CURRICULUM FRAMEWORK AND SYLLABI FOR MASTER OF SCIENCE IN PHYSICS (FOR THE CANDIDATE TO BE ADMITTED FROM THE ACADEMIC YEAR (2018-2019) (UNDER CHOICE BASED CREDIT SYSTEM-CBCS)

DEPARTMENT OF PHYSICS

MOTHER TERESA WOMEN'S UNIVERSITY KODAIKANAL

DEPARTMENT OF PHYSICS

VISION
To catalyze quality achievement in higher learning of Physics

MISSION
To empower women in Physics by the synergetic effect of the faculty.

ABOUT THE DEPARTMENT

Department of Physics has established on 2002 in Mother Teresa Women's University, Kodaikanal. It acts as instrument for spreading higher education in Physics to remote rural areas of Kodaikanal. The Department of Physics was started in the year 2002 with M.Sc Physics with Specialization in Astrophysics, M.Sc Physics with Specialization in Materials Science, M.Phil Physics and Ph.Dprogramme were introduced in the year 2005.

M.Sc. PHYSICS

Programmeoutcomes (POs):

1. To develop an ability to become a specialist in various areas of Physics and apply the same in day to day life.
2. To acquire knowledge about the nature, concepts, methods, techniques and objectives in the core physics subjects
3. To make the students in mastering in the field of materials science and astrophysics and prepare them for research
4. To cultivate scientific approach and culture of research aptitude.
5. To enhance the problem solving skills of the students so that they will be able to tackle the national level competitive exams like NET, GATE and SET etc
6. To understand the links of Physics to other disciplines and also to the societal issues.
7. To train the students to develop their skill development, employability and entrepreneurship skills

Program specific outcomes:

1. Understand and apply inter disciplinary concepts of Physics for understanding and describing the natural phenomenon
2. Provide basic foundations with a sound knowledge of underlying principles along with recent developments

3.Enable students to work with state-of-the art technologies

4. Ability to plan and execute their own innovative ideas in the form of projects, product

design and development.

5. Know about the importance of research methodology in science by acquiring knowledge in the form of project, summer internship and field visit/industrial visit.

SYLLABUS (for candidates admitted from 2018 onwards)

ELIGIBLITY: B.Sc. Physics, Applied Physics, with Mathematics as allied subject at the UG level

MEDIUM: English

S. No.	Subject Code	Subject	Hrs/ Week	Total Credits	Int	Ext	Total
First Semester							
1	PPHT11	Mathematical Physics I	5	5	25	75	100
2	PPHT12	Classical Mechanics	5	5	25	75	100
3	PPHT13	Applied Electronics	5	5	25	75	100
4	PPHP11	Electronics Practical I	6	5	25	75	100
5	PPHE11	Astrophysics/ Numerical methods	5	5	25	75	100
		Total	***26***	***25***			**500**
Second Semester							
6	PPHT21	Mathematical Physics II	*5*	*5*	25	75	100
7	PPHT22	Quantum Mechanics I	5	5	25	75	100
8	PPHT23	Statistical Mechanics and Thermodynamics	5	5	25	75	100
9	PPHP22	General Practical II	6	5	25	75	100
10	PPHE22	Materials Characterization/ Microprocessor	5	5	25	75	100
		Total	***26***	***25***			**500**
Third Semester							
11	PPHT31	Electromagnetic Theory	*5*	*5*	25	75	100
12	PPHT32	Quantum Mechanics II	*5*	*5*	25	75	100
13	PPHT33	Solid State Physics	*5*	*5*	25	75	100
14	PPHP33	Practical III	*6*	*5*	25	75	100
15	PPHE33	Materials Science/Solar Cells	*5*	*5*	25	75	100
		Total	***26***	***25***			**500**
Fourth Semester							
16	PPHT41	Spectroscopy	*5*	*5*	25	75	100
17	PPHT42	Nuclear and Particle Physics	*5*	*5*	25	75	100
18	PPHP44	Project & viva-voce	*18*	*5*	25	75	100
		Total	***28***	***15***			**300**
Grand Total			***106***	**90**			**1800**

PPHT11 **Mathematical Physics I** **5hrs/5credit**

Cognitive level:

K2: Understand

K3: Apply

K4: Analyze

Objective:

- Different order ODE's are introduced and solved problems in Physics.
- Special functions learnt.
- Laplace transform are introduced
- It will be applied in all mathematical concepts in various courses.

Unit 1 First-Order ODEs (9 hrs)

Basic Concepts. Modeling - Geometric Meaning of y' = f(x, y). Direction Fields - Separable ODEs - Exact ODEs. Integrating Factors - Linear ODEs.Bernoulli Equation. Population Dynamics - Orthogonal Trajectories. Optional - Existence and Uniqueness of Solutions

Unit 2 Second-Order Linear ODEs (9 hrs)

Homogeneous Linear ODEs of Second Order - Homogeneous Linear ODEs with Constant Coefficients - Differential Operators. Optional –Modeling: Free Oscillations. (Mass-Spring System) - Euler-Cauchy Equations - Existence and Uniqueness of Solutions. Wronskian - Nonhomogeneous ODEs - Modeling: Forced Oscillations. Resonance -Modeling: Electric Circuits - Solution by Variation of Parameters.

Unit 3 Higher Order Linear ODEs (8 hrs)

Homogeneous Linear ODEs - Homogeneous Linear ODEs with Constant Coefficients - Nonhomogeneous Linear ODEs

Unit 4 Series Solutions of ODEs. Special Functions (10 hrs)

Power Series Method - Theory of the Power Series Method - Legendre's Equation .Legendre Polynomials - Frobenius Method - Bessel's Equation.Bessel Functions - Bessel Functions of the Second Kind - Sturm-Liouville Problems. Orthogonal Functions - Orthogonal Eigen function Expansions

Unit 5 Laplace Transforms (12 hrs)

Laplace Transform. Inverse Transform.Linearity.s-Shifting - Transforms of Derivatives and Integrals. ODEs -Unit Step Function's-Shifting - Short Impulses. Dirac's Delta Function. Partial Fractions - Convolution. Integral Equations - Differentiation and Integration of Transforms. - Systems of ODEs -Laplace Transform: General Formulas.

Book for Study

Unit 1-5 - Chapter 1-3,5,6-Advanced Engineering Mathematics – Erwin Kreyszig, 9th Edition, John Wiley and Sons, Inc. 2006.

Books for Reference

Mathematical Methods for Physicist - George B. Arfken, Hans J. Weber, 6th Edition, Elsevier Academic Press, 2005.
Mathematical Physics – P.K. Chattopadhyay – Wiley Easter, (1990)
Introduction to Mathematical Physics – Charlie Harper – Prentice Hall India (1987) New Delhi
Applied Mathematics for Engineers and Physicists, III Edn. – Pipes &Harveill 0 McGraw Hill (1971)

Course Outcomes (CO):

CO1: Expose to solve first, second, higher order, series differential equations K2
CO2: Acquire sound knowledge on special functions K4
CO3: Solve differential equations using Laplace transform K3
CO4: Grasp problem solving skills K4
CO5: Understand the physics concepts using mathematics K2

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**W**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**W**
CO2	**S**	**M**	**M**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**M**
CO3	**S**	**W**	**M**	**S**	**S**	**W**	**S**	**S**	**S**	**M**	**S**	**W**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**

Strongly correlating (S) : 3 Marks – 45/60
Moderately correlating (M): 2 Marks – 10/60
Weekly correlating (W) : 1 Marks
No correlation (N) : 0 Marks

PPHT12 **CLASSICAL MECHANICS** **5hrs/5credit**

Cognitive level:

K1: Recall
K2: Understand
K3: Apply
K4: Analyze

Objectives:

- Familiarization of elementary principles
- Clear understanding of symmetry properties
- Vivid knowledge of kinematics of rigid body motion.
- Deep insight into oscillation and canonical transformation.

Unit I: Survey of elementary Principles (9 hrs)
Mechanics of a particle and a system of particles, Constraints, D'Alembert's Principle and Lagrange's equation, Velocity dependent potential and dissipation function, Simple application of the lagrangian formulation, Variational principle and Lagrange's equation, Hamiltonian principle, Basic techniques of calculus of variations, Derivation of Lagrange's equations from Hamiltonian's Principle

Unit II: Symmetry Properties, two body central force problem (9 hrs)
Reduction to the equivalent one body problem, the equations of motion and first integrals, the equivalent one dimensional problem and classical of orbits, virial theorem, differential equation for the orbit and integrable power law potentials, the Kepler problem

Unit III: The Kinematics of rigid body motion (10 hrs)
The independent coordinate of a rigid body, The Euler angles, Euler's theorem on the motion of rigid body, finite and infinitesimal rotation, rate of change of a vector, coriolis force, angular momentum and kinetic energy of motion about a fixed point, Moment of inertia tensor and its diagonalization, equation of torque – free motion, concepts of precession and nutation.

