KONGUNADU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

COIMBATORE - 641029

DEPARTMENT OF PHYSICS (PG)

CURRICULM AND SCHEME OF EXAMNINATIONS (CBCS)

(2022-2023)

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE -641029

DEPARTMENT OF PHYSICS

Vision:

The goal of the Department of Physics is to bring eminence and excellence in teaching learning process and to fetch ours as one of the Benchmark Department with "Potential for Academic excellence"

Mission:

To execute the teaching profession to bring the students as an asset for a productive and fascinating career, successful in their life and to realize learning with real world experience.

PROGRAMME OUTCOME (PO)

Upon successful completion of the programme, the student will be able to

PO1: Develop knowledge of scientific phenomena, facts, laws, concepts, theories, scientific quantities and their determination, scientific and technological applications as well as their social, economic and environmental implications.

PO2: Think critically; interpret precise concepts to arrive at scientific conclusions.

PO3: Acquire relevant information from a variety of sources and be able to communicate scientific information in a clear, concise and logical manner both verbally and in writing.

PO4: Students are expected to acquire a basic knowledge in various branches of Physics.

PO5: Students are expected to develop written and oral communication skills in communicating Physics related topics.

PO6: Students will realize and develop an understanding of the impact of Physics and Science on the society.

PO7: Apply conceptual understanding of Physics in other disciplines such as Engineering, Mathematics, Computer science and Chemistry.

PO8: Demonstrate the ability to do advanced lab experiments that apply the principles learned in the class rooms.

PROGRAMME SPECIFIC OUTCOME (PSO)

1. Students are expected to acquire a basic knowledge in various branches of Physics.
2. Students are expected to develop written and oral communication skills in communicating Physics related topics.
3. Students will realize and develop an understanding of the impact of Physics and Science on the society.
4. Apply conceptual understanding of Physics in other disciplines such as Engineering, Mathematics, Computer science and Chemistry.
5. Demonstrate the ability to do advanced lab experiments that apply the principles learned in the class rooms.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE-641 029

Course Name: M.Sc. PHYSICS
Curriculum and Scheme of Examination under CBCS
(Applicable to students admitted during the Academic year 2022–2023)

Semester	Subject code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam. Hrs.	Credits
				CIA	ESE	Total		
I	22PPH101	Core Paper 1 - Classical Mechanics	5	50	50	100	3	4
	22PPH102	Core Paper 2 - Mathematical Physics	5	50	50	100	3	4
	22PPH103	Core Paper 3 - Condensed Matter Physics I	5	50	50	100	3	4
	22PPH1E1	**Major Elective 1**	5	50	50	100	3	5
		Core Practical 1 - General Experiments	5	-	-	-	-	-
		Core Practical 2 - Electronics Experiments	5	-	-	-	-	-
Total			**30**	**-**	**-**	**400**	**-**	**17**
II	22PPH204	Core Paper 4 - Quantum Mechanics I	5	50	50	100	3	4
	22PPH205	Core Paper 5- Thermodynamics and Statistical mechanics	5	50	50	100	3	4
	22PPH206	Core Paper 6 – Thin Film Physics, Plasma Physics and Crystal growth	5	50	50	100	3	4
	22PPH2E2	**Major Elective 2**	5	50	50	100	3	5
	22PPH2CL	Core Practical 1 - General Experiments	5	50	50	100	4	5
	22PPH2CM	Core Practical 2 - Electronics Experiments	5	50	50	100	4	4
Total			**30**	**-**	**-**	**600**	**-**	**26**

III	22PPH307	Core Paper 7 - Quantum Mechanics II	**5**	**50**	**50**	**100**	**3**	**4**
	22PPH308	Core Paper 8 - Electromagnetic theory and Electrodynamics	**5**	**50**	**50**	**100**	**3**	**4**
	22PPH309	Core Paper 9 -; Condensed Matter Physics II	**4**	**50**	**50**	**100**	**3**	**4**
	22PPH3N1	**Non Major Elective 1**	**4**	**50**	**50**	**100**	**3**	**4**
		EDC	**2**	**100**	**-**	**100**	**3**	**2**
		Core Practical 3 - Advanced Experiments	**5**	**-**	**-**	**-**	**-**	**-**
		Core Practical 4 - Special Electronics Experiments	**5**	**-**	**-**	**-**	**-**	**-**
Total			**30**	**-**	**-**	**500**	**-**	**18**
IV	22PPH410	Core Paper **10** - Problems in Physics	5	50	50	100	3	4
	22PPH411	Core Paper **11** - Atomic & Molecular Spectroscopy	6	50	50	100	3	4
	22PPH412	Core Paper 12 - Nuclear and Particle Physics	5	50	50	100	3	4
	22PPH4N2	**Non Major Elective 2**	4	100	-	100	3	4
	22PPH4CN	Core Practical **3** - Advanced Experiments	5	50	50	100	6	5
	22PPH4CO	Core Practical **4** - Special Electronics Experiments	5	50	50	100	6	4
	22PPH4Z1	**Project and Viva Voce**	-	50	50	100	-	4
Total			**30**	**-**	**-**	**700**	**-**	**29**
Grand Total			**-**	**-**	**-**	**2200**	**-**	**90**

Note:

- CBCS - Choice Based Credit System
- CIA - Continuous Internal Assessment
- ESE - End-of-Semester Examinations

Major Elective papers

(2 papers are to be chosen from the following 4 papers)

1.Electronics and Microprocessors
2.Communication Physics
3.Energy Physics
4.Industrial Physics

Non - Major Elective Papers

(2 papers are to be chosen from the following 4 papers)

1. Nanotechnology: Principles and Applications
2. Intellectual Property Rights
3. Information Security #
4. Research Ethics

To be offered by the department

Sub. Code & Title of the Extra Departmental Course (EDC):

22PPH3X1 - EDC Paper - Biomedical Instrumentation

Advanced Learners Course (ALC):

Advanced Experimental Techniques

Tally Table:

Subject	No. of Subjects	Total Marks	Credits
Core – Theory / Practical / Project	**17**	**1700**	**70**
Major Elective Papers	**2**	**200**	**10**
EDC Paper	**1**	**100**	**2**
Non Major Elective Paper	**2**	**200**	**8**
Grand Total	**22**	**2200**	**90**

- 50 % CIA is applicable to all subjects except NME1(Information Security) , JOC and SWAYAM courses. JOC and SWAYAM courses are considered as extra credit courses.

- The students should complete a **SWAYAM-MOOC** before the completion of the 3rd semester and the course completed certificate should be submitted through the HOD to the Controller of Examinations. Two **extra credits** will be given to the candidates who have successfully completed. In case the students have completed more than one online course, the appropriate two extra credits shall be awarded to such candidates upon the submission of certificate through the HOD to the Controller of Examinations.

- A **Field Trip** preferably relevant to the course should be undertaken every year.

Components of Continuous Internal Assessment (50 Marks)

Components		Marks	Total
Theory			
CIA I	75	(75+75) converted to 30	50
CIA II	75		
Problem based Assignment**		10	
Attendance		5	
Others*		5	
Practical			
CIA Practical		(50) converted to 30	50
Observation Notebook		15	
Attendance		5	
Project			
Review		45	50
Regularity		5	

* Class Participation, Case Studies Presentation, Field Work, Field Survey, Group Discussion, Term Paper, Workshop/Conference Participation, Presentation of Papers in Conferences, Quiz, Report/Content writing. Etc.

** Two Assignments to be given. (Each 5 marks).

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

(K1-Remembering;**K2**-Understanding;**K3**-Applying;**K4**-Analyzing;**K5**-Evaluating)

1. Theory Examination

i) CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 – K2 Q1 to 20	A (Answer all)	20 x 1 = 20	MCQ-10/ Fill ups-5/ One word-5	75**
K2 – K5 Q21 to 28	B (5 out of 8)	5 x 5= 25	Short Answers	
K2 – K5 Q29 to 33	C (3 out of 5)	3 x 10 = 30	Descriptive / Detailed	

**** For ESE 75 marks converted to 50 marks.**

2. ESE Practical Examination:

Knowledge Level	Section	Marks	Total
K3, K4, K5	Experiments	40	50
	Record Work	10	

3. ESE Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3, K4, K5	Project Report	30	50
	Viva voce	20	

4. Add On Course: Advanced Learners Course (ALC)

Section A – Multiple Choice (10 × 1 = 10 marks)
Section B – Either or type (5 × 6 = 30 marks)
Section C – Either or type (5 ×12 = 60 marks)

***

Sub. Code: 22PPH101

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper 1 – Classical Mechanics		
Batch 2022-2023	Semester 1	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

To enable the learners to know about the

1. Mechanics of single and system of particle
2. Generalized coordinates, Lagrangian formulation and mechanics of rigid body motion
3. Hamiltonian formulation of mechanics, Hamilton-Jacobi theory, harmonic oscillator problem, theory and applications of small oscillations.

Course outcomes (CO)

K1 to K5	**CO1**	Know about Newtonian mechanics
	CO2	Gain knowledge about Lagrangian formulation
	CO3	Acquire knowledge about mechanics of rigid body motion.
	CO4	Know about Hamiltonian formulation
	CO5	Understand Hamilton-Jacobi theory and small oscillations

Syllabus

Unit – I **15 hrs**

Mechanics of single and system of particles

Newton's laws of motion – Mechanics of a particle - Equation of motion of a particle – Motion of a particle under constant force and alternating force – Mechanics of systems of particles – Angular momentum of the system – kinetic energy of the system – Motion of two particles equivalent to single particle – Equation of motion of center of mass with respect to center of force – Motion in an inverse square law force field – Classification of orbits.

