T. G. Palanivelu, PHI Learning Pvt. Ltd. (2011).
11. Electronic Communications system – Fundamentals through advanced-Wayne Tomasi, Pearson Education, 2004.

Books for Reference:

1. Electronics fundamentals and applications - D. Chattopadhyay and P.C. Rakshit, New Age International, 2008.
2. Basic Electronics Solid state -B.L. Theraja, S. Chand & Co., 2006.

Web Resources:

1. NPTEL Electronics and Communication Engineering Video Lecture... https://www.btechguru.com/courses--nptel--electronics-and-communication-engineering

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Describe** the basic concepts of transmission and reception of electromagnetic waves in communication	K_2
CO2	**Demonstrate** the working of various types of communication systems	K_3
CO3	**Analyse** the concepts involved in designing of communication systems	K_4
CO4	**Assess** the appropriate coding and multiplexing techniques	K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	S	S
CO 2	S	S	S	S	S
CO 3	S	S	M	S	S
CO 4	S	S	M	S	S

Programme Title : **M.Sc. Physics**

Course Title : **Elective – IV: PHOTONICS**

Course Code : **21PPHSEC4** **Hours/Week : 5**

Semester : **IV** **Credits: 4**

Course Objective :

The aim of the course is to make the students learn the impact of photonics in fields ranging from nanotechnology to communications in a fundamental level.

SYLLABUS

UNIT - I (Hours: 15)

INTRODUCTION TO PHOTONICS

Description: Photonics and light technology – Scientific topics of Photonics – technical topics – properties of photonics – speed – Energy – Frequency – Wavelength– Moments – Mass – timing – Uncertainty principle for photons – Position and momentum – Energy and time – Frequency and time – Uncertainty of field strength – Gaussian beams – Ray matrices – Deriving Ray matrices – Ray matrices of some optical elements.

UNIT - II (Hours: 15)

LINEAR INTERACTION BETWEEN LIGHT AND MATTER

Refraction – Dispersion – Absorption – Emission – Measurement of absorption – Polarization in refraction and reflection – Relation between reflection absorption and refraction – Birefringence – Optical activity – Diffraction – Diffraction at a one dimensional slit – Diffraction at a two dimensional slit – Diffraction at a circular aperture – Diffraction at one dimensional gratings – Diffraction at a two dimensional gratings – Diffracting at optically thin and thick gratins.

UNIT - III (Hours: 15)

NON–LINEAR INTERACTION OF LIGHT AND MATTER

Non–linear polarization of the medium – second order effects – General second harmonic – Phase matching – Type I and Type II phase match Quasi phase matching – frequency mixing – Parametric amplifiers oscillator – Pockel's effect – electro optical beam deflection – Third order effects –Generation of third harmonics – Kerr effect – Spatial solitons – Stimulated Raman scattering (SRS) – Inverse Raman scattering(IRS) – Stimulated gain spectroscopy(SRGS) – coherent antistokes Raman scattering (CARS) – Higher order non–linear effects.

UNIT - IV (Hours: 15)

LASERS

Principle – Pump mechanism – Quantum defect and efficiency – pumping in diode lasers – Lamp pumping – chemical pumping – resonators – Stable resonators – unstable resonators – Threshold gain and power of laser beams – Laser intensity and power – Q switching – nano second pulses – Active Q switching – passive Q switching – Theoretical description of Q switching.

UNIT - V (Hours: 15)

NON–LINEAR OPTICAL SPECTROSCOPY

Non–Linear transmission measurements – Experimental method – Evaluation of the nonlinear absorption measurement – Variation of excitations wave – variation of excitation pulse width – Variation of spectral width of exciton pulse – Non–Linear emission measurements – Time resolved measurements – White Light generation with fs duration – white light generation with ps duration – Fluorescence in the ns range.

Books for Study:

1. Photonics – Linear and Nonlinear interactions of Laser light and matter – Ralf Men Zel – Springer – New Delhi, 2004.

Books for Reference:

1. Nonlinear optics – R.W.Boyd – Academic press, 1992.
2. The elements of non–linear optics – P.N.Butcher, Cambridge University press, 1990.
3. Hand book of photonics – M.C. Gupta – CRC press, New York, 1997.
4. Non–linear photonics – H.M. Gibbs – Springer – New York, 1990.