Unit IV: Small Oscillations (10 hrs)
Formulation of the problem, Eigen value equation and the principle axis transformation, frequencies of free vibrations on normal coordinates, free vibrations of a linear triatomic molecule. Legendre transformation and Hamiltonian's equations of motion, cyclic coordinates and conservation theorems

Unit V: The equations of canonical transformation (10 hrs)
Examples, The sympletic approach to canonical transformation, Poisson brackets and other canonical invariants, equations of motion, Infinitesimal canonical transformation and

conservation theorem in the Poisson bracket formation, Hamiltonian Jacobi equation and its application to the harmonic oscillator problem

Books for Study

1. H.Goldstein, Classical Mechanics, II Edition, Narosa Publishing House, New Delhi, Chennai, Mumbai and Kolkata, 2000. (Unit I-V, Chapter 1-10).

References

1. Naranya Chandra Rana, Classical Mechanics- Tata McGraw-Hill Publishing Company Limited, New Delhi, 1991.
2. T W. B. Kibble, Classical Mechanics- Longman, 1985
3. J.L.Synge and B.A.Griffith, Principles of Mechanics, McGraw- Hill, New York, 1942.

Course Outcomes (CO):

CO1: Learn about the dynamics of system of particles using Hamiltonian, Lagrangian and Jacobi K1
CO2: Understand the planetary motion using Kepler's law K2
CO3: Get great exposure about kinematics of rigid motion K4
CO4: Solve small oscillations using Legendre transformations and Hamiltonian K3
CO5: Solve harmonic oscillator problem using canonical transformation and Hamiltonian Jacobi K5

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**W**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**W**
CO3	**S**	**S**	**N**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO4	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO5	**S**	**S**	**W**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**W**

Strongly correlating (S) : Marks --- 51/60
Moderately correlating (M): Marks---- 04/60
Weekly correlating (W) : Mark--- 04/60
No correlation (N) : Marks ---01/60

PPHT13 APPLIED ELECTRONICS 5hrs/5 credit

Cognitive level:

K1: Recall
K2: Understand
K3: Apply
K4: Analyze
K5: Create

Objectives:

- Deep knowledge of Op-amps and its application is acquired.
- Analytical study of the circuits and working of counters, registers
- Basic introduction of various D/A and A/D converters
- Better insight on optical devices

Unit I: (12 hrs)

Differential DC amplifier– Stable AC Coupled amplifier – Analogue integration and differentiation – Solution to simultaneous and differential equations using Op Amps- Active Filters – Comparator-Zero crossing detector – Regenerative comparator – Clippers- Half wave Recifier- peak detector – Clampers- Logarithmic amplifiers – Wave form generators - 555- timer IC and its applications

Unit II: (9 hrs)

Flip Flops: SR Flip flop-D Flip flop - JK flip flop- T flip flop
Registers and Counters: Shift Registers – Ring Counter- Shift Counter- Asynchronous Counter-Synchronous counters – Designs of Mod -3, Mod- 16, Random sequence generator
Semiconductors Memories: ROM, EPROM, EEPROM – Static and Dynamic Ram

Unit III: D/A and A/D Converters (9hrs)

Binary weighed resistor D/A converter - R-2R ladder D/A converter – Flash counter type, Successive approximation and dual slope A/D converters – Resolution and accuracy

Unit IV: Digital Integrated Circuits (9hrs)

Introduction – Bipolar transistor characteristics – RTL and DTL circuits – Integrated injection – logic- transistor- transistor logic – emitter – Coupled logic – Metal Oxide Semiconductor – Complementary MOS (CMOS)

Unit V: (9 Hrs)

Optical Devices: Optical absorption- Photon Absorption Coefficient- Electron –Hole Pair Generation rate- Solar Cells- pn junction solar cell- Conversion efficiency and solar concentration- nonuniform absorption effects- heterojunction solar cells- amorphous silicon solar cell- Photodetectors- Photoconductor- photodiode- PIN photodiode- Avalanche photodiode- phototransistor- LED-Generation of lights- Internal Quantum efficiency- external quantum efficiency-LED devices- Laser diodes- Stimulated emission and population conversion-optical cavity-threshold current-device structures and characteristics.

Book for Study:

1. G.K. Mithal, Electronic devices and Circuits (22nd Edition), Khanna Publishers, Delhi, 1999 (Unit I)
2. V. Vijayendran, Introduction to Integrated Electronics, Viswanathan Printers, 2007. (Unit- II, III, IV)
3. Donald A. Neamen, Semiconductor Physics and devices (3rd edition), Tata Mc. Graw, 2003. (Unit V)

Books for reference:

1. R.F. Coughlin and F.F. Driscol, Opamp and linear integrated circuits (6th Edition), Pearson,2001
2. A.Ghatak and K.Thyagarajan, Optical electronics, Cambridge Press, 1989.
3. M.S.Tyagi, Introduction to Semiconductor Devices Wiley, NY, 1991
4. S.M.Sze, Physics of Semiconductor Devices (2nd Edition), Wiley, NY, 1981
5. M.Sayer and A.Mansingh, Measurement, Instrumentation and Experimental Design in Physics and Enginnering, Prentice- Hall India, New Delhi, 2000.

Course Outcomes (CO):

CO1: Know about operation of Operational Amplifier K1
CO2: Solve mathematical equation using OP-Amp K3
CO3: Understand the concept of data storage elements K2
CO4: Know about theory and operation of different optical devices. K4
CO5: Train the students to get employability in electronic industry K5

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S	S	S	S	S	S	S	M
CO2	S	S	S	S	S	S	S	S	S	S	S	M
CO3	S	S	M	S	M	S	S	S	S	S	S	M
CO4	S	S	W	S	S	S	S	S	S	S	S	M
CO5	M	S	S	S	M	M	S	S	M	S	M	S

Strongly correlating (S) : Marks – 47/60
Moderately correlating (M): Marks – 12/60
Weekly correlating (W) : Marks – 1/60
No correlation (N) : Marks – 0

PPHP11 **ELECTRONICS PRACTICAL**I 6hrs/5 credit

Cognitive level:

K1: Recall
K2: Understand
K3: Apply
K4: Analyze
K5: Create

Objectives:

This paper aims at providing an in- depth knowledge of the operational amplifier. The students will also get the opportunity to practically work out during the lab sessions.

1. Operational Amplifier – Design – Phase – Shift Oscillator,
2. Operational Amplifier – Design – Wein Bridge Oscillator
3. Operational Amplifier – Square wave generator
4. Operational Amplifier – saw tooth wave generator
5. Operational Amplifier – Triangular wave generator
6. Operational Amplifier – Design of Schmitt Trigger
7. Operational Amplifier – Construction of Monostable Multi vibrator
8. Timer IC NE 555 Schmitt Trigger
9. Clock Generators using 7400 and 7413 Ics
10. Up- Down Counters – Design of modulus counters
11. Arithmetic operations using IC 7483
12. 7490 as modulus counters and display using 7447
13. Study of Multiplexer and Demultiplexer
14. Active Filters using IC 741

Course Outcomes(CO):

CO1:Construct different waveform generators using op-amp K2
CO2: Solve arithmetic operations using IC7483 K4
CO3: Design Multiplexer and demultiplexer using op-amp K3
CO4:Acquiring the skill of fabricating the various electronic circuits K2
CO5: Mastering the concept of Op-amps K5

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**W**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Strongly correlating (S) : Marks – 55/60
Moderately correlating (M): Marks – 4/60
Weekly correlating (W) : Marks – 1/60
No correlation (N) : Marks – 0

PPHE11 **ASTROPHYSICS** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objectives:

- Renewal of the concepts of coordinate system and stellar spectra
- Clear understanding of astronomical instruments
- Broad idea on the cosmology
- Familiarization of the concept of stellar evolution

Unit I: Basic Concepts & Celestial Mechanics (9hrs)
Coordinate systems, systems of time, parallaxes, distances, Luminosity, Apparent and absolute magnitudes, stellar radial velocities, masses, Binary stars, stellar spectra, spectral classification, HR diagram, Variable stars (definition only)