Unit – II **15 hrs**

Lagrangian formulation

Generalized coordinates and constraints – principle of virtual work and D'Alembert's principle – Lagrange's equation for a conservative system – velocity dependent potentials and dissipation function - Hamilton's principle – Lagrange's equations of motion from Hamilton's principle – extension of the principle to non-conservative and non-holonomic systems – conservation theorems and symmetry properties - Applications of Lagrangian and variational principle: simple pendulum, compound pendulum, double pendulum, simple harmonic oscillators.

Unit - III **15 hrs**

Mechanics of rigid body motion

Generalized coordinates for rigid body motion – Euler's integrals – infinitesimal rotations – Coriolis force – application of a free fall of a body on earth's surface and Foucault's pendulum – moments and products of inertia – Euler's equation of motion – force free motion of a symmetrical rigid body – heavy symmetrical top under gravity **– fast top and sleeping top conditions*.**

Unit - IV **15 hrs**

Hamiltonian formulation

Hamilton's equation of motion – cyclic coordinates and Routh's procedure – conservation theorem – Hamilton's equation of motion from variational principle – principle of least action – canonical transformation – equations of canonical transformation and generating functions – examples of canonical transformations – integral invariance of Poincare-Lagrange and Poisson's brackets – equations of motion in Poisson bracket notation – Jacobi's identity-infinitesimal contact transformations – angular momentum – Poisson bracket relations – Liouville's theorem.

UNIT – V **15 hrs**

Hamilton-Jacobi theory and small oscillations

Hamilton-Jacobi equations for Hamilton's principle and characteristic functions – harmonic oscillator problem – separation of variable method – action angle variables – applications – linear harmonic oscillator and Kepler problem – theory of small oscillations – Eigenvalue equations – normal modes and normal coordinates – application to triatomic molecule.

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Gupta S.L.Kumar, Sharma, (2012), Classical Mechanics – Pragathi Publications, Meerut.
2. Sathya Prakash, Gupta B.D, (2012), Classical Mechanics - Kedarnath Ramnath & Co., Meerut.

Reference Books:

1. Aruldhas.G, (2008), Classical Mechanics - Prentice Hall of India Pvt. Ltd., New Delhi.
2. Goldstein, Pearson, (2014), Classical Mechanics - New Age International Ltd., New Delhi.
3. Sankara Rao, (2009), Classical Mechanics - PHI learning Pvt. Ltd., New Delhi.

e-Resources:

1. https://nptel.ac.in/courses/115106123
2. https://nptel.ac.in/courses/115105098
3. https://nptel.ac.in/courses/122106027
4. https://youtu.be/rk0rp2Jpidc?list=PLyqSpQzTE6M_d9f-9fKxUQYR1qI5YEnSz
5. https://www.youtube.com/watch?v=W0Kd_gouAyQ

Mapping

CO PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	S	H	S	S	H
CO 2	S	H	S	S	H
CO 3	H	S	S	H	S
CO 4	S	H	H	S	S
CO5	S	H	S	S	H

S- Strong **H-High** **M-Medium** **L – Low**

Sub. Code: 22PPH102

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper 2 - Mathematical Physics		
Batch 2022-2023	Semester 1	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

To enable the learners to

1. Understand complex variables, group theory & tensors
2. Know about types of differential equations in Physics
3. Study about numerical methods

Course outcomes (CO)

K1 to K5	**CO1**	Understanding of complex analysis including important theorems and determination of residues to evaluate definite integrals
	CO2	Solve partial differential equations and be familiar with special functions such as Bessel, Legendre and Hermite
	CO3	Have knowledge in abstract group theory and tensors
	CO4	Understand partial differential equations in Physics
	CO5	Apply numerical methods to obtain appropriate solutions to mathematical problems

Syllabus

UNIT I **15 hrs**

Complex variables

Elements of complex analysis –**Taylor and Laurent series** *- Cauchy- Riemann differential equation - Complex line integrals-Cauchy's integral theorem – Cauchy's integral formula-derivatives of an analytic function–Singularities of an analytic function - Residues and their evaluation - Cauchy's residue theorem – Evaluation of definite integrals by contour integration – integration round the unit circle of the type $f(\cos\theta, \sin\theta)d\theta$ - evaluation of $f(x)dx$.

UNIT II **15 hrs**

Special functions

Bessel differential equation: Series Solution – Bessel's function of first kind - Half order Bessel function - Recurrence formula for Jn(x) – Generating function for Jn(x). Legendre's differential equation: Series solution - Legendre polynomials - Generating function- Recurrence relations – Rodrigue's formula - Orthogonality of Legendre's polynomials. Hermite's differential equation: Series solution – Hermite's polynomials – Generating function Recurrence formula – Rodrigue's formula for Hermite's polynomials - Orthogonality of Hermite's polynomials

UNIT III **15 hrs**

Group theory and Tensors

Group Theory

Definition of groups – groups of transformation – multiplication table (C_{4v}) - conjugate elements and classes – sub groups - cyclic groups - cosets - Lagrange's theorem- normal subgroups - factor subgroups - reducible and irreducible representation of a group - Schur's lemma orthogonality theorem – construction of character table for C_{2v}.

Tensors

Introduction – n dimensional space – superscripts and subscripts – coordinate transformation – indicial and summation conventions – dummy and real indices – Kronecker delta symbol – scalars, contravariant and covariant vectors – tensors of higher ranks – algebraic operations of tensors.

UNIT IV **15 hrs**

Partial differential equations in Physics

Introduction – solution of Laplace's equation in Cartesian coordinates – solution of Laplace's equation in two dimensional cylindrical coordinates(r, θ): circular harmonics - solution of Laplace equation in general cylindrical coordinates: cylindrical harmonics - solution of Laplace's equation in spherical polar coordinates; spherical harmonics - diffusion equation or Fourier equation of heat flow - solution of heat flow equation - (method of separation of variables) - two dimensional heat flow - three dimensional heat flow.

UNIT V **15 hrs**

Numerical Analysis

Bisection and Newton – Raphson's method of finding roots of the equation - Giraffe's root squaring method of solving algebraic equation - Gregory-Newton forward and backward interpolation formulae - solution of simultaneous linear equation by Gauss elimination and Gauss – Jordan's method – solution of ordinary differential equation by Euler method and Runge - Kutta second and fourth order methods – Evaluation of integral by means of Trapezoidal and Simpson's one third rule.

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Sathya Prakash, (2001), Mathematical Physics with Classical Mechanics - S.Chand & Co. New Delhi.
2. M.K.Venkataraman, (2001), Numerical Methods in Science and Engineering - National Pub. Co. New Delhi.

Reference Books:

1. B.D Gupta, (2010), Mathematical Physics - Vikas Publishing House, New Delhi.
2. A.W. Joshi, (2009), Elements of group theory for Physicists - New Age International Pub., New Delhi.
3. A.Singaravelu, (2000), Engineering Mathematics - Meenakshi Pub. Co., Hyderabad.

e-Resources:

1. https://nptel.ac.in/courses/115105097 - Mathematical Methods in Physics-I
2. https://nptel.ac.in/courses/111106152 - Mathematical Methods in Physics-II

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	S	H	S
CO 3	S	H	S	S	H
CO 4	S	H	S	H	H

CO5	**H**	**S**	**S**	**H**	**S**

S- Strong **H-High** **M-Medium** **L – Low**

Sub. Code: 22PPH103

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper 3 – Condensed Matter Physics I		
Batch 2022-2023	Semester 1	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

To enable the learners to

1. Understand the crystal system of materials
2. Know about crystal imperfection and lattice vibrations
3. Study about lattice and electronic specific heat

Course outcomes (CO)

K1 to K5	CO1	Understand the crystal structure and reciprocal lattice
	CO2	Understand the crystal structure by XRD
	CO3	Gain knowledge about crystal imperfection
	CO4	Acquire knowledge on lattice vibrations and thermal properties
	CO5	Acquire knowledge about lattice and electronic specific heat

Syllabus

Unit I **15 hrs**

Crystal structure and reciprocal lattice

Space lattices - Bravais lattices, crystal structures – finding Miller indices of a plane - Interplanar distance – separation between lattice planes in SC, FCC and BCC lattices - Hexagonal closed packed structure (qualitative) - crystal density - packing fraction - reciprocal lattice - Graphical construction and vector development – Properties of reciprocal lattice – **Bragg's condition in terms of reciprocal lattice**[*].

Unit II **15 hrs**

Structure determination by x-ray diffraction

Structure factor - Bragg's law of x-ray diffraction - determination of lattice parameters and interplanar spacing from Bragg's equation - Powder method of x-ray diffraction - crystal structure determination - condition of reflections for SC, BCC, FCC and DC structures - Evaluation of lattice planes - lattice constant and inter - atomic distance from XRD data.

Bonding in solids

Ionic bonds – Metallic bonds – Vander waals' bonds – Hydrogen bonds – Binding energy of ionic crystals – Evaluation of the Madelung constant – Binding energy of crystals of inert gases.

Unit III **15 hrs**

Crystal imperfections

Classification of imperfections: Point imperfections: Frenkel defects and Schottky defect – Line imperfections: edge dislocation - screw dislocation - Burger's vector - energy of dislocation - Surface imperfections: grain boundaries - tilt boundary - twin boundary - Plastic deformation by slip: shear strength of perfect and real crystals - stress to move a dislocation - effect of temperature on stress to move a dislocation.