Web Resources:

1. www.newport.com/n/gaussian–beam–optics

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the properties of light and laser	K_1
CO2	**Summarize** linear and non-linear interaction between light and matter	K_2
CO3	**Apply** the techniques of Photonics to far–flung reaches of science	K_3
CO4	**Analyse** the problems related to photonics	K_4

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	M	S	S	S
CO 2	S	M	S	S	S
CO 3	S	S	S	S	S
CO 4	S	S	S	S	S

Programme Title : **M.Sc. Physics**

Course Title : **Elective – V: FIBRE OPTICS AND ITS APPLICATIONS**

Course Code : **21PPHEC5** **Hours/Week : 5**

Semester : **IV** **Credits: 4**

Course Objective :

The aim of the course is to make the students learn the nuances of the Optoelectronics and how it can be used for expansion and introduction of new telecommunication services.

SYLLABUS

UNIT - I (Hours: 15)

OPTICALFIBRES

Structure and Properties of Optical fibres– Types. Acceptance angle and acceptance core of a fibre – Numerical aperture (General) –Numerical aperture of a graded index fibre – modes of propagation –Meridional and skew rays–Numbering modes and cut–off parameters eg. Fibres – Single mode propagation – Comparison ofstepandgradedindexfibres– Applicationoffibres–Fibresclassification–steppedindexfibre– Stepped–index monomode fibre– Disadvantage of monomode fibre – Graded index multimode fibre –Plastic fibres.

UNIT - II (Hours: 15)

FIBRE FABRICATION, FIBRE LOSSES

Fibre fabrication–External CVD- Axial Vapour Deposition (AVD) –Internal Chemical Vapour Deposition (ICVD) –Characteristics of all these methods–Fibre drawing and coating–Double–Crucible method–Attenuation in optical fibres–Material loss–Rayleigh Scattering loss–Absorption loss–Leaky modes–Bending losses radiation induced losses–Inherent defect losses–Inverse square law losses – Transmission Losses – Temperature dependence of fibre losses– Core and cladding losses.(any 4)

UNIT - III (Hours: 15)

OPTICAL COUPLERS–SPLICING AND MEASUREMENT ON OPTICAL FIBRES

Types of optical couplers–Biconically tapered direction coupler–Beam splitting directional couplers–T–couplers–Calculation on couplers–splicing–Mechanical Splicing–splicing procedures–Loss comparison–Losses in splices and connectors Measurement of numerical aperture and its related terms–OTDR–Working of OTDR–Applications of OTDR–Fibre loss measurement by OTDR– Limitations – Advantages.

UNIT - IV (Hours: 15)

OPTICAL FIBRE COMMUNICATION, LIGHT SOURCES AND DETECTORS

Introduction–Important applications of Integrated Optic fibre technology–Long Haul communication Coherent optical fibre communication–Principle of coherent detection–comparison of coherent and direct–detection. Introduction–LED–The processes involved in LEDs–Structures of LED – LED materials – Output characteristics of LED – Fibre– LED coupling – Modulation Bandwidth of LED – Spectral emission of LEDs, Photo detectors–characteristics of photo–detectors – Photo emissive photo detectors –Photo conductive devices–Photo–Voltaic devices.

UNIT - V (Hours: 15)

SPECIAL APPLICATIONS

Angular division multiplexing, Analog Link, FDM for multiple channel, WDM, AM for optical fibres, Video link –Satellite link,-Computer Link,-Nuclear reaction link ,CATV-Switched star CATV-Computer networks types –LAN,MAN,WNA, its features, Physical topology, star topology, Mesh topology, Ring topology, Cellular topology-its benefits – transmission types –Asynchronous –Synchronous-Distinction between synchronous and Asynchronous

Books for Study:

1. Optical fibres and fibre optic communication systems –Subir Kumar Sarkar, Fourth revised edition, S. Chand & Co, (2010).
2. Introduction to Fibre Optics-Ajay Ghatak, K.Thyagarajan (2017)
3. Understanding Fibre Optics –Jeff Hecht (2005)

Books for Reference:

1. Optoelectronics and Optical Communication–ArijitSaha and Nilotpal Manna, Publisher by University science (2011).
2. Optical Communication –V.S.Bagad, Technical publication (2009).
3. Fibre optic communication – D.C. Agarwal, S.Chand & company Ltd.(1933)

Web Resources:

1. http://research.psut.edu.jo/Project/Puplications/Optical%20losses.pdf
2. https://en.wikipedia.org/wiki/Optical_time–domain_reflectometer
3. NPTEL LECTURE https://youtu.be/ougKUUM3hJA

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Recall** the basic principle involved in Fibre optic communication	K_1
CO2	**Summarize** the basic concepts in fibre optic communication systems	K_2
CO3	**Apply** the knowledge of optoelectronics in device applications and to solve problems	K_3
CO4	**Analyse** the working of fibre optic cables and its applications	K_4
CO5	**Compare** between the synchronous and Asynchronous means of communication	K_5
CO6	**Predict** the role of optical fibres in communication systems.	K_6

Mapping of COs with POs

CO	PO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**M**	**M**	**S**	**S**	**M**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**L**	**S**	**S**
CO5	**S**	**S**	**L**	**M**	**S**
CO6	**S**	**S**	**S**	**S**	**S**

Programme Title : M.Sc. Physics

Course Title : Elective – V: THIN FILM PHYSICS

Course Code : 21PPHSEC5 **Hours/Week : 5**

Semester : IV **Credits: 4**

Course Objective :

The aim of the course is to enhance the knowledge about the physics of new materials and describe the properties of thin films.