Unit II: Astronomical Instruments and Observational Techniques & Solar Physics(9 hrs)
Types of optical telescopes, Characteristics, Photometers, UBV System, color index, atmospheric effects, CCD camera.
Solar Interior structure (Pressure Density, temperature, generation of energy, radioactive and convective zones), Solar Neutrino
Solar Atmosphere: Photosphere, Model of solar photosphere, Chromosphere, corona, sunspots, their properties, cyclic variation, connection with magnetic fields, solar prominences, solar flares, active regions, helioseismology

Unit III: Interstellar Medium (10 hrs)
Stellar Structure: Physical processes in solar system, the terrestrial planets, Jupiter, Saturn, Uranus and Pluto, Comets, Asteroids, Meteoroid – formation of the system

Unit IV: Cosmology (8 hrs)
Hubble's Law: Newtonian Cosmology, Cosmic Background radiation, cosmological red shifts, Observational techniques

Unit V: Stellar Evolution, White dwarfs, Neutron Stars and Black Holes (12 hrs)
Vogt-Russel Theorem, mass luminosity relation - Proto stars, Premain sequence evolution, main sequence evolution, last stage of stellar evolution, fate of massive stars, discovery of Sirius – B, White dwarfs, Quantum mechanics of degenerate matter, mass radius relation for neutron stars, pulsars, crab nebula pulsar, stellar and super massive black holes

Book for study:

1. Shu F.H: The Physical Universe – An Introduction to Astronomy, 1981,

Books for Reference:

1. B.W.Carroll&D.A.Ostlie: An Introduction to Modern Astrophysics, 2nd Edn, Cambridge University Press, 2017
2. Karttunen, H., Kröger, P., Oja, H., Poutanen, M., Donner, K.J. : Fundamental Astronomy, Springer Verlag 2007
3. Astrophysics II: Interstellar Matter and Galaxies 1st Edition, Richard Bowers, Terry Deeming, 1984, Jones & Bartlett Pub.
4. Abhayankar K.D: Astrophysics of the Solar System, Cambridge university Press, 1999
5. Abhayankar K.D: Astrophysics; Stars and Galaxies, Cambridge university Press, 2001

Course Outcomes (CO):

CO1: Grasp basic knowledge about celestial mechanics K2
CO2: Understand the usage of various astronomical instruments K2
CO3: Know the physical processes involved in solar systems K4
CO4: Gain deep insight on cosmology and Cosmic radiation K3
CO5: Acquire the fundamental concepts of Stellar Evolution, White dwarfs, Neutron Stars and Black Holes K2

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**W**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**W**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**

Strongly correlating (S) : Marks – 53/60
Moderately correlating (M): Marks – 05/60
Weekly correlating (W) : Marks – 2/60
No correlation (N) : Marks – 0

PPHE11 **NUMERICAL METHODS** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objectives:

- Curve fitting methods are introduced
- The methods of solving algebraic equations and Transcendental equations learnt.
- Simultaneous equations and interpolation problems familiarized.
- Good exposure of Numerical Differentiation and Integration

Unit I : Curve Fitting (8 hrs)
Introduction-Linear Law-Method of Group Averages-Method of Moments-Method of Least Squares.

Unit II : Algebraic and Transcendental Equations (8hrs)
Introduction-Errors in Numerical Computation-Iteration Method-Bisection Method-Regular Falsi Method-Newton-Raphson Method-Horner's Method.

Unit III: Simultaneous Equations (10hrs)
Introduction-Simultaneous Equations-Back Substitution-Gauss Elimination Method-Gauss-Jordan Elimination Method-Calculation of Inverse of a Matrix-Crout's Method-Iterative Methods-Gauss Jacobi Iteration Method-Gauss-Seidel Iteration Method-Relaxation Method-Newton-Raphson method for Simultaneous Equations.

Unit IV: Interpolation (10hrs)
Introduction-Newton's Interpolation Formulae-Central Difference Interpolation Formulae-Lagrange's Interpolation Formula-Divided Differences-Newton's Divided Differences Formula-Inverse Interpolation-Hermite's Interpolating Polynomial.

Unit V: Numerical Differentiation and Integration (12hrs)
Introduction-Derivatives using Newton's Forward Difference Formula-Derivatives Using Newton's Backward Difference Formula-Derivatives Using Central Difference Formulae-Maxima and Minima of the Interpolating Polynomial-Numerical Integration-Gaussian Quadrature Formula-Numerical Evaluation of Double Integrals.

Book for Study:

1. S. Arumugam, A. ThangapandiIssac, A. Somasundaram, Numerical Methods, Scitech (2002).

Book for References:

1. R.L. Burden, J.D. Faires, Numerical Analysis, Thomson Asia, 2002
2. P.B. Patil, U.P. Verma, Numerical Computational Methods, Narosa, 2006.

Course Outcomes (CO):

CO1: Understand the curve fitting methods and its significance K2
CO2: Improve the problem solving skills in algebraic, transcendental and simultaneous equation K3
CO3: Learn to interpolate and get an idea about various interpolation techniques K3
CO4: Gain deep conceptual insight on different polynomials K4
CO5: Enhance the analytic skill to crackthe competitive examinations K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**W**	**S**
CO2	**S**	**M**	**W**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**W**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**

Strongly correlating (S) : Marks – 48/60
Moderately correlating (M) : Marks – 09/60
Weekly correlating (W) : Marks – 3/60
No correlation (N) : Marks – 0

PPHT21 **MATHEMATICAL PHYSICS II** **5hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze

Objective:

- Clear understanding of Fourier series, Power series, Laurent series and problems related to them.
- PDE are learnt.
- Complex variables, Fourier series and integrals of various Physics problems are understood.
- Mathematical concepts learnt here are applied to various courses.

Unit 1 Fourier Series, Integrals, and Transforms (10hrs)
Fourier Series - Functions of Any Period p = 2L - Even and Odd Functions- Half-Range Expansions - Complex Fourier Series. - Forced Oscillations - Approximation by Trigonometric Polynomials -Fourier Integral - Fourier Cosine and Sine Transforms - Fourier Transform. Discrete and Fast Fourier Transforms

Unit 2 Partial Differential Equations (PDEs) (10hrs)
Basic Concepts -Modeling: Vibrating String, Wave Equation - Solution by Separating Vatiables. Use of Fourier Series - D' Alembert's Solution of the Wave Equation. Characteristics - Heat Equation: Solution by Fourier Series- Heat Equation: Solution by Fourier Integrals and Transforms - Modeling: Membrane, Two-Dimensional Wave Equation.

Unit 3 Complex Numbers and Functions (10 hrs)
Complex Numbers. Complex Plane - Polar Form of Complex Numbers .Powers and Roots - Derivative. Analytic Function - Cauchy-Riemann Equations. Laplace's Equation - Exponential Function - Trigonometric and Hyperbolic Functions - Logarithm. General Power.

Unit 4 Complex Integration (8 hrs)
Line Integral in the Complex Plane - Cauchy's Integral Theorem - Cauchy's Integral Formula - Derivatives of Analytic Functions.

Unit 5 Power Series, Taylor Series, Laurent Series. Residue Integration (10 hrs)
Sequences, Series, Convergence Tests - Power Series - Functions Given by Power Series - Taylor and Maclaurin Series- Laurent Series - Singularities and Zeros. Infinity - Residue Integration Method - Residue Integration of Real Integrals.

Book for Study

Unit 1-5 - Chapter 11-16-Advanced Engineering Mathematics – Erwin Kreyszig, 9th Edition, John Wiley and Sons, Inc. 2006

Books for Reference

Mathematical Methods for Physicist - George B. Arfken, Hans J. Weber, 6th Edition, Elsevier Academic Press, 2005.
Mathematical Physics – P.K. Chattopadhyay – Wiley Easter, (1990)
Introduction to Mathematical Physics – Charlie Harper – Prentice Hall India (1987) New Delhi
Applied Mathematics for Engineers and Physicists, III Edn. – Pipes &Harveill McGraw Hill (1971)

Course Outcomes (CO):
CO1: Understand about Fourier series, integrals and transform K2
CO2: Solve physics problem using partial differential equations K3
CO3: Grasp knowledge about complex numbers and functions K4
CO4: Apply different integral methods to solve complex variables K4
CO5: Choose right series to solve problem in Physics. K5
Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**W**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**

Strongly correlating (S) : Marks – 51/60
Moderately correlating (M): Marks – 08/60
Weekly correlating (W) : Marks – 1/60
No correlation (N) : Marks – 0

PPHT22 **QUANTUM MECHANICS I** **5Hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze

Objective:

- Detailed knowledge on Schrödinger's Equation and its applications
- Familiarization of the concepts of Wave Mechanics
- Broad idea on the 1-3D problems
- New insight on the Angular momentum operators

Unit I: Wave Mechanical Concepts (9 hrs)

Wave Nature of Particle – The Uncertainty Principle - The Principle of Superposition – Wave Packet – time dependent Schrodinger Equation – Interpretation of the Wave Function – Ehrenfest's Theorem – Time independent Schrodinger Equation – Stationary States – Admissibility Condition on the Wave function

Unit II: General Formalism of Quantum Mechanics (9 hrs)

Linear Vector Space – Linear Operator – Eigen function and Eigenvalue – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous Measurability of Observables – General Uncertainty Relation – Dirac's Notation – Equation of Motion – Momentum Representation.