Sub. Code: 22PPH103

Unit IV **15 hrs**

Lattice vibrations and thermal properties

Concept of lattice mode of vibration - elastic vibrations of continuous media - phase velocity - group velocity - vibrations of one dimensional monatomic linear lattice - vibrations of one dimensional diatomic linear lattice - concept of phonons - momentum of phonons - inelastic scattering of photons by phonons - inelastic scattering of x-rays by phonons - inelastic scattering of neutrons by phonons.

Unit V **15 hrs**

Lattice specific heat: Concepts of specific heat - Dulong and Petit's law - Einstein theory of lattice specific heat - Debye theory of lattice specific heat

Free electron theory and electronic specific heat: Classical free electron theory of metals - drawbacks of classical theory - quantum theory of free electrons - free particle - tunnel effect - particle in one and three dimensional box - density of states - Fermi Dirac distribution function - heat capacity of electron gas - Sommerfeld's quantum theory for electronic heat capacity - electrical and thermal conductivity -failures of Sommerfeld's theory - thermoelectric power *.

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. S.O.Pillai, (2018), Solid State Physics - New Age Publishers, New Delhi.
2. V.Raghavan, (2015), Material science and Engineering - Prentice Hall Limited, New Delhi.

Reference Books:

1. Puri R.K, Babbar.V.K, (2017), Solid State Physics - S.Chand & Co., New Delhi.
2. Charles Kittel, (2019), Introduction to Solid State Physics – Wiley, India Edition.

e-Resources:

1. https://www.uou.ac.in/lecturenotes/science/MSCPHY17/Solid%20state%20physics%20unit%202%20(3)(1).pdf
2. https://khwarizmi.org/wp-content/uploads/2010/10/csd1.pdf
3. https://www.slideshare.net/Mandardj/types-of-bonding-in-solids
4. http://www.nitjsr.ac.in/course_assignment/MME09MM%201101Crystal%20Imperfections--%20point,%20line%20and%20planar%20defect.pdf
5. https://www.itp.tu-berlin.de/fileadmin/a3233/upload/SS12/TheoFest2012/Kapitel/Chapter7.pdf

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	S	S	M	L
CO 2	S	S	S	M	M
CO 3	S	L	S	M	L
CO 4	S	S	S	M	L
CO 5	S	M	S	M	L

S- Strong **H-High** **M-Medium** **L – Low**

Sub. Code: 22PPH204

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper 4 – Quantum Mechanics I		
Batch 2022-2023	Semester 2	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

Enable the learners to

1. Gain knowledge on General formalism of quantum mechanics
2. Gain knowledge on energy Eigenvalue problems, angular momentum and approximation methods
3. Understand time dependent, time independent and perturbation theories.

Course Outcomes (CO)

K1 to K5	**CO1**	Knowledge on General formalism of quantum mechanics
	CO2	Knowledge on one and three dimensional energy Eigenvalue problems
	CO3	Knowledge on energy angular momentum
	CO4	Acquire knowledge on time independent quantum approximation methods
	CO5	Understand time dependent perturbation theory and semi-classical treatment of radiation

Syllabus

UNIT I **15 hrs**

General formalism of quantum mechanics

Linear vector space – linear operator – Eigenvalues and Eigenfunctions – Hermitian operator – postulates of Quantum mechanics – simultaneous measurability of observables – General uncertainty relation - Dirac's notation – equations of motion – Momentum representation.

UNIT II **15 hrs**

One and three dimensional energy Eigenvalue problems

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 – Particle moving in a spherically symmetric potential – spherical harmonics – radial equation – system of two interacting particles – rigid rotator – hydrogen atom – radial equation and its solution – energy eigenvalues – radial wave functions – wave function of hydrogen like atoms – radial probability density.

UNIT III **15 hrs**

Angular momentum and their properties

Angular momentum operator in position representation – spin angular momentum – total angular momentum operators – commutation relations of total angular momentum with components – Eigenvalues of J^2 and J_Z – Eigenvalues of J_+ and J_- - Eigenvalues of J_X and J_Y – Explicit form of the angular momentum matrices – Addition of angular momenta: Clebsch Gordan coefficients – properties of Clebsch Gordan coefficients.

Sub. Code: 22PPH204

UNIT IV **15 hrs**

Time independent quantum approximation methods

Stationary perturbation theory (non-degenerate case): evaluation of first order energy and evaluation of first order correction to wave function – normal helium atom – stationary perturbation theory (degenerate case): first order Stark effect in hydrogen atom – variation method – WKB method – application of WKB method – probability of penetration of a barrier

UNIT V **15 hrs**

Time dependent perturbation theory : Time development of states – transition probability – Fermi Golden rule – adiabatic approximation

Semiclassical treatment of radiation: Einstein coefficients – atom field interaction – spontaneous emission rate –quantum theory of radiation and its interaction with matter – quantization of radiation field*

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. G.Aruldhas, (2019), Quantum Mechanics - PHI learning Pvt. Ltd., New Delhi.
2. Gupta,Kumar and Sharma, (2010),Quantum Mechanics -Jai Prakash Nath Co., Meerut.

Reference Books:

1. P.M.Mathews, K.Venkatesan, (2010), A Text Book of Quantum Mechanics - Tata McGraw Hill education Pvt. Ltd., New Delhi.
2. Leonard. I. Schiff, (2002), Quantum mechanics - McGraw Hill Co., New Delhi.

e-Resources:

1. https://web.mst.edu/~parris/QuantumOne/Class_Notes/GeneralFormulation.pdf
2. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Quantum_Mechanics/05.5%3A_Particle_in_Boxes/Particle_in_a_3-Dimensional_box
3. https://www.lehman.edu/faculty/anchordoqui/chapter19.pdf
4. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf
5. http://www.tcm.phy.cam.ac.uk/~bds10/aqp/handout_dep.pdf

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	S	H	H	H
CO 2	H	S	S	S	S
CO 3	H	H	H	H	H
CO 4	S	S	H	S	S
CO5	H	S	S	H	S

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH205

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper 5 - Thermodynamics and Statistical Mechanics		
Batch 2022-2023	Semester 2	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

To enable the learner to know about

1. Thermodynamics and ensembles
2. Classical distribution law and quantum statistics
3. Application of quantum statistics.

Course outcomes (CO)

K1 to K5	CO1	Know about thermodynamics and radiations
	CO2	Acquire knowledge on ensembles
	CO3	Get knowledge about classical distribution law
	CO4	Get knowledge about quantum statistics
	CO5	Understand applications of quantum statistics

Syllabus

UNIT I: Thermodynamics and Radiation **15 hrs**

Second law of thermodynamics: entropy - disorder - thermodynamic potential and reciprocity relation - thermodynamic equilibrium - chemical potential - black body radiation – Planck's radiation law.

UNIT II: Ensembles **15 hrs**

Phase space - volume in phase space - number of phase cells in a given energy range of harmonic oscillator - number of phase cell in a given energy range of 3 dimensional free particle - concept of ensemble - microcanonical ensemble - canonical ensemble- grand canonical ensemble - density distribution in phase space- Liouvilles theorem- principle of equal a priori probabilities - statistical equilibrium - thermal equilibrium - mechanical equilibrium - particle equilibrium - connection between statistical and thermodynamic quantities.

UNIT III: Classical Distribution Law **15 hrs**

Microstates and Macrostates - Classical Maxwell Boltzmann distribution law- Evaluation of constants (α and β) - Maxwell's law of Distribution of velocities - Principle of equipartition of energy - Connection between the partition function and thermodynamic quantities – Boltzman's entropy relation – Perfect gas in microcanonical Ensembles - Gibbs paradox- Partition function and its correlation with thermodynamics quantities - Partition functions and its properties - Comparison of ensembles.

UNIT IV: Quantum Statistics **15 hrs**

Indistinguishability and quantum statistics - Statistical weight and a priori probability- Identical particle's and symmetry requirements - Bose Einstein' Statistics - Fermi Dirac Statistics - Maxwell Boltzmann's statistics - Comparison of M-B, B-E, and F-D statistics- Thermodynamic interpretation of parameters (α and β) - Eigenstates and Maxwell Boltzmann's equation - Thermodynamic properties of diatomic molecules - Specific heat of solids: Dulong and Pettit's law - Einstein's Theory - Debye theory.

Sub. Code: 22PPH205

UNIT V: Application of Quantum Statistics **15 hrs**

Ideal Bose Einstein gas

Energy and pressure of ideal Bose Einstein gas - Gas Degeneracy - Bose Einstein condensation - Thermal properties of Bose Einstein gas - Liquid helium.

Ideal Fermi- Dirac gas

Energy and pressure of ideal Fermi Dirac gas – Weak degeneracy – Strong degeneracy at T=0 K - Fermi energy - Fermi temperature - Thermodynamic functions of degenerate Fermi Dirac gas - Electron gas - Free electron model and electronic emission.

*** Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Gupta Kumar, (2019), Elementary statistical mechanics - Pragati Prakashan Pub., Meerut.
2. Kamal Singh, S.P.Singh, (2019), Elements of Statistical Mechanics - S.Chand & Co., New Delhi.