SYLLABUS

UNIT - I (Hours: 15)

PREPARATION OF THE THIN FILM

Nature of thin film– Deposition Technology – Distribution of Deposit – Thermal Deposition in Vacuo – Kinetic theory of Gas and Emission condition – Resistance heating – Thermal Evaporation – Election beam Method.

UNIT - II (Hours: 15)

SPUTTERING AND DEPOSITION SPUTTERING

Cathodic sputtering – Glow discharge sputtering – Low pressure sputtering–Reactive sputtering – R.F.Sputtering – Chemical Vapour Deposition (CVD) – Thermal Decomposition or Pyrolysis – Vapour phase Reaction – Vapour Transportation method – Disproportionation method – Chemical deposition – Electro deposition– Anodic oxidation – Electrodless plating – Deposition by chemical Reaction – Chemical Displacement – Spray pyrolytic process– characterization features of the spray pyrolytic process

UNIT - III (Hours: 15)

FILM THICKNESS AND ITS CONTROL

Mass methods –Microbalance Technique – Crystal oscillator – Optical method – Photometric – Ellipsometry – Interferometry – Other methods–Substrate cleaning.

Microscopic defect and dislocation –Edge dislocation–Screw dislocation – boundary defect– Inter granualar boundary– Twinning –stacking fault– Super lattice and anti–phase boundary – defect crystal and non–stoichiometric compound– surface states and interfacial effect–Removal of defect–Defect and energy state – Donor and Acceptor levels – Trap and Recombination centres – Exciton– Phonon.

UNIT - IV (Hours: 15)

THIN FILM ANALYSIS

Electron diffraction technique–High energy electron diffraction – low energy electron diffraction– Electron microscopy – Spinning electron microscopy – X–ray photoelectron spectroscopy – Mass spectroscopy – Thermodynamics of nucleation – Nucleation theories capillarity model – Atomistic model – Film growth – Incorporation of defects. Impurities etc. in film – Deposition parameters and grain size.

UNIT - V (Hours: 15)

EPITAXY

Epitaxy – Thin film structure – Substrate effect – Epitaxial deposit– Twinning and multiwinning – Phase transition – Dissociation – Film thickness effect – Crystal growth process – Nucleation stage – Epitaxial Stage – Intermediate stage – Final stage.

Books for Study:

1. Thin film fundamentals – A. Goswami– New age international Pvt., Ltd, New Delhi (1996).
2. Thin film phenomena – K.L. Chopra, 1600.

Books for Reference:

1. Hand Book of thin film technology – L.T. Maissel and R. Glang – McGraw Hill Instrumentational Publishers, 1600 (1978).

Web Resources:

1. physics.bu.edu/py106/notes/Thinfilm.html

Course Outcomes (CO): On completion of the course, students should be able to

CO number	CO statement	Knowledge Level
CO1	**Recall** the fundamentals of thin film Physics	K_1
CO2	**Explain** the different methods of preparation of thin films	K_2
CO3	**Solve** simple problems in thin films based on theory	K_3
CO4	**Analyze** the different applications of thin films based on properties	K_4
CO5	**Asses** the relation between deposition technique, film structure and film properties.	K_5

Mapping of COs with POs

CO	PO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**L**
CO3	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**L**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**

Programme Title : M.Sc. Physics

Course Title : CORE PRACTICAL – IV

Course Code : 21PPHQC4 **Hours/Week : 8**

Semester : IV **Credits: 4**

Course Objective :

The aim of the course is to

- give exposure to experimental techniques in Electronics, Micro Processor and Micro Controller and Interfacing Devices so that they can verify some of the things read in theory here or in earlier classes and develop confidence to handle sophisticated equipment.
- Impart the broad knowledge of experimental methods and measurement techniques.

SYLLABUS

Students are expected to perform at least 13 experiments out of following list.