Unit III: One Dimensional Problems (10 hrs)

Square Well Potential with Rigid Walls-Square Well Potential with Finite Walls-Square Potential Barrier-Alpha Emission-Bloch Waves in a Periodic Potential-Kronig Penney Square Well Periodic Potential-Linear Harmonic Oscillator: Schrodinger Method-Linear Harmonic Oscillator: Operator Method.

Unit IV: Three Dimensional Problems (10 hrs)

Particle Moving in a Spherically Symmetric Potential-System of Two Interacting Particles-Rigid Rotator-Hydrogen Atom-Hydrogenic Orbitals-The Free Particle-Three Dimensional Square-Well Potential-The Deuteron.

Unit V: Angular momentum (10 hrs)

The Angular Momentum Operators-Angular Momentum Commutation Relations-Eigen Values and Eigen Functions of $L^2$and L_Z-General Angular Momentum-Eigenvalues of $J^2$and J_Z-Angular Momentum Matrices-Spin Angular Momentum-Spin Vectors for Spin-(1/2) System-Addition of Angular Momentum

Book for Study

1. Unit I-V; Chapter 2-5,8, G.Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2008.

Book for Reference

1. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill, New Delhi. 2nd Edn, 2017
2. I.L. Schiff, Quantum Mechanics, 3rd Edition, 2017, McGraw Hill, New York.
3. B.K. Agarwal, H. Prakash, Quantum Mechanics, 2004, Prentice Hall of India, New Delhi.

Course Outcomes(CO):

CO1: Get knowledge about wave mechanics K1
CO2: Solve one dimensional and three dimensional problem using Schrodinger equation K3
CO3: Acquire the knowledge about the importance of operators in quantum mechanics K2
CO4: Understand the commutation relations, in turn determine eigen values K3
CO5: Ability to develop the problem solving skills in quantum mechanics K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**W**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Strongly correlating (S) : Marks – 55/60
Moderately correlating (M): Marks – 04/60
Weekly correlating (W) : Marks – 1/60
No correlation (N) : Marks – 0

PPHT23 **STATISTICAL MECHANICS AND THERMODYNAMICS5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objective:

- Concepts of Ensembles are introduced.
- Clear understanding of Bose Einstein and Fermi Dirac statics
- Familiarization on the properties of gases
- Broad idea on the Time dependence of fluctuations

Unit I: Phase Space, Concept of ensembles (8 hrs)
Canonical ensembles – Thermo dynamical relation in a canonical ensemble, Micro canonical ensemble and Grand Canonical ensemble – Information theory and statistical mechanics problems

Unit II: Properties of gases (11 hrs)
Partition function for the system and for the particles Translation partition function – Gibb's paradox: Sackur Tetrode Equation, Boltzmann equipartition theorem, Rotational partition function, Vibrational contributions to thermodynamic quantities, Electronic partition function, Maxwell's distribution of velocities – Problems

Unit III: Bose-Einstein and Fermi-Dirac Statistics (9 hrs)
Symmetric and anti symmetric wave function Bose Einstein and Fermi Dirac distributions- Weak and strong degeneracy of perfect gases, Bose – Einstein condensation – Black Body radiation, Photons

Unit IV: Kinetic Theory of gases
Mean free path – Viscosity of gases- Heat conduction in gases – Effusion Phenomena
Energy fluctuations in a canonical ensemble – Fluctuations in a grand canonical ensemble, Brownian motion , Langevin equation for random motions – Random walk problem – Diffusion, Einstein relation for mobility (10 hrs)

Unit V: Time dependence of fluctuations
Power spectrum of fluctuations – Persistence and correlation of fluctuations – Wiener-Khinchin theorem – Johnson noise: Nyquist theorem, Shot noise problem- Irreversible Thermodynamics: Onsager reciprocity relations-Derivation of the Onsager relations- Thermo electric phenomena – Linear response theory – Kubo relations fluctuations dissipation theorem

Books for study:

1. E.S.R. Gopal, Statistical Mechanics and properties of Matter (Theory and Applications) Ellis Horwood Ltd, 1974. (Unit I- V, Chapter 1-6)
2. R.K. Srivasta and J. Ashok, Statistical Mechanics, Prentice-Hall of India Private Limited, New Delhi, 2006. (Unit III, IV Chapter 6, 12).

Books for reference:

1. B.K.Agarwal and M.Eisner, Statistical mechanics, Second Edition, New Age international Private Limited, Delhi, 2016.
2. R.K. Pathtria, Statistical Mechanics-Second Edition, Butterworth- Heinemann, 1972.
3. L.D. Landau and E.M. Lifshitz, Statistical Mechanics- Third Edition, Publisher by Robert Maxwell M.C, 1959.
4. J.K.Bhattacharjee, Statistical Mechanics: An Introductory Text, Allied Publsihers Pvt. Ltd, ISBN : 4567149629
5. W.Greiner.,L.Neise and H.Stoecker, Thermodynamics and Statistical Mechanics, 1995.
6. C.Kalidas, M.V. Sangaranarayanan, Non – Equilibrium Thermodynamics, Macmallan India Limited, New Delhi, 2002.
7. M.Glazer and J. S. Wark, Statistical Mechanics, First Edition, Oxford University Press.
8. L.P. Kadanoff, Statistical Physics – Statics, Dynamics and Renormalization, World Scientific Publishing Co Pte Ltd, Singapore, 2000.
9. Suresh Chandra and Mohit Kumar Sharma, A Textbook of Statistical Mechanics- Second Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, 2008

Course Outcomes(CO):

CO1: Gain knowledge basic concept of ensembles K2
CO2: Explore the different theories and functions related to properties of gases K3
CO3: To distinguish between Bose –Einstein and Fermi- Dirac statistics K4
CO4: Exposure about kinetic theory of gases K2
CO5: Get knowledge about the different fluctuations and noise problems in thermodynamics K2

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**

Strongly correlating (S) : Marks – 55/60
Moderately correlating (M): Marks – 05/60
Weekly correlating (W) : Marks – 0/60
No correlation (N) : Marks – 0

PPHP22 **GENERAL PRACTICAL II** **6hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objectives: The course aims at exposing the students to the intricacies of handling general equipments and analysis of results. This laboratory session also aim the students to analysis the data given by Indian Institute of Astrophysics, Kodaikanal.

1. Solar Spectrum – Hartmann's Interpolation formula
2. Electrical resistance of a metal / an alloy by four probe method – as a function of temperature
3. Measure of numerical aperture (NA) of a telecommunication-grade Optic fibre
4. Fibre attenuation of a given optical fiber
5. Laser Experiments
6. Zeeman effect
7. Band Gap of Thermistor
8. Determination of Solar Constant
9. Michelson Interferometer – Wavelength and separation of wavelengths
10. Michelson Interferometer- Thickness of a mica sheet / thin film
11. Susceptibility – Quinke's or Gouy's method
12. Hall Effect
13. Spectral analysis of a salt
14. Absorption spectra
15. Ultrasonics – Compressibility of a liquid
16. Ultrasonics – Compressibility of a solid
17. B-H curve using CRO
18. Calibration of a Gamma ray spectrometer and determination of the energy of unknown source
19. Any 4 experiments on Astrophysics to be recommended by **IIA**

Course Outcomes(CO):

CO1: Understand the concept and get hands on training on instruments K2
CO2: Apply different physics concepts to analyze the data K3
CO3: Understand and determine the different physical parameters K2
CO4: Practically acquire the applications of theoretical physics K4
CO5: Analyze the data obtained from Indian Institute of Astrophysics, Kodaikanal and get knowledge about different astronomical objects K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO5	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**

Strongly correlating (S) : Marks – 54/60
Moderately correlating (M): Marks – 06/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHE22 **MATERIALS CHARACTERIZATION** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objectives:

- Principles involved in the working of thermal analysis instruments are understood.
- Knowledge of the working of different parts of X-ray and spectral analysis instruments is acquired.
- Overall view of the usage of microscopy techniques are provided.
- Analysis of various instruments are known

Unit I: Thermal Analysis (8 hrs)

Introduction- thermo gravimetric analysis- instrumentation – determination of weight loss and decomposition products- Differential scanning Calorimetry- instrumentation- specific heat capacity measurements- determination of thermochemical parameters- Differential thermal analysis-basic techniques.