Reference Books:

1. Keiser Huang, (2008), Fundamentals of Statistical Mechanics – Wiley, India.
2. Fried, (2010), Fundamentals of Statistical Mechanics and Thermal Physics - McGraw Hill Pub., New Delhi.

e-Resources:

1. https://nptel.ac.in/courses/115/103/115103113/
2. https://www.youtube.com/watch?v=rDHQ60CXDbU
3. https://www.youtube.com/watch?v=XIXQ38JnF0k
4. https://nptel.ac.in/courses/115/103/115103113/
5. https://www.youtube.com/watch?v=Ih01TfuEfqU

Mapping

CO PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	S	S	H	H	S
CO 2	S	H	S	H	S
CO 3	S	S	H	S	S
CO 4	S	H	S	H	S
CO5	S	H	S	H	S

S- Strong **H-High** **M-Medium** **L – Low**

Sub.Code: 22PPH306

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper-6 Thin Film Physics, Plasma Physics and Crystal Growth		
Batch 2022-2023	Semester 3	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

To enable the learners to

1. Understand the preparation and characterization of thin films
2. Understand the fundamentals of plasma Physics
3. Acquire knowledge about crystal growth techniques

Course outcomes (CO)

K1 to K5	CO1	Understand the principles, advantages and disadvantages of different thin film deposition methods
	CO2	Understand the growth mechanism of thin films
	CO3	Understand the fundamentals of plasma
	CO4	Can distinguish single particle approach and fluid approach
	CO5	Understand different crystal growth techniques

Syllabus

UNIT I **15 hrs**

Methods of preparation of thin films

Physical vapor deposition: Basic vacuum systems - vacuum evaporation – sputtering - DC/RF sputtering - electron beam evaporation - pulsed laser deposition.

Chemical deposition: Sol-gel method - spin coating - dip coating- spray pyrolysis- chemical bath deposition- atomic layer deposition.

UNIT II **15 hrs**

Nucleation, growth and thickness measurements

Nucleation and growth: Thermodynamics of nucleation – nucleation theories - film growth - incorporation of defects, impurities in thin film – deposition parameters - grain size.

Thickness measurements: Interferometry – Fringes of equal thickness (FET) – Fringes of equal chromatic order (FECO) – step gauges - ellipsometry – stylus profilometry - vibrating quartz crystal method - gravimetric balance method.

UNIT III **15 hrs**

Plasma state characterization

Occurrence of plasma in nature - definition of plasma – concept of temperature - Debye shielding - plasma parameters - criteria for plasma – single particle motion: uniform B field – uniform E and B fields - Gravitational field – **non uniform B field*** – curved B –magnetic mirrors.

UNIT IV **15 hrs**

Fluid theory and Application of Plasma

Derivation of fluid equation of motion - fluid drifts perpendicular to B - fluid drifts parallel to B - Production of nanoparticles by plasma - Plasma nitriding - Plasma sources for hospital waste - Plasma treatment of textiles.

Sub.Code: 22PPH306

UNIT V **15 hrs**

Crystal growth

Growth from liquid solution: Aqueous solution growth – Holden's rotary crystallizer- Mason jar method - temperature differential methods- chemical reactions – sol gel growth – liquid crystal (preliminary ideas only). Hydrothermal growth: Modified Bridgemann hydrothermal autoclave- Morley hydrothermal autoclave – phase equilibria and solubility - kinetic quartz.

*** Self-study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. A.Goswami, (2006), Thin Film Fundamentals - New Age International Ltd, New Delhi.
2. Francis F.Chen, (2016), Introduction to Plasma Physics and controlled fusion - Plenum Press, Open library.
3. P.I. John, (2005), Plasma Sciences and the creation of wealth, Tata McGraw Hill, India.
4. H. L. Bhat, (2014), Introduction to Crystal Growth: Principles and Practice, CRC Press, USA.

Reference Books:

1. L.T. Meisssel and R.Glang, (1970), Hand book of thin film Technology - McGraw Hill, India
2. Nichola A. Krall, Alvin W. Trivelpiece, (1986), Principles of Plasma Physics- McGraw Hill, India.
3. K.L. Chopra, (1979), Thin Film Phenomena - Robert E. Krieger Publishing Company, USA.

e-Resources:

1. https://www.youtube.com/watch?v=p0XxWT2QdEk
2. https://www.youtube.com/watch?v=lxNYAxr5lPc
3. https://www.youtube.com/watch?v=wO2HS7hcSb8
4. https://www.digimat.in/nptel/courses/video/115102020/L01.html
5. https://www.youtube.com/watch?v=NTVGPRvFpR0

Mapping

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	S	H	H
CO 2	S	H	H	S	S
CO 3	H	S	S	S	H
CO 4	S	H	H	H	S
CO 5	H	S	H	S	H

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH307

Programme: 03		M.Sc. Physics		
Title of the Paper		**Core Paper 7 - Quantum Mechanics II**		
Batch	**Semester**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**3**	**5**	**75**	**4**

Course Objectives

To enable the learners to

1. Understand the basic approximate methods in molecular quantum mechanics
2. Understand relativistic quantum theory, quantum optics
3. Understand quantization of fields and scattering

Course outcomes (CO)

K1 to K5	**CO1**	Understand different approximations and models to describe a many electron system
	CO2	Comparison of MO and VB theories to explain molecular structure of hydrogen molecule and hydrogen ion
	CO3	Understand relativistic quantum mechanics
	CO4	Acquire knowledge on quantum field theory
	CO5	Interpret scattering theory in terms of quantum aspects.

Syllabus

UNIT I **15 hrs**

Many electron atoms

Indistinguishable particles – Pauli principle – Inclusion of Spin – Spin functions for two electrons - Spin functions for three electrons – Helium atom – Central Field approximation – Thomas Fermi model of the atom – Hartree equation – Hartree Fock equation

UNIT II **15 hrs**

Molecular structure

Born Oppenheimer approximation – molecular orbital theory (LCAO approximation) - hydrogen molecule ion – hydrogen molecule (MO method) - valence bond (VB method) – comparison of MO and VB theories

UNIT III **15 hrs**

Relativistic Quantum mechanics

Klein Gordan equation – interpretation of Klein Gordan equation – particle in a coulomb field – Dirac's equation for a free particle – Dirac matrices – covariant form of Dirac's equation - probability density - plane wave solution - negative energy states - spin of Dirac particle – magnetic moment of the electron – spin orbit interaction.

UNIT IV **15 hrs**

Quantum field theory

Concept of field - second quantization - quantization of wave field –Lagrangian & Hamiltonian density – Lagrangian and Hamiltonian field equations - quantum canonical equations - Quantum equations for nonrelativistic Schrödinger equation - creation, destruction and number operators – anti commutation relations (basic concepts) – **Quantization of electromagnetic field***

Sub. Code: 22PPH307

UNIT V **15 hrs**

Quantum theory of scattering

Scattering cross section - scattering amplitude – partial waves – scattering by a central potential - partial wave analysis - significant number of partial waves - Born approximation – scattering by a screened coulomb potential – validity of Born approximation.

*** Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. G.Aruldhas, (2019). Quantum mechanics - PHI learning Pvt. Ltd., New Delhi.
2. A.K.Chandra, (2017), Introductory Quantum Chemistry - Tata McGraw Hill.,

Reference Books:

1. Gupta Kumar Sharma, (2010), Quantum mechanics - Jai Prakash Nath & Co, Meerut.
2. P.M.Mathews, K.Venkatesan, (2010), A Text Book of Quantum Mechanics - Tata Mc Graw Hill, India
3. Lenard I Schiff, (2010), Quantum mechanics - Tata Mc Graw Hill, India

e-Resources:

1. https://youtu.be/RTjJ7H79WAI
2. https://youtu.be/iPRW1ft90vk
3. https://youtu.be/ryp5FRIB6A0
4. https://youtu.be/JjidYZYb_ck
5. https://www.youtube.com/watch?v=OO9Wr9uveFg

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	H	S
CO 2	H	H	H	S	H
CO 3	S	S	S	H	S
CO 4	S	H	H	S	S
CO5	S	S	S	H	S

S- Strong **H-High** **M-Medium** **L – Low**

Sub. Code: 22PPH308

Programme: 03		M.Sc. Physics		
Title of the Paper		Core Paper 8 – Electromagnetic Theory and Electrodynamics		
Batch	**Semester**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**3**	**5**	**75**	**4**

Course Objectives

To know about

1. Electrostatics and magnetostatics
2. Applications of Maxwell's equations
3. Antenna arrays

Course outcomes (CO)

K1 to K5	**CO1**	Understand electrostatics and magnetostatics
	CO2	Acquire knowledge on field equations and conservation laws
	CO3	Understand the propagation of electromagnetic waves in different media on microscopic scale
	CO4	Study the interaction of electromagnetic waves with different media on macroscopic scale
	CO5	Acquire knowledge on relativistic electrodynamics

Syllabus

UNIT I **15 hrs**

Electrostatics

Dielectric polarization – external field of a dielectric medium – electric displacement vector (D) - linear dielectrics – relation connecting electric susceptibility, polarization vector (P), D and dielectric constant – Molecular field and Clausius Mosotti relation for nonpolar molecules – Langevin Debye formula for polar molecules - Electrostatic energy and energy density.

Magnetostatics

Biot Savart law statement – Lorentz force law and definition of B – general proof of Ampere's Circuital law – divergence and curl of B – magnetic scalar potential (derivation of expression only) – equivalence of a small current loop and a magnetic vector potential (derivation of expression only).