Hours: 120

1. Laser beam parameters - Wavelength and beam divergence
2. C programming
    1. Matrix multiplication
    2. Students' Rank list
    3. Students' Record.
3. Design of binary Weighted and R/2R Ladder DAC using the IC 741.
4. Parity checker, generator, Encoder, decoder.
5. Quincke's method-Magnetic Susceptibility
6. Microprocessor Program– Keyboard display interface
7. Microprocessor Programs – Counters Interface
8. Microprocessor Programs –Stepper motor interface
9. Microcontroller Programs – Counters Interface
10. Microcontroller Programs – Analog to digital & Digital to Analog Conversion interfaces
11. Microcontroller Program - Keyboard display interface
12. Microcontroller Programs - Stepper motor interface
13. Microcontroller Program-Traffic control Interface
14. Microcontroller Program-Seven Segment LED display interface
15. Determination of Numerical aperture of Optical fibre
16. Determination of bond length, bond angle, dihedral angle of organic molecules using Gaussian 09 software
17. Determination of functional groups of organic molecules by IR and Raman Spectra using Gaussian 09 software
18. Determination of refractive index of the liquid using He Ne Laser

Books for Study:

1. Practical Physics and Electronics - C.C.Ouseph, U.J.Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., 2007.
2. Programming in Ansi C - E.Balagurusamy, Tata McGraw Hill, 2008.
3. Advanced Practical Physics- Ghosh, New Central Book Agency, 1997.
4. A Text Book of Practical Physics- S. N. Ganguly, K. P. Basu Publishing, 1960.
5. Microprocessor and its Application-A.NagoorKani, RBA Publications, 2004.

Books for Reference:

1. Microprocessor-Gillmore,TMH Editions,1997.
2. Microprocessor Architecture, Programming and Application with 8085-Ramesh S.Gaonkar, Wiley Eastern, 2000.
3. Microprocessor and interfacing-Doughlas V.Hall, TMH, 2006.
4. Microcontrollers (Theory and Applications)-Ajay V.Deshmuk, TMH, 2007.
5. Fundamentals of Microprocessor and Microcontroller - B.Ram, 2011.

Web Resources:

1. http://iitg.ac.in/subhasht/ph511%20July-Dec-2015/Manual%20PH511.pdf

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Analyze** and **interpret** the experimental data with techniques of advanced general experiments.	K_3 ,K_4
CO2	**Evaluate** and **compare** properties and behavior of magnetic materials.	K_4, K_5
CO3	**Interface** different programmable devices with 8085 microprocessor and 8531 microcontrollers.	K_3
CO4	**Design** and analyze electronic circuits.	K_6
CO5	**Apply** the C language to solve problems.	K_3, K_5

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	M	M
CO 2	S	S	S	M	M
CO 3	S	S	S	M	M
CO 4	S	S	S	M	M
CO 5	S	S	S	M	M

Programme Title : M.Sc. Physics

Course Title : PROJECT AND PROJECT VIVA-VOCE

Course Code : 21PPHPC **Hours/Week : 6**

Semester : IV **Credits: 4**

Course Objective :

The aim is to expose the students to preliminaries and methodology of research in Theoretical and Experimental Physics. Students get the opportunity to participate in some ongoing research activity and development of a laboratory experiment.

Course Outcomes (CO): On completion of the course, students should be able to

CO Number	CO Statement	Knowledge Level
CO1	**Explain** the significance and value of problem in physics to both scientific and societal communities.	K_2
CO2	**Apply** and put to use the methods of analytical, logical , theoretical experimental and scientific reasoning that have been taught in the various subjects to address a relevant real time problem with clear objectives, depth and a well articulated roadmap	K_3
CO3	Critically **analyse** and evaluate experimental strategies, and decide which is most appropriate for answering specific questions.	K_4
CO4	**Evaluate** scientific problems/issues of their interest	K_5
CO5	**Develop** interest to explore the new areas of research in physics and to present and communicate scientific knowledge effectively	K_6

Guidelines for the Project:

- The aim of project work in M.Sc. 4thsemesters is to expose the students to preliminaries and methodology of research and as such it may consist of review of some research papers, development of a laboratory experiment, identification of methodology, fabrication of a device, working out some problem, participation in some ongoing research activity, analysis of data, etc..
- Project work can be in Experimental or Theoretical Physics in the thrust as well as non-thrust research areas of the department.
- A student opting for this course will be attached to one teacher of the department before the end of the 3rd semester.
- A report about the work done in the project (typed on both the sides of the paper and properly bound) will be submitted on the announced date
- Assessment of the work done under the project will be carried out by both the guide and external examiner on the basis of effort put in the execution of the project, interest shown

in learning the methodology, report prepared, grasp of the problem assigned and viva-voce etc. as per course guidelines.

Mapping of COs with POs

CO	PO				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	S	S	S	S	S
CO 2	S	S	S	S	S
CO 3	S	S	S	S	S
CO 4	S	S	S	S	S
CO 5	S	S	S	S	S