Unit II: X-Ray Analysis and Optical Methods (14 hrs)

Single and powder diffraction- Diffractometers-interpretation of diffraction patterns- indexing-phase identification- thin film characterization- X-ray fluorescence spectroscopy- uses. FTIR-UV- Visible spectroscopy- Photoluminescence- light matter interaction- fundamental transitions-excitations- instrumentation- electroluminescence- instrumentation- photo reflectance.

Unit III: Electron Microscopy (8 hrs)

Principles of SEM, TEM, EDAX, AFM, EPMA-instrumentation-sample preparation and analysis of materials- study of dislocations-ion implantation- uses.

Unit IV: Electrical Methods (8 hrs)

Hall effect – Carrier density – resistively – two probe and four probe methods – scattering mechanism- Vander paw method – CV characteristics- schottky barrier capacitance- impurity concentration – electrochemical CV profiling – Limitations.

Unit V: Magnetic and Mechanical properties (10 hrs)

Magnetic measurements using vibrating sample magnetometer (VSM) - magnetic force microscopy (MFM) - Electron Paramagnetic Resonance (EPR)-Nuclear Magnetic Resonance (NMR) spectroscopy – Mechanical properties-micro hardness - nano indentation- elastic and plastic deformation- fracture toughness – Superplasticity.

Books for study:

1. Willard, Merritt, Dean, Settle, Instrumental Methods and Analysis- Seventh Edition, CBS Publishers, New Delhi, 1986. (Unit I-III, V, Chapter- 6,11,13, 25)
2. Jasprit Singh, Semiconductor Devices- Basic Principles, John Wiley & Sons (ASIA) Pvt. Limited, 2001. (Unit IV, Chapter- 3, 4, 6)
3. V. Raghavan, Materials Science and Engineering-Fourth Edition, Prentice-Hall of India Private Limited, New Delhi, 2001. (Unit- III, V, Chapter 6, 10, 11)
4. G. Aruldhas, Molecular Structure and Spectroscopy- Second Edition, PHI Learning Private Limited, New Delhi, 2017. (Unit-V, Chapter-11)
5. William D. Callister, Jr. Materials Science and Engineering an Introduction- Sixth Edition, Wiley International Edition, 2003. (Unit-IV, Chapter-8)
6. Douglas A. Skoog, F. James Holler, Timothy A. Nieman, Principles of Instrumental Analysis- Fifth Edition, Thomson Business Information India Private Limited, India, 2006. (Unit- III, Chapter 21- Section-C)

References:

1. J.A.Belk, Electron Microscopy and microanalysis of crystalline materials, Applied Science Publishers, London, 1979.
2. J.W. Gardner, H.T. Hingle, From Instrumentation to Nanotechnology, Gordon and Breach Science Publishers, 1990.

Course Outcomes (CO):

CO1: Understand the theory and working principle of different instruments. K2
CO2: Grasp the knowledge about concept of differentequipments used for material analysis K4
CO3: Learn the technical specifications of research instruments K3
CO4: Learn specific analysis physical and chemical properties of the materials K3
CO5: Enhance the employability skills K5

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**

Strongly correlating (S) : Marks – 52/60
Moderately correlating (M): Marks – 08/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHE22 **MICROPROCESSOR** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objectives:

- Microprocessor architecture memory and i/o (8085µP) is understood.
- Skill in software development using microprocessors is developed.
- Concepts of peripheral devices learnt
- Concept of interfacing and execution of simple projects are understood.

Unit I:8085 Microprocessor – Architecture

Intel 8085-ALU-Timing and Control Unit-Registers-Data and Address Bus- Pin Configuration-Intel 8085 Instructions-Opcode and Operands- Instruction Word size-Instruction cycle- Fetch operation-Execute operation- Machine cycle and state-Instruction and data flow-Timing

Diagram-Timing Diagram for Opcode Fetch Cycle-Memory read-I/O read-Memory write-I/O write. (9 hrs)

Unit II:8085 Microprocessor – Instruction Set

Instruction and data format-Addressing modes-Direct addressing-Register addressing - Register Indirect addressing-Immediate addressing-Implicit addressing-Status Flags. (9 hrs)

Unit III:8085 Microprocessor – Programming

Assembly language-High-level language-Areas of applications of various language-Machine language-Assembly language-High-level language-Stacks- Subroutine. (9 hrs)

Unit IV:8085 Microprocessor – Peripheral devices

Address space partitiononing-Memory Mapped I/O scheme-I/O mapped I/O scheme-Memory and I/O interfacing-Memory interfacing-I/O Interfacing-Synchronous data transfer-asynchronous data transfer-interrupt driven data transfer-multiple interrupts. (10 hrs)

Unit V:Interfacing memory and its application

Keyboard interface, Seven segment display interface. Stepper motor interface- Interfacing Digital to Analog Converters (DAC) and Analog to Digital Converters (ADC) (10 hrs)

Books for Study

1. Ramesh Goanker: Microprocessor Architecture, Programming & Application with the 8085/8080A (2nd Edition) - Wiley Eastern Ltd ,1993.

Books for Reference

1. A.P. Mathur, Introduction to Microprocessors (3rd edition), Tata Mc.Graw, Delhi, 1989.
2. Walter A. Triebel&Avtar Singh : 16 bit Microprocessor – Architecture , software & interface techniques, 1stEdn, 1990 – Printice – Hall Inc
3. Badri Ram, Fundamentals of Microprocessors and Microcomputers, DhanpatRai Publications 1990.

Course Outcomes(CO):

CO1: Gain knowledge about architecture, instruction set, peripheral devices of 8085 microprocessor. K2
CO2: Familiarize with interface memory and application of microprocessor. K3
CO3: Able to write program and solve some mathematical problems. K4
CO4: Interface specific software with devices/instruments K5
CO5: Can seek employability in electronic industry K3

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S	M	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S

CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**S**	**S**

Strongly correlating (S) : Marks – 49/60
Moderately correlating (M): Marks – 11/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHT31 **ELECTROMAGNETIC THEORY** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objectives:

- Deep knowledge about electrostatics.
- Clear understanding of magnetostatics
- Understanding of Maxwell equation and wave propagation
- Introducing to the concepts of electromagnetic radiation.

Unit I: Electrostatics (12 hrs)

Introduction to Electrostatics- Gauss law- electrostatic potential- Poisson's and Laplace's equation – Green's theorem – Green's functions – Potential with Dirichlet and Neumann boundary conditions – Solution of Laplace's equation in rectangular box – Solution by separation in spherical polar coordinates – Multiple expansion, electrostatic field in matter – Dielectrics – Polarization – Polarization vector – Field outside polarized dielectric – Bound charges- Electric displacement vector – Gauss law in presence in dielectrics – linear dielectrics – Boundary conditions in dielectric media – Electrostatic energy in presence of dielectrics- Alignment of polar molecules – Dielectric sphere in uniform electric field – Molecular polarizability and electrical susceptibility

Unit II: Magneto Statics (8 hrs)

Introduction to Magneto statics – Conservation of charge and equation of continuity – Biot – Savart's law- Magnetic field due to a localized current distribution – Ampere's law – Magnetic vector potential – Magnetic scalar potential – Magnetic moment, force and torque on a current distribution in an external field – Magnetization – Field of a magnetized object – Bound Currents – Auxiliary field H- Ampere's law – linear media – Magneto static theory – Uniformly magnetized sphere – Multipole expansion

Unit III: Maxwell Equations (9 hrs)

Equation of continuity in electro dynamics- Faraday's law of induction – Maxwell equation – Maxwell displacement current – Maxwell's equation in free space and matter – Physical significance – Boundary conditions

Unit IV: Wave Propagation (10 hrs)

Plane wave in non-conducting media – Poynting Vector, electromagnetic waves in conducting media – Reflection and refraction of EM waves at a plane interface – laws of reflection and refraction for EM waves – Fresnel formulae – Polarization of EM waves – Brewster's angle and degree of polarization – Total internal reflection –Propagation of EM waves between parallel and perfectly conducting planes – Rectangular wave guide.

Unit V: Electromagnetic Radiation (9 hrs)

Inhomogeneous wave equation and retarded potentials – Oscillating electric dipole – Energy radiated by an oscillating electric dipole- Jefimenko's Equation, Lienard- Wiechert Potentials- The fields of a moving point Charge.