UNIT II **15 hrs**

Field equations and conservation laws

Equation of continuity – displacement current –Maxwell's equations derivation and Physical significance – Poynting vector – momentum in electromagnetic fields - electromagnetic potentials - Maxwell's equation in terms of electromagnetic potentials - concept of gauge – Lorentz gauge - Coulomb gauge - radiation from an accelerated charged particle at low velocity (Larmour formula) - oscillating electric diode- radiation from a small current element – linear half wave antenna **- antenna array*.**

Sub. Code: 22PPH308

UNIT III **15 hrs**

Propagation of electromagnetic waves

Electromagnetic waves in free space – poynting vector of free space (energy flow) - plane electromagnetic waves in matter – isotropic dielectric in conducting media – poynting vector in conducting media - propagation in ionized gases.

Interaction of EMW with matter on microscopic scale

Scattering and scattering parameters - scattering by a free electron (Thomson scattering) – scattering by a bound electron (Rayleigh scattering) – dispersion in gases – normal and anomalous dispersion in liquids and solids.

UNIT IV **15 hrs**

Interaction of EMW with matter on macroscopic scale

Boundary conditions at interfaces – reflection and refraction - Fresnel's law – Brewster's law and degree of polarization – total internal reflection and critical angle - reflection from a metal surface - wave guide (rectangular) – TE waves – TM waves.

UNIT V **15 hrs**

Relativistic Electrodynamics

Four vectors and Tensors – Transformation equations for charge (ρ) and current densities (J) – Transformation equations for the electromagnetic potentials A and ϕ - Electromagnetic field tensor - Transformation equations for the field vectors E and B – Covariance of Maxwell equation in terms of four vectors – Covariance and Transformation law of Lorentz force.

UNIT V **15 hrs**

Relativistic Electrodynamics

Four vectors – Transformation relation for charge and current densities for electromagnetic potentials – covariant form of inhomogeneous wave equations - covariance of field equation in terms of four vectors – covariant form of electric and magnetic field equations – covariance of electromagnetic field tensor –transformation relation for field vector E and B – covariance form of Lorentz force law.

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Chopra & Agarwal, (2010), Electromagnetic theory - K.Nath & Co, Meerut.
2. Gupta Kumar& Singh, (2020), Electromagnetics - Pragathi Prakashan, Meerut.
3. Electromagnetic theory (Electrodynamics), (2020), K.K.Chopra and G.C. Agarwal, Kethar Nath & Co, Meerut.

Reference Book:

1. Sathya Prakash, (2018), Electromagnetic theory and Electrodynamics - Kedar Nath, Ram Nath & Co, Meerut.

Sub. Code: 22PPH308

e-Resources:

1. https://www.youtube.com/watch?v=ZC4GgMapjHo
2. https://www.youtube.com/watch?v=CX7X6YrVUdk
3. https://www.youtube.com/watch?v=GvtFNfotKaE
4. https://www.youtube.com/watch?v=GurdC_KknKY
5. https://www.youtube.com/watch?v=e8EjV0AzKVI

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	S	H	H	S
CO 2	H	S	S	S	H
CO 3	S	H	H	H	H
CO 4	H	S	H	H	S
CO 5	H	S	H	H	S

S- Strong H-High M-Medium L – Low

Sub. Code: 22PPH309

Programme: 03		M.Sc. Physics		
Title of the Paper		**Core Paper 9 – Condensed Matter Physics II**		
Batch	**Semester**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**3**	**4**	**60**	**4**

Course Objectives

To gain knowledge about

1. Band theory of solids
2. Semiconductors, dielectrics and ferroelectrics
3. Magnetism and superconductors

Course Outcomes (CO)

K1 to K5	**CO1**	Knowledge on band theory of solids
	CO2	Understand semiconductors
	CO3	Acquire knowledge on superconductors
	CO4	Gain knowledge on dielectrics and ferroelectric materials
	CO5	Acquire knowledge on magnetism

Syllabus

Unit I **12 hrs**

Band Theory of solids

Kronig Penney model - construction of 1D, 2D and 3D Brillouin zones - Extended, Reduced and Periodic zone schemes – Number of possible wave function in a band - motion of electron in one dimensional periodic potential - Effective mass of an electron and hole – classification of materials using band theory - **Energy bands in metals, semiconductors and insulators***.

Unit II **12 hrs**

Semiconductors

Intrinsic semiconductors: band model - electron and hole concentrations – law of mass action – electrical conductivity – Extrinsic semiconductors: impurity state and band model – electron and hole concentrations – impurity electrical conductivity - variation of electrical conductivity with temperature - Hall effect – Hall parameters - PN junction and Fermi energy.

UNIT III **12 hrs**

Superconductivity

Mechanism of superconductivity - critical current – critical magnetic field - Meissner effect – Type I and Type II superconductors - energy gap - isotope effect - penetration depth - specific heat capacity - BCS theory - London equation - superconductors in AC fields - Quantum tunneling: Josephson superconductor tunneling - DC Josephson effect - AC Josephson effect - Macroscopic Quantum interference - SQUID.

Sub. Code: 22PPH309

Unit IV **12 hrs**

Dielectrics and Ferroelectrics

Maxwells equation – Polarization – Macroscopic Electric field : depolarization electric field – Local electric field in an atom – Lorentz field –field of dipoles inside a cavity – dielectric constant and: Electric polarizability – structural phase transition – Ferroelectric crystals : classifications – displacive transition - soft optical phonon – antiferroelectricity and ferroelectric domains – Piezoelectricity - Pyroelectricity - Ferroelasticity.

Unit V **12 hrs**

Magnetism

Langevin's theory of diamagnetism : quantum theory of diamagnetism of mono nuclear systems – Paramagnetism: quantum theory of paramagnetism - rare earth ions – Ferromagnetism: Spontaneous magnetization - Weiss theory of spontaneous magnetization – Hysteresis – Weiss theory of Hysteresis – Ferromagnetic domains – Antiferromagnetism – Molecular field theory – Susceptibility above and below Neel temperature – Ferrimagnetism – Molecular field theory of Ferrimagnetism.

***Self-study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. S.O.Pillai, (2018), Solid State Physics- New Age Publishers, New Delhi.
2. R.L.Singhal, (2019), Solid State Physics - Kedar Nath Ram Nath & Co., Meerut.

Reference Books:

1. R.K Puri, V.K Babbar, (2010), Solid State Physics - S.Chand & Co., New Delhi.
2. Charles Kittel, (2012), Introduction to Solid State Physics-Wiley, India.
3. V.Raghavan, (2015), Material science and Engineering- Prentice Hall Ltd, New Delhi.

e-Resources:

1. http://hyperphysics.phy-astr.gsu.edu/hbase/Solids/band.html
2. https://byjus.com/jee/semiconductors/
3. https://youtu.be/D-9M3GWoBrw
4. https://en.wikipedia.org/wiki/Superconductivity
5. https://en.wikipedia.org/wiki/Magnetism

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	S	H	S
CO 2	S	S	H	S	S
CO 3	S	S	S	S	H
CO 4	S	S	S	S	S
CO 5	S	S	S	S	H

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH410

Programme: 03		M.Sc. Physics		
Title of the Paper		**Core Paper 10 - Problems in Physics**		
Batch	**Semester**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**4**	**5**	**75**	**4**

Course Objectives

To enable the learners to

1. Acquire knowledge and skills to solve problem through the concept behind physics
2. Apply creative thinking techniques towards realistic problem
3. Visualize the basic concepts clearly

Course outcomes (CO)

K1 to K5	**CO1**	Understand and solve problems in classical mechanics
	CO2	Understand and solve problems in quantum mechanics
	CO3	Understand and solve problems in electromagnetics
	CO4	Understand and solve problems in electronics
	CO5	Understand and solve problems in thermodynamics and statistical Physics

Syllabus

UNIT I

Classical Mechanics **15 hrs**

Newton's laws – dynamical systems – phase space dynamics – stability analysis – central force motions – two body collisions – scattering in laboratory and center of mass frames – rigid body dynamics – moment of inertia tensor–non-inertial frames and pseudo forces–variational principle – generalized co-ordinates–Lagrangian and Hamiltonian formalism and equations of motion– conservation laws and cyclic coordinates – periodic motion – small oscillations, normal modes.

Objective type questions (Problem no. 1-100, page no. 148-158), Descriptive type questions (Problem no. 1-15 , page no.185-193)

UNIT II **15 hrs**

Quantum Mechanics

Wave-particle duality – Schrodinger equation (time-dependent and time-independent) – Eigenvalue problems (particle in a box, harmonic oscillator) –Tunneling through a barrier – Wave function in coordinate and momentum representations – Commutators and Heisenberg uncertainty principle – Dirac notation for state vectors – Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta – Hydrogen atom – Stern Gerlach experiment – Time-independent perturbation theory and applications.

Objective type questions (Problem no. 1-100, page no. 330-339), Descriptive type questions (Problem no. 1-15 , page no.388-398

UNIT III **15 hrs**

Electromagnetics

Charge density – total charge of the system – distribution of electric charge – Yukawa potential – spherically symmetric charge distribution – scalar and vector functions of an electric field – electric field inside a uniformly polarized sphere and inside a dielectric – electrostatic energy – of an electron – coplanar electric dipoles – array of charges – repulsion between a point charge and a spherical conductor – negative charge inside an hydrogen atom – potential energy of a nucleus.

Objective type questions (Problem no. 1-100, page no. 224-233), Descriptive type questions (Problem no. 1-15, page no.288-293)

Sub. Code: 22PPH410

UNIT IV **15 hrs**

Electronics

Semiconductor device Physics : diodes - junctions – transistors – field effect devices – homo and heterojunction devices – device structure – device characteristics – Optoelectronic devices : solar cells – photodetectors – LEDs – operational amplifiers and their applications- impedance matching, amplification.

Objective type questions (Problem no. 1-100, page no. 570-577), Descriptive type questions (Problem no. 1-15, page no.637-642)

UNIT V **15 hrs**

Thermodynamics and Statistical Physics

Laws of thermodynamics and their consequences – thermodynamics potentials – axwell relations, chemical potential, phase equilibria – phase space – micro and macrostates – micro canonical – grand canonical ensembles and partition functions –free energy and its connection with thermodynamic quantities.

Objective type questions (Problem no. 1-100, page no. 440-450), Descriptive type questions (Problem no. 1-10, page no.493-498)

Text Book:

1. Dr.Surekha Tomar, (2017), CSIR-UGC NET/JRF/SET Physical Science - Upkar Prakashan, Agra, India

Reference Books:

1. Jain K.C.Arora, (2013), Numerical Problems in Physics - S.Chand & Co., New Delhi.
2. Bukhovtsev.B.Krivchenkov, (2012), Problems in Elementary Physics - CBS Publishers and distributors Pvt. Ltd., New Delhi.

e-Resources:

1. https://iopscience.iop.org/book/978-0-7503-1401-5
2. https://youtu.be/vblPUxn7Om8
3. https://ostad.hormozgan.ac.ir/ostad/UploadedFiles/1859694/1859694-1368629834498910.pdf
4. https://stemez.com/subjects/technology_engineering/1LElectromagnetics/1LElectromagnetics.php
5. https://youtu.be/tw3lZ-GFgpk

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	H	H	H
CO 3	H	S	H	H	S
CO 4	S	H	S	H	H
CO5	S	H	H	S	H

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH411

Programme: 03		M.Sc. Physics		
Title of the Paper		Core Paper 11 - Atomic and Molecular Spectroscopy		
Batch 2022-2023	Semester 4	Hours/Week 6	Total Hours 90	Credits 4

Course Objectives

To enable the learners to

1. Understand atomic, microwave and IR spectroscopy
2. Know about Raman, NMR and NQR spectroscopy
3. Know about ESR and Mossbauer spectroscopy

Course outcomes (CO)

K1 to K5	**CO1**	Understand atomic spectroscopy
	CO2	Gain knowledge on microwave and IR spectroscopy
	CO3	Acquire knowledge on Raman spectroscopy
	CO4	Understand NMR and NQR spectroscopy
	CO5	Acquire knowledge on ESR and Mossbauer spectroscopy

Syllabus

UNIT I **18 hrs**

Atomic spectroscopy

Spectra of alkali metals – elements with more than one outer valence electron - space quantization of angular momentum - magnetic moment of an atom – normal Zeeman effect – anomalous Zeeman effect – emitted transitions in anomalous Zeeman transitions – Lande's g formula – Paschen back effect – hyperfine structure of spectral line – Zeeman effect of hyperfine structure – Back Goudsmit effect.

UNIT II **18 hrs**

Microwave Spectroscopy

Rotation of molecules – rotational spectra of rigid diatomic molecules – intensities of spectral lines – non rigid rotator –spectrum of a non rigid rotator – symmetric top molecules.

IR Spectroscopy

Vibrating diatomic molecules –simple harmonic oscillator – anharmonic oscillator – diatomic vibrating rotator – fundamental vibrations and their symmetry – influence of rotation on vibrational spectra of polyatomic molecules – linear molecules – symmetric top molecules.

Unit III **18 hrs**

Raman spectroscopy

Quantum theory – classical theory – pure rotational Raman spectra – linear molecules – symmetric top molecules – Raman activity of vibrations – rule of mutual exclusion – vibrational Raman spectra – rotational fine structure.

Electronic spectra of diatomic molecules

Vibrational coarse structure – Deslandres tables – Frank Condon principle – rotational fine structure of electronic vibrational transition.

Sub. Code: 22PPH411

UNIT IV **18 hrs**

NMR spectroscopy

Quantum mechanical and classical description – Bloch equations - relaxation processes - spin lattice and spin relaxation – Fourier transformation - Experimental technique - principles and working of Fourier transform - NMR spectrometer - chemical shift.

NQR spectroscopy

Fundamental requirements - general principles - Half integral spins - Integral spins - experimental detection of NQR frequencies.

UNIT V **18 hrs**

ESR Spectroscopy

Basic principles of ESR - ESR Spectrometer - Reflection cavity and microwave bridge – ESR spectrum - Hyperfine structure **– Study of free radicals*.**

Mossbauer Spectroscopy

Mossbauer effect - recoil emission and adsorption – Mossbauer spectrum - experimental methods.

*** Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. C.N.Banwell, E.M.Mc Cash, (2017), Fundamentals of Molecular Spectroscopy- Tata McGraw Hill, India
2. B.P.Straughan, S.Walker, (2016), Spectroscopy - John Wiley & Sons, UK.

Reference Books:

1. Gupta Kumar, (2011), Elements of spectroscopy - Pragathi Prakasan, Meerut.
2. G. Aruldhas, (2008), Molecular structure and Spectroscopy - Prentice Hall of India, New Delhi

e-Resources :

1. https://nptel.ac.in/courses/115105100 - Atomic and Molecular Physics
2. https://www.classcentral.com/course/youtube-special-select-topics-in-atomic-physics-47820 - Special/Select Topics in Atomic Physics
3. https://www.classcentral.com/course/youtube-quantum-chemistry-and-spectroscopy-53141 - Quantum Chemistry and Spectroscopy
4. https://www.digimat.in/nptel/courses/video/104108078/L01.html
5. https://www.youtube.com/watch?v=NzbDEjI8IKE

Mapping

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	H	H	H
CO 3	H	S	H	H	S
CO 4	S	H	S	H	H
CO 5	H	S	H	H	S

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH412

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Paper 12 - Nuclear and Particle Physics		
Batch 2022-2023	Semester 4	Hours/Week 5	Total Hours 75	Credits 4

Course Objectives

To enable the learners to

1. Know about radioactivity
2. Gain knowledge on Alpha and Beta particles and Gamma rays
3. Understand nuclear models and particle Physics

Course Outcomes (CO)

K1 to K5	CO1	Study the phenomenon of radioactivity
	CO2	Understand Alpha and Beta particles and Gamma rays
	CO3	Gain knowledge on nuclear properties
	CO4	Acquire knowledge on nuclear models
	CO5	Gain knowledge on elementary particles

Syllabus

UNIT I **15 hrs**

Radioactivity

Discovery of radioactivity - law of radioactive decay – half life of radioactive nuclei – average or mean life of an atom – successive radioactive transformations – radioactive equilibrium – unit of radioactivity – radioactive dating - carbon dating- ratio of Uranium to Helium – ratio of Pb^{206} to Pb^{207} – specific ionization – secondary ionization and delta rays – straggling : stopping power – range of straggling for electrons.

UNIT II **15 hrs**

Alpha particles: Properties of alpha particles – velocity and energy of alpha particles – alpha decay and barrier penetration – Gamow's theory of alpha decay.

Beta particles: General features of beta ray spectrum – Pauli's hypothesis – Fermi's theory of allowed beta decay – beta decay lifetime – experimental verification of beta decay – forms of interaction and selection rules.

Gamma rays: Nature of Gamma rays – passage – photoelectric absorption – Compton scattering – electron – positron pair production and annihilation.

Unit III **15 hrs**

Nuclear properties

Nonexistence of electrons inside the nucleus – nuclear spin – Pauli's spin – parity – statistics – angular momentum – magnetic dipole moment – electric moments – electric quadrupole moment – nuclear size – electrical methods : Mesonic x rays – electron scattering method

Nuclear methods – neutron scattering method – isotopic shift in line spectra – nuclear mass and mass spectrometery : Aston's mass spectrograph – double focusing spectrometer – Nier's mass spectrograph – mass synchrometer – nuclear stability – binding energy – mass defect and packing fraction – semiempirical mass formula.

Unit IV **15 hrs**

Nuclear models

Constitution of nucleus – neutron proton hypothesis – nuclear models – liquid drop model – Bethe Weizsacker formula – applications of semiempirical binding energy formula – ermi gas model of the nucleus – nuclear shell structure – single particle shell model – individual particle model – collective model.

UNIT V **15 hrs**

Particle Physics

Classification of elementary particles – fundamental interactions: gravitational – electromagnetic – strong and weak – properties of elementary particles – Gell Mann Okubo mass formula for Baryons – CP violation in K decay – Quark model – **Higgs boson*.**

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books

1. M.L.Pandya, R.P.S.Yadav, Amitya Dash, (2020), Elements of Nuclear Physics- Kedar Nath Ram Nath & Co, Meerut.
2. S.N.Ghoshal, (2019), Nuclear Physics - S.Chand & Co., New Delhi.