Books for Study

1. B.B.Laud, Electromagnetic 2nd Edition- New age international publishes, 1987. (Unit I-V, Chapter 1-7).
2. David J. Griffiths Introduction to Electrodynamics, Third edition, Prentice- Hall of India Private Limited, New Delhi, 2002. (Unit-V, Chapter 10).

References:

1. W.PanofskyM.Phillips, Classical Electricity and Magnetism- Second Edition, Addition Wesley Publishing Company, Inc. 1962.
2. J.D.Jackson, Classical Electrodynamics- 2 nd edition – John Wiley & Sons, Inc. New Delhi, 1962.
3. B.B.Laud, Electromagnetic 2nd Edition- New age international publishes, 1987.

Course Outcomes (CO):

CO1: Learn the fundamentals of electrostatics K1
CO2: Acquire the knowledge about magnetostatics K2
CO3: Gain knowledge about the Maxwell equation K2
CO4: Apply Maxwell equation and its application to wave propogation K3
CO5: Learn about electric dipoles and its theory K2

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	M	S	M
CO3	S	M	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S	S	W
CO5	S	S	M	S	S	S	S	S	S	M	S	S

Strongly correlating (S) : Marks – 51/60
Moderately correlating (M): Marks – 08/60
Weekly correlating (W) : Marks – 01/60
No correlation (N) : Marks – 0

PPHT32 **QUANTUM MECHANICS-II** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze

Objective:

- Clear understanding on Perturbation Theory
- Vivid knowledge on the concepts of variation method, WKB
- Broad idea on Scattering
- Familiarization on applications of quantum mechanics

Unit I Time Independent Perturbation Theory (10 hrs)

Basic concepts – NondegenerateEnergy Levels – Anharmonic Oscillator: First Order Correction-The Ground State of Helium-Effect of Electric Field on the Ground State of Hydrogen – Degenerate Energy Levels – effect of electric Field on the n=2 State of Hydrogen – Spin-Orbit Interaction.

Unit IIThe Variation Method (9 hrs)

The Variation Method – Rayleigh Ritz Method – Variation Method for Excited States – The Hellmann Feynman Theorem – the Ground State of Helium – The Hydrogen Molecule Ion – the Ground State of Deuteron.

Unit IIIWKB Approximation (9 hrs)

The WKB Method – The Connection Formula – Validity of WKB Method – Barrier Penetration – Alpha Emission – Bound States in a Potential Well.

Unit IV Time Dependent Perturbation Theory **(9 hrs)**

Introduction – First order Perturbation – Harmoic Perturbation – Transition to Continuum States – Absorption and Emission of Radiation – Einstein's A and B Coefficients- Selection Rules.

Unit V Scattering **(11 hrs)**

Scattering Cross-section – Scattering Amplitude – Partial Waves-Scattering by Central Potenials: Partial Wave Analysis –Significant Number of Partial Waves – Scattering by an Attractive Square Well Potential-Breit-Wigner Formula – Scattering Length – Expression for Phase shifts-Integral equation – the Born Approximation – Scattering by Screened Coulomb Potential-Validity of Born Approximation – Laboratory and Centre of Mass Coordinate Systems.

Book for Study

1. Unit I-V; Chapter 9-12,14,G.Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi 2008.

Book for Reference

1. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill, New Delhi 2ndEdn, 2017.
2. I.L. Schiff, Quantum Mechanics, 3rd Edition, 2017, McGraw Hill, New York.
3. B.K. Agarwal, H. Prakash, Quantum Mechanics, 2004, Prentice Hall of India, New Delhi.

Course Outcomes (CO):

CO1: Learn about the fundamental difference between time dependent and time independent perturbation theory K2
CO2: Grasp the concept of WKB approximation and its application K3
CO3: Gain knowledge about Variation method and apply to hydrogen molecule K3
CO4: Explore the features of Scaterring cross section using different formula K2
CO5: Acquire problem solving skill in quantum physics K5

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Strongly correlating (S) : Marks – 58/60
Moderately correlating (M): Marks – 02/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHT33 **SOLID STATE PHYSICS** **5hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze

Objective:

- Basic concepts about crystal structure
- Deep knowledge of lattice dynamics and free electron theory.
- Clear understanding of superconductivity.
- Theoretical knowledge of magnetic properties of materials.

Unit I: Crystal Lattices (9hrs)

Periodic Arrangements of atoms – concept of a lattice – lattice translation vectors – primitive lattice cell – two and three dimensional lattice types. Miller indices of crystal plane- simple crystal structure like sodium chloride type – cesium Chloride type hexagonal and face centered-close packed structures. Diamond structure and cubic zinc sulphide structure- Diffraction of waves by crystals: Bragg's law – reciprocal lattice vectors- Laue equations- Brillouin zones-Reciprocal lattices to sc, bcc, fcc lattices

Unit II: Lattice Dynamics (11hrs)

Vibrations of linear monoatomic and diatomic chains - quantisation of elastic waves - phonon momentum. Plank distribution for a system of identical harmonic oscillators. Periodic boundary conditions and density of states in one and two dimensions. Einstein and Debye's theories of specific heat.Anharmonicity of lattice vibrations, Thermal expansion. Thermal conductivity and Umklapp process

Unit III: Free electron theory (9hrs)

Energy levels in one dimensions. Fermi- Dirac distribution for a free electron gas. Periodic boundary condition and free electron gas in three dimensions. Heat capacity of the electron gas.Ohm's law, Mattiessen's rule and Umklapp process. Hall effect, Wiedmann- Franz law – Nearly free electron model and the origin and the magnitude of the energy gap. Bloch functions. Motion of an electron in a periodic potential, Kronig-Penny model, Bloch Theorem. Approximate solution near a zone boundary

Unit IV: Superconductivity (9hrs)

Occurrence of super conductivity, Destruction of superconductivity by magnetic fields, Meissner Effect, Heat Capacity, Energy gap, Microwave and infrared properties, Isotope effect, Thermodynamics of the superconducting transition , (Stabilization energy of the super conductor), London equation, Coherence Length, BCS theory of superconductivity, BCS ground state, Flux quantization in a super conduction ring, duration of persistence currents, type II

superconductors, Vortex state, Estimation of Hc_1 and Hc_2, single particle tunneling, DC Josephson effect, AC Josephson effect, macroscopic quantum interference , High temperature superconductors

Unit V: Magnetism of Solids (10 hrs)

Ferro magnetic order, Curie point and exchange integral, Temperature dependence of the saturation magnetization at absolute zero, Magnons, Quantisation of spin waves, Thermal excitations of magnons, Ferri magnetic order, Curie temperature and susceptibility below the Neel temperature, Ferromagnetic domains, Anisotropy energy, Transition region between domains, Origin of domains, Coercivity and Hysterisis

Book for Study:

1. C. Kittel, Introduction to Solid State Physics (8^{th} Edition), John Wiley & Sons (2005) (Unit I-V).

Books for reference:

1. S.O. Pillai, Solid State Physics (7^{th} Edition), New Age International Publishers Ltd. 2010.
2. R.Asokamani, Solid State Physics, Anamaya Publishers, 2006
3. A.J.Dekker, Solid State Physics, Macmillan (1965).
4. N.W.Ashcroft and N.D.Mermin, Solid State Physics, Harcourt College Publishers (1976)

Course Outcomes (CO):

CO1: Learn and determine different crystal structures of materials K1
CO2: gain knowledge on the theory of lattice vibration and correlate with materials thermal Properties K2
CO3: Learn about physical properties of materials in terms of its band structure K3
CO4: Understand about superconductivity and its application in real world K2
CO5: Grasp the knowledge about magnetic properties of material K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO5	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Strongly correlating (S) : Marks – 53/60
Moderately correlating (M): Marks – 07/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHP33 **PRACTICAL III** **6hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze
K5: Create

Objectives:

The course aims at exposing the students to solve different numerical equation by C programming.