Reference Books

1. Bernard L Cohen, (2018), Concept of Nuclear Physics - Tata Mc Graw Hill, India.
2. Kenneth S Krane, (2019), Modern Physics, JohnWiley & Sons.
3. D.C.Tayal, (2018), Nuclear Physics - Himalayan Publishing House, New Delhi.

e-Resources:

1. https://www.youtube.com/watch?v=Rd0CJje59bE
2. https://www.youtube.com/watch?v=josqjcH79PE&list=PLbMVogVj5nJRvq-w3zway7k3GzmUDte3a
3. https://www.youtube.com/watch?v=iMhDYarsfII&list=PLbMVogVj5nJRvq-w3zway7k3GzmUDte3a&index=24
4. https://www.youtube.com/watch?v=VTHQYjkCqV0
5. https://www.youtube.com/watch?v=cD-ZlLA2UgI

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	S	H	S
CO 2	S	H	H	S	S
CO 3	H	S	S	S	H
CO 4	S	H	H	H	S
CO 5	S	H	S	H	S

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH2CL

Programme code : 03		M.Sc. Physics		
Title of the Paper		**Core Practical I – General Experiments**		
Batch	**Semesters**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**1 & 2**	**5**	**150**	**5**

Course Objectives

To enable the learners to

1. Perform experiments in the field of general Physics
2. Explain physical phenomena and enable to relate physical laws and their applications
3. Apply standard techniques and analyze the experimental results and output.

Course outcomes (CO)

K3,K4,K5	**CO1**	Have a foundation in fundamentals and applications of general Physics
	CO2	Able to design, carry out record and analyze experimental data.
	CO3	Provide hands on experiences in conducting laboratory experiments.
	CO4	Understand the relationship between theory and experimental results.
	CO5	Practice record keeping of experimental work and data graphing.

List of Experiments (Any fifteen)

1. Determination of Young's modulus-elliptical fringes (Cornu's method)
2. Determination of Young's modulus-hyperbolic fringes (Cornu's method)
3. Determination of coefficient of viscosity of a liquid-Mayer's oscillating disc
4. Determination of Stefan's constant
5. Determination of Rydberg's constant - solar spectrum
6. Determination of thickness of insulation of a thin wire using laser source
7. Determination of wavelength by oblique incidence - Grating
8. Determination of wavelength of laser source - Grating
9. Determination of refractive index of a liquid - Newton's ring method
10. Determination of refractive index of a liquid - Air wedge method

11. Study of emission line spectra - Constant deviation spectrometer
12. Determination of refractive index of given liquids - Laser
13. Study of characteristics of Laser
    i Determination of Gaussian nature of laser source and evaluation of beam spot size.
    ii Measurement of laser beam divergence.
    iii Study of absorption of light on various filters.
14. Determination of TCR and band gap energy of thermistor- Carey Foster's bridge
15. Determination of thermal conductivity – Forbe's method
16. Determination of specific heat of liquid - Ferguson's method
17. Determination of liner expansion of solids - Fizeau's method
18. Determination of coefficient of selfinductance of a coil - Anderson's bridge method.
19. Determination of audio frequencies -Wien Bridge method
20. Determination of e/m - Millikan's method
21. Determination of e/m - Thomson's method

e- Resources:

1. https://www.youtube.com/watch?v=acBEQ8qqVKU
2. https://www.youtube.com/watch?v=U5sdiQSjyHA
3. https://www.youtube.com/watch?v=9mmgpRDoENo
4. https://www.youtube.com/watch?v=UFiPWv03f6g
5. https://www.youtube.com/watch?v=3XJez8bzU34

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	S	H	S
CO 3	S	H	S	S	H
CO 4	S	H	S	H	H
CO5	S	H	H	S	H

S- Strong H-High M-Medium L – Low

Sub. Code: 22PPH2CM

Programme code : 03		M.Sc. Physics		
Title of the Paper		Core Practical II – Electronics Experiments		
Batch 2022-2023	Semesters 1 & 2	Hours/Week 5	Total Hours 150	Credits 4

Course Objectives

To enable the learners to

1. Design and construct electronic circuits
2. Develop experimental skills and understand relation between experimental data and theoretical analysis.
3. Have a foundation in the fundamentals and applications of experimental Physics.

Course outcomes (CO)

K3,K4,K5	CO1	Acquire a basic knowledge in solid state electronics
	CO2	Analyse and design analog electronic circuits using discrete components.
	CO3	Observe the amplitude / frequency response of amplifiers.
	CO4	Take measurements to compare experimental results in the laboratory with the theoretical analysis.
	CO5	Practice record keeping of experimental work and data graphing.

List of Experiments (Any fifteen)

1. Construction of dual regulated power supply
2. Determination of Op-Amp parameters
3. Study of triangular and square wave generator
4. Study of Wien's bridge oscillator
5. Study of active filters - Op Amp
6. Study of monostable and astable Multivibrator - Op Amp
7. Study of inverting and non-inverting amplifiers – Op Amp
8. Study of phase shift oscillator – Op Amp
9. Study of clippers and clampers
10. Study of differentiator and integrator – Op Amp

11. Solving first order differential equations - Op Amp
12. Study of pulse width modulation
13. Characteristics of MOSFET
14. Characteristics of DIAC and TRIAC
15. Characteristics of tunnel Diode
16. Characteristics of SCR
17. Characteristics of UJT and UJT relaxation oscillator
18. Study of FET as common source amplifier
19. Study of FET as common drain amplifier
20. Study of direct coupled amplifier.

e-Resources:

1. https://www.youtube.com/watch?v=gbUXbaxvX94
2. https://www.youtube.com/watch?v=hpCu3HbAiWg
3. https://www.youtube.com/watch?v=j47Yk7bJbxw
4. https://www.youtube.com/watch?v=RZAiZSM92gQ
5. https://www.youtube.com/watch?v=gaSLHttLwag

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	**S**	**H**	**H**	**S**	**H**
CO 2	**H**	**S**	**S**	**H**	**S**
CO 3	**S**	**H**	**S**	**S**	**H**
CO 4	**S**	**H**	**S**	**H**	**H**
CO5	**S**	**H**	**S**	**S**	**H**

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH4CN

Programme: 03		M.Sc. Physics		
Title of the Paper		**Core Practical III – Advanced Experiments**		
Batch	**Semesters**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**3 & 4**	**5**	**150**	**5**

Course Objectives

To enable the learners to

1. Perform experiments in the field of advanced Physics and interpret the results.
2. Explain physical phenomena and enable to estimate various related parameters and to analyze them.
3. Apply the experimental techniques to research level.

Course outcomes (CO)

K3,K4,K5	**CO1**	Gain fundamental knowledge on applications of advanced Physics.
	CO2	Understand the relationship between theory and experiments
	CO3	Provide hands on experiences in conducting scientific investigations
	CO4	Provide hands on experiences in conducting laboratory experiments.
	CO5	Recording and analyzing experimental data.

List of Experiments (Any Fifteen)

1. Determination of numerical aperture, acceptance angle and fiber loss of an optical fiber - Fiber optic experiment
2. Determination of λ of a monochromatic light – Biprism – Optical bench
3. Determination of λ, dλ and thickness of mica sheet – Michelson interferometer
4. Study of optoelectronic devices
5. Determination of Planck's constant – Photocell
6. Determination of magnetic field strength – Search Coil method
7. Determination of magnetic susceptibility of the given solutions – Quincke's method
8. Determination of magnetic susceptibility of the given solutions – Guoy's method
9. Determination of bulk modulus and compressibility of liquids – Ultrasonic diffraction
10. Determination of resistivity of a semiconductor material – Four probe method

11. Determination of Hall parameters of n-type and p-type semiconductors
12. Determination of very low resistance and specific resistance – Kelvin's double Bridge
13. Determination of e/m – Zeeman effect
14. Determination of e/m – Magnetron method
15. Determination of e/m – Helical method
16. Study of BH curve – Anchor ring
17. Study of BH curve – Solenoid
18. Study of IH curve – Solenoid
19. Study of emission arc spectra (Copper/Brass/Iron) – Constant Deviation Spectrograph
20. Study of absorption spectra using $KMNO_4$ solution

e-Resources:

1. https://www.youtube.com/watch?v=Iq3Xv2GdgQk
2. https://www.youtube.com/watch?v=MD_zkNzF3eA
3. https://www.youtube.com/watch?v=qHptDfsBxAs
4. https://www.youtube.com/watch?v=vb8KwB0ANrg
5. https://www.youtube.com/watch?v=bAkNC1wIlGc

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	**S**	**S**	**H**	**S**	**H**
CO 2	**H**	**S**	**S**	**H**	**S**
CO 3	**S**	**H**	**S**	**S**	**H**
CO 4	**S**	**H**	**S**	**H**	**H**
CO 5	**S**	**H**	**S**	**S**	**H**

S- Strong **H-High** **M-Medium** **L – Low**

Sub. Code: 22PPH4CO

Programme: 03		M.Sc. Physics		
Title of the Paper		**Core Practical IV – Special Electronic Experiments**		
Batch	**Semesters**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**3 & 4**	**5**	**150**	**4**

Course Objectives

To enable the learners to

1. Design and construct special electronic circuits
2. Develop experimental skills and understand relation between experimental data and theoretical analysis.
3. Have a foundation in the fundamentals and applications of experimental Physics.