1. Ascending and descending order of numbers and characters
2. Matrix addition, subtraction and multiplication
3. Transpose of a matrix
4. Evaluating a root of non-linear equation by Newton-Raphson method using external function
5. Program to solve system of linear equations using simple Gaussian elimination method
6. Program for straight line fit using the method of least squares for a table of data points
7. Program for polynomial curve fitting
8. Program to integrate any function or tabulated data using trapezoidal rule
9. Program to integrate any function or tabulated data using Simpson's rule
10. Program to compute the solution of a first order differential equation of type y'=f(x,y) using the fourth order Runge-Kutta method

11. Program to compute the interpolation value at a specified point, given a set of data points using Lagrangian interpolation representation

12. Program to compute the interpolation value at a specified point, given a set of data points using Newton's interpolation representation

13. Program to calculate and print the mean, variance and standard deviation of set of N numbers

14. Program to solve the quadratic equation

15. Program to read a set of numbers, count them and find and print the largest and smallest numbers in the list and their positions in the list

Course Outcomes (CO):

CO1: Understand the structure of C programming K2
CO2: Learn about variables and constant of C-programming K1
CO3: Understanding a functional hierarchical code organization K2
CO4: Ability to write algorithm for given mathematical problem K3
CO5: Ability to execute and solve any mathematical problems. K3

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

Strongly correlating (S) : Marks – 55/60
Moderately correlating (M): Marks – 06/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHE33 **MATERIALS SCIENCE** **5hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze
K5: Create

Objectives:

- Preparation methods of nanomaterials are known.
- Properties of different materials are studied.

- Applications of new materials are known.
- Motivate students to research carrier

Unit I: Nanomaterials

Grains in solids, measurement of grain size, nanomaterials, methods of preparation – Electro deposition, Sol-gel, Spark discharge and other methods, characterization and applications, Hetrojunction – Quantum well, wire and dots (15 hrs)

Unit 2:Polymers

Structural features of polymer material – Mechanisms of polymerization and types of Polymers- Thermoplastics – rubbers and elastomers- mechanical physical and chemical properties- Cellular plastics- Liquid crystal polymers (8 hrs)

Unit 3: Dielectrics

Electrical polarization – Mechanisms of polarization – Optical, molecular and interfacial polarizability- some dielectric materials – piezoelectric materials – pyroelectric and ferro electric material – Applications of these materials (8 hrs)

Unit 4: Electronic Materials

Purification of electronic materials – Crystal growth and doping techniques (an over view)- Epitaxial growth – Impurity Diffusion- Ion Implantation – Junction Formation – Metallisation – Lithography (an over view) – contact formation (8 hrs)

Unit 5: Magnetic materials

Classification of magnetism – Concept of magnetic domain structure – Soft magnetic materials iron and iron based materials, permalloys Ni-Zn and Mn-Zn ferrite- Microwave ferrite and garnets- Amorphous magnets (metgalsses) Hard magnetic materials High Carbon steel AlNiCo alloys – Structure and magnetic properties of Barium ferrite, Sm-Co and Nd_2Fe_4B magnets- Rare earth element magnets- Effects of 3^{rd} transition elements – Application of hard vs soft magnets (9 hrs)

Books for Study

1. J.C.Anderson, K.D.Leaver, R.D.Rawlings and J.M.Alexander, Material Science. 4th edition (Chapman – Hall , London) 1990
2. V.Ragavan, Materials Science and Engineering 3rd Ed. 2011 (Prentice- Hall India, New Delhi)(For Units 2,3, & 5)
3. C.M.Srivata and C.Srinivasan, Science of EngineeringMaterials and Carbon Nanotubes, Wiley – Eastern Ltd,New Delhi 2010 (For Units 1,2, & 5)

Books for Reference

1. G.K.Narula, H.S.Narula and V.K.Gupta, Materials Science (Tata McGraw- Hill , 1988)
2. Z.D.Jaberezk, The Nature and Properties of Engineering Materials (Wiley eastern) 1987
3. H.Ibach and H.Luth, Solid State Physics- An Introduction to Principles of Material Science 2^{nd} Ed 2009
4. R.K.Gupta (Editor) Physics of Particles Nucleus and Materials – Recent trends (new Horozon of Physics Series, Narosa, New Delhi) 2002

Course Outcomes (CO):
CO1: Understand the basic knowledge preparation method ofnanomaterialsK1
CO2: Acquire knowledge about application and various properties of polymers K2
CO3: Gain knowledge aboutdielectric, pyroelectric and ferroelectric materials and its Application K2
CO4: Understand the different purification techniques involved in electronic materialsK3
CO5: Gain in depth knowledge about magnetic materials. K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S	S	S

Strongly correlating (S) : Marks – 54/60
Moderately correlating (M): Marks – 06/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHE33 **SOLAR CELLS** **5hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze
K5: Create

Objective:

- Basic knowledge about basic concepts of sunlight
- Understanding about physics of semiconductor materials
- Familiarization of design and fabrication of solar cells
- Better insight of third and fourth generation solar cells

Unit I
Introduction to Solar cells and Sun light
Outline of solar cell developments – Physical sources of sunlight – solar intensity at the Earth's Surface – direct and diffused radiation – apparent motion of the sun – solar insolation data – Types of solar energy converter – Photons in, electrons out – Basic principles of Photo-voltaic.

Unit II

Semiconductor Materials, properties and its characteristics

Basics of crystal structure and orientations - Basic concepts – electron states in semiconductors – semiconductor in equilibrium – impurities and doping - semiconductor under bias- drint and diffusion – semiconductor transport equations – photo-generation – recombination – formulation of the transport problem

Unit III

Junction Investigations

Origin of photovoltaic action – work function and types of junction –Homo-junctions - metal semiconductor junction – semiconductor-semiconductor junctions – electrochemical junction – organic material junctions – surface and interface states – p-n junction – dark and illuminated current — effect of temperature – efficiency loss - short circuit current-open circuit voltage – introduction to various resistance .

UNIT IV

Design, fabrication and characterization of silicon Solar cells

Basic silicon Solar cells - Basic theoretical performance – Major considerations for solar cell fabrication – doping of the substrate – Back surface fields – top layer limitations – top contact design – optical design – spectral response – cell fabrication process – surface treatment – etching – doping and diffusion – contact formation – solar cell measurement (IV) – analysis of the output- future direction in silicon cell design.

Unit V

Towards Third and fourth generation solar cells

Introduction to nanoparticles – concepts of quantum dot solar cells – dye sensitized solar cell – organic solar cells - hybrid solar cell-other types of advanced solar materials and solar cell devices.

Books for study:

1. Solar Cells (operating Principles, Technology and System applications) by Martin A. Green (Published by The University of New South Wales).1986
2. The Physics of Solar cells by Jenny Nelson (Published by Imperial college press) 2003
3. Light-Induced Redox Reactions in Nanocrystalline Systems, Anders Hagfeldtt and Michael Gratzel, Chem, Rev.1995,95, 49-68.

Books for Reference:

1. Third Generation Photovoltaics: Advanced Solar Energy Conversion (Springer Series in Photonics) 1st ed. 2003. 2nd printing 2005 Edition, by Martin A. Green
2. Physics of Solar Cells: From Basic Principles to Advanced Concepts 2nd Edition by Peter Warfel 2004

Course Outcomes (CO):

CO1: Grasp the knowledge about semiconductor materials K1
CO2: Understand about solar energy and its utilization K2
CO3: Learn about third and fourth generation solar cells K3

CO4: Design and fabricate the solar cell K5
CO5: Start the research work related to solar cell K3

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**

Strongly correlating (S) : Marks – 51/60
Moderately correlating (M): Marks – 09/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHT41 **SPECTROSCOPY** **5hrs/5credit**

Cognitive level:

K2: Understand
K3: Apply
K4: Analyze
K5: Create

Objectives:

- Detailed Knowledge of IR and Raman spectroscopy and its application
- Clear understanding of electronic spectroscopy
- Familiarization of NMR and ESR techniques
- Understanding NQR and Mossbauer Techniques.

Unit I: Infrared spectroscopy
Vibrational energy of a diatomic molecule- Infrared selection rules-Vibrating diatomic molecule-Diatomic vibrating rotator- Vibrations of polyatomic molecules-Fermi resonance-Rotation vibration spectra of polyatomic molecules-Normal modes of vibration in crystal-Interpretation of vibrational spectra-Group frequencies-IR spectrophotometer-Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications (10 Hrs)

Unit II: Raman spectroscopy
Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman spectra-Mutual Exclusion principle-Raman spectrometer-Sample handling techniques-Polarization of Raman scattered light-Structure determination using IR and Raman spectroscopy-Raman investigation of phase transitions-Resonance Raman scattering-Nonlinear Raman phenomena-

Preliminaries-Hyper Raman effect-Stimulated Raman scattering-Inverse Raman effect-Coherent Anti-Stokes Raman scattering (9hrs)

Unit III: Electronic spectroscopy

Introduction-Vibrational Coarse structure-Vibrational analysis of band systems-Deslandres table-Progression and sequences-Information derived from vibrational analysis-Franck-Codon principle-Intensity of vibrational electronic spectra-Rotational fine structure of electronic vibration spectra-The Fortratparabolae-Dissociation-Predissociation-Electronic angular momentum in diatomic molecules-Photoelectron spectroscopy (9 hrs)

Unit IV:

NMR Techniques:

Magnetic properties of Nuclei-Resonance condition-NMR instrumentation-Relaxation processes-Bloch equations-Dipolar interaction-Chemical shift-Indirect spin-spin interaction-High resolution Hamiltonian-Matrix elements of the High resolution Hamiltonian-NMR spectrum of a spin ½ AB systems-NMR spectra of solids-Magic angle spinning NMR-Resonance of other Nuclei-Nuclear quadrupole effects-Intermolecular exchange-Hindered rotation-NMR imaging-Interpretation of certain NMR spectra

ESR Techniques:

Introduction-Principle of ESR-ESR spectrometer-Total Hamiltonian-Hyperfine structure-ESR spectra of free radicals in solution-Anisotropic systems-System in Triplet states-EPR of Transition metal ions (10 hrs)

Unit V:

NQR Techniques:

Introduction-Principle of Nuclear quadrupole resonance-Transitions for axially symmetric systems-Transitions for non-axially symmetric systems-NQR instrumentation-Crystallographic inequivalence-Chemical bonding-Halogen quadrupole resonance-Quadrupole resonance of minerals- Nitrogen Quadrupole resonance-NQR group frequencies-Hydrogen bonding

Mossbauer Techniques:

Recoilless emission and absorption-Experimental techniques-Isomer shift-Quadrupole interaction-Magnetic hyperfine interaction-Applications (10 hrs)

Book for Study

1. G. Aruldhas, Molecular structure and spectroscopy (Second Edition), PHI Learning Private Ltd, 2017. (Unit I-V)

Books for Reference

1. Colin N. Banwell, Elaine M. McCash, Fundamentals of Molecular Spectroscopy (Fourth Edition), Tata McGraw-Hill Publishing Company Ltd, 1995.
2. J.D. Graybeal, Molecular Spectroscopy, McGraw-Hill, New York, 1988.
3. Hollas, Michael, Modern Spectroscopy (Fourth Edition) John Wiley, New York, 2004.
4. R.P Straughen, S.Walker, Spectroscopy Vols.I,II and III, Chapman & Hall, London, 1976

Course Outcomes (CO):

CO1: Understand about principle and concept of different spectroscopic techniques K2
CO2: Understand deeply about different instrumentation and working procedure of spectroscopic technique. K2
CO3: Identity the spectroscopic techniques to analyze different mechanism and properties of the Materials K3
CO4: Identify and analyze which spectroscopic tool is used for their research work K3
CO5: Can seek employability in industries K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**M**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**

Strongly correlating (S) : Marks – 46/60
Moderately correlating (M): Marks – 14/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHT42 **NUCLEAR PHYSICS AND PARTICLE PHYSICS** **5hrs/5credit**

Cognitive level:

K1 : Recall
K2: Understand
K3: Apply
K4: Analyze

Objective:

- Different properties of nucleus learnt
- Detailed knowledge on nuclear models.
- Familiarization of the experimental tecniques.
- Understanding the concept of Elementary Particles.

Unit I: General Properties of nuclei (10 hrs)

Charge-Mass-Radius-Angular momentum (Spin)- Magnetic dipole moment- Electric Quadra pole moment- Parity- Isobaric spin (isospin) – statistics- The nuclear level spectrum - Nuclear forces

Unit II: Nuclear models (10hrs)

Types of models- The liquid drop model, Shell model – Empirical evidence for the regularity of nuclear properties- The single particle shell model- The collective Model –Collective vibration & rotation – Single Particle motion in a deformed potential – Decay of unstable nuclei- Electromagnetic transitions – General properties and selection rules- the lifetime- energy

relation- internal conversion- determination of transistionprobalities- angular correlation-β decay –General prosperities- Neutrinos and antineutrinos- The Fermi theory – selection rules- electron capture- Alpha decay- general properties- barrier penetration of alpha decay-Spontaneous fission decay

Unit III: Experimental Techniques: (8 hrs)

Passage of charged particles and radiation through matter – Energy loss by collision- Energy loss by radiation- Absorption of electromagnetic radiation-Detectors for nuclear structure studies – Gaseous detector- Solid state detector-Detectors for particle physics studies- Bubble chamber- Multiwire proportional chambers and drift chambers- streamer chamber- spark chamber- Cherenkov and transition radiation detectors- total absorption calorimeters

Unit IV: Nuclear reactions (8 hrs)

Disintegration of nitrogen by alpha particles & proton- induced activity & fission– Formalism – Compound nuclear reactions- origin- discrete resonanace-continuum states- The Optical model of particle induced nuclear reactions

Unit V: Elementary Particle Physics (12 hrs)

Classification of elementary particles – Leptons, Hadrons and Quarks – Fundamental interactions and their unification

Symmetry Transformations and conservation laws: The group SU (2) and isospin symmetry an example of the SU(2) group - charge conjugation – Time reversal – The CPT theorem – SU(3) symmetry, Nucleon doublet and pion triplet – Meson octet, Baryon octet and decuplet.

Book for study

1. W.E.Burcham and M.Jobes, Nuclear and Particle Physics, International student edition, Addison Wesley Longmen, Inc (1998) (Unit I-V)

Books for reference

1. D,C, Tayal, Nuclear Physics (2nd Edition), Himalayan Publishing House, Bombay (2009)
2. K.S. Krane, Introductory Nuclear Physics (John - Wiley, New York, 1987.
3. M.L.Pandya and R.P.S. Yadav, Elements of Nuclear Physics, KedarNath Ram Nath, Meerut, 2004.

Course Outcomes (CO):

CO1: Learn about basic properties of nuclei K1
CO2: Acquire knowledge about different nuclear models K2
CO3: Understand what happen when charged particles and radiation passed through matter by various experimental procedure K2
CO4: Gain knowledge about Q-value and theories of nuclear reactions K4
CO5: Learn about different classification and properties of elementary particles.K4

Outcome Mapping

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**M**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**

Strongly correlating (S) : Marks – 46/60
Moderately correlating (M): Marks – 14/60
Weekly correlating (W) : Marks – 0
No correlation (N) : Marks – 0

PPHP44 **PROJECT and VIVA-VOCE** **18hrs/5 credit**

Each Candidate will submit a project report on a topic in Physics/ Material Science/ Astrophysics after carrying out the project work under the supervision of a guide. The project may be theoretical or experimental or even a compilation of literature on a current topic. The duration of the project will be roughly two months (including the vacation of one month) in the final semester.

The project report will be evaluated by an external examiner and viva voce will be conducted by a committee consisting of the external examiner, guide and the department faculty.

Employability/Entrepreneurship/ Skill Development

Name of the Course	Course Code	Name of the Programme	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development
Mathematical Physics-I	PPHT11	M.Sc. Physics	Problem Solving Skill
Mathematical Physics- II	PPHT21	M.Sc. Physics	Problem Solving Skill
Applied Electronics	PPHT13	M.Sc.Physics	In Electronics industries-Employability
Electronics Practical I	PPHP11	M.Sc.Physics	Skill Development
Astrophysics/ Numerical Methods	PPHE11	M.Sc.Physics	Telescope operator in Astro Laboratory
Quantum Mechanics I	PPHT22	M.Sc.Physics	Problem solving skill
Statistical Mechanics and Thermodynamics	PPHT23	M.Sc.Physics	Thermodynamics problem solving Skills
General Practical-II	PPHP22	M.Sc.physics	Skill Development
Classical Mechanics	PPHT12	M.Sc.Physics	Problem solving skill in rigid body motion
Material Characterisation / Microprocessor	PPHE22	M.Sc.Physics	In Electronics industries-Employability
Electromadnetic Theory	PPHT31	M.Sc.Physics	Problem Solving Skills in electro and magnetostatics.
Quantum Mechanics II	PPHT32	M.Sc.Physics	Problem solving Skill
Solid State Physics	PPHT33	M.Sc.Physics	In Material Science laboratory-Employability
Practical-III	PPHP33	M.Sc.Physics	Skill Development
Material Science/Solar Cells	PPHE33	M.Sc.Physics	In Electronics industries & in Solar companies- Employability
Nuclear and Particle Physics	PPHT42	M.Sc.Physics	In nuclear and atomic laboratory
Project	PPHP44	M.Sc.Physics	Skill development
Spectrography	PPHT41	M.Sc.Physics	As technician in Spectroscopy Laboratory-employability