Course outcomes (CO)

K3,K4,K5	**CO1**	Acquire knowledge in solid state electronics
	CO2	Develop the ability to construct electronic circuits using discrete components.
	CO3	Acquire knowledge to construct Op. amp based circuits
	CO4	Acquire knowledge to construct microprocessor based circuits
	CO5	Understand the relation between theory and experiments

List of Experiments (Any Fifteen)

1. Study of V to I and I to V converters – Op Amp
2. Study of D/A converter – binary weighted and ladder methods – Op Amp
3. Study of A/D converter – voltage indicator – Op Amp
4. Study of log and antilog amplifiers – Op Amp
5. Study of half wave and full wave rectifiers – Op Amp
6. Study of clippers and clampers – Op Amp
7. Study of comparator and zero crossing detector – Op Amp
8. Study of window detector and time marker – Op Amp
9. Study of light intensity inverse square law – Op Amp
10. Solving second order differential equations – Op Amp

11. Study of monostable and astable multivibrators – 555 Timer
12. Study of Schmitt trigger and voltage controlled oscillator – 555 Timer
13. Study of RS and JK flip flops
14. Microprocessor – Music tone generator
15. Microprocessor – DAC – Wave form generator
16. Microprocessor – ADC interface
17. Microprocessor – LED display interfacing
18. Microprocessor – Stepper motor interfacing
19. Microprocessor – Traffic control simulation
20. Microprocessor – Temperature controller

e-Resources:

1. https://www.youtube.com/watch?v=Uc2R7GND0Dk
2. https://circuitdigest.com/electronic-circuits/jk-flip-flop-truth-table-working
3. https://www.youtube.com/watch?v=w9otDOoAUpk
4. https://www.wikitechy.com/tutorials/linear-integrated-circuits/clippers
5. https://www.youtube.com/watch?v=ypV6gdIJJU4

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	**S**	**H**	**H**	**S**	**H**
CO 2	**H**	**S**	**S**	**H**	**S**
CO 3	**S**	**H**	**S**	**S**	**H**
CO 4	**S**	**H**	**S**	**H**	**H**
CO 5	**S**	**H**	**S**	**S**	**H**

S- Strong **H-High** **M-Medium** **L - Low**

Sub. Code: 22PPH4Z1

Programme: 03		**M.Sc. Physics**		
Title of the Paper		**Project and Viva Voce**		
Batch	**Semester**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**4**	**-**	**-**	**4**

Marks Distribution

CIA/ESE	**Particulars**	**Marks**
CIA	Project Review	45
	Regularity	05
	Total Internal Marks	**50**
ESE *	Project Report Presentation	30
	Viva Voce	20
	Total External Marks	**50**
Total Marks (CIA + ESE)		**100**

* Project report and viva voce will be evaluated jointly by project supervisor and external examiner.

MAJOR ELECTIVE PAPERS

(2 papers are to be chosen from the following 4 papers)

1. Electronics and Microprocessor
2. Communication Physics
3. Energy Physics
4. Industrial Physics

Programme code : 03		M.Sc. Physics		
Title of the Paper		Major Elective Paper - Electronics and Microprocessor		
Batch 2022-2023	Semester 1 / 2	Hours/Week 5	Total Hours 75	Credits 5

Course Objectives

To enable the learners to

1. Know about power electronics, operational amplifiers and non-linear integrated circuits
2. Understand architecture of microprocessors
3. Know about peripheral devices, interfacing and data acquisition systems.

Course Outcomes (CO)

K1 to K5	**CO1**	Understand power electronics
	CO2	Gain knowledge on operational amplifiers and non-linear integrated circuits
	CO3	Understand architecture of microprocessors
	CO4	Know about peripheral devices and interfacing
	CO5	Know about data acquisition systems

Syllabus

UNIT I **15 hrs**

Power Electronics

Triac: construction - operation –characteristics – applications - Diac: applications - Unijunction transistor (UJT): equivalent circuit – characteristics – applications – Silicon controlled rectifier (SCR) – Power control - Thyristors - Power MOSFET.

UNIT II **15 hrs**

Nonlinear integrated circuits

Operational amplifiers: inverting, non-inverting and differential amplifiers - integrator and differentiator – log and antilog amplifiers - voltage to current converters – current to voltage converters – sample and hold circuits - high input impedance amplifiers – Instrumentation amplifiers: sensing amplifier and comparator – zero crossing detector – window detector – Time marker.

UNIT III **15 hrs**

Microprocessor architecture

Introduction – Intel 8085 - pin diagram - Instruction cycle –Timing diagram for OP code - fetch cycle – Memory read – Memory write – I/O read - I/O write – Instruction set – Addressing mode.

UNIT IV **15 hrs**

Peripheral devices and interfacing

Addressing space partitioning – memory and I/O interfacing – programmable peripheral interface - Intel 8255 - programmable DMA controller - Intel 8257 - programmable communication interface - Intel 8251 - Programmable counter - Time interval - Intel 8253.

UNIT V **15 hrs**

Microprocessor based data acquisition system

Analog to digital converter (ADC) - Digital to analog (DAC) - **LED Interfacing*** – Stepper Motor Interfacing – Traffic control simulation – Music tone generator –Temperature controller.

*** Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Millman Halkias, (2017), Integrated Electronics - Tata McGraw Hill, New Delhi.
2. B.Ram, (2011), Fundamentals of Microprocessors & Microcontrollers - Dhanpat Rai Publications, New Delhi.

Reference Books:

1. P.Mathur, C.Kulshreshta, R.Chada, (2005), Electronic Devices Applications and Integrated Circuits - Umesh Publications, New Delhi.
2. D.Roy Choudhary, Shail B.Jain, (2014), Linear Integrated Circuits - New Age International, New Delhi.

e-Resources:

1. https://www.youtube.com/watch?v=R9dQ875hkfg
2. https://youtu.be/iXSXIJn_Xwc
3. https://youtu.be/djbJm-xWo2w
4. https://www.youtube.com/watch?v=tas2eUavhRE
5. https://www.youtube.com/watch?v=FJknBjBJrOM

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	**S**	**H**	**H**	**H**	**S**
CO 2	**S**	**S**	**S**	**S**	**H**
CO 3	**H**	**H**	**S**	**S**	**S**
CO 4	**H**	**S**	**S**	**H**	**S**
CO 5	**S**	**S**	**H**	**S**	**H**

S- Strong **H-High** **M-Medium** **L - Low**

Programme: 03		M.Sc. Physics		
Title of the Paper		Major Elective Paper - Communication Physics		
Batch 2022-2023	Semester 1/2	Hours/Week 5	Total Hours 75	Credits 5

Course Objectives

To enable the learners to

1. Understand various modulation and detection techniques
2. Acquire knowledge about antennas and wave propagation
3. Understand generation and propagation of microwaves
4. Acquire knowledge on radar and communication electronics

Course Outcomes (CO)

K1 to K5	**CO1**	Understand the concept of modulation and demodulation
	CO2	Understand the principle of antennas and wave propagation
	CO3	Knowledge on television and radar
	CO4	Acquire knowledge on communication electronics
	CO5	Understand microwave generation

Syllabus

UNIT I **15 hrs**

Modulation and Detection

Need for modulation – modulation index - principles of AM and FM with circuit diagrams – Comparison of DSB, SSB, DSBSC and VSB transmission – multichannel communications (FDM, TDM) – AM detection – Frequency Discriminator - Ratio detector.

UNIT II **15 hrs**

Antennas and Wave propagation

Elementary doublet - terms and definitions in connection with antennas - effect of ground on antennas – effect of antenna height - antenna coupling at medium frequencies - antenna arrays : Yagi Uda antenna - broad side array - end fire array - Wide band and special purpose antennas : helical antenna, discose antenna and phased arrays – Ground wave propagation - sky wave propagation - line of sight.

UNIT III **15 hrs**

Television and Radar

Black and white TV: Transmission – reception – Color TV: Transmission - Reception - Elements of RADAR system –RADAR equation – Radar performance factors – Radar Transmitting systems – Radar Antennas - Duplexers - Radar Receivers and Indicators – Pulsed systems.

UNIT IV **15 hrs**

Communication electronics

Fundamentals of data communication systems – data sets and interconnection requirements – network and control considerations – multiplexing – short and medium haul systems – long haul systems – elements of long distance telephony – satellite communication – **Features of a communication network –TYMNET, ARPANET, ISDN, LAN*.**

UNIT V **15 hrs**

Microwaves

Microwave generation – Multicavity Klystron - Reflex Klystron – Magnetron, TWT and other microwave tubes - Microwave transistors – Microwave integrated circuits – Parametric amplifiers – Tunnel diode – Gunn diode.

* **Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. George Kennedy Davis, (2011), Electronic Communication systems-Tata McGraw Hill, India.
2. Anokh Singh, A.K.Chhabra, (1999), Principles of Communication Engineering - S.Chand & Co., New Delhi.

Reference Books:

1. F.E. Terman, (1992), Electronics and Radio Engineering - McGraw Hill, India.
2. Simon Haykin, (2010), Communication Systems - John Wiley & Sons, India.

e-Resources:

1. https://www.youtube.com/watch?v=Q-9VkiR_RE0
2. https://www.youtube.com/watch?v=fSoXIqBlg9M
3. https://www.youtube.com/watch?v=XlUx9xDJqeg
4. https://www.youtube.com/watch?v=qhjj6WG7Rgc
5. https://www.youtube.com/watch?v=ZbNItCNZK3s

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	S	H	S
CO 3	S	H	S	S	H
CO 4	S	H	S	H	H
CO 5	S	H	H	S	H

S- Strong **H-High** **M-Medium** **L – Low**

Programme code : 03		M.Sc. Physics		
Title of the Paper		Major Elective Paper - Energy Physics		
Batch 2022-2023	Semester 1 / 2	Hours/Week 5	Total Hours 75	Credits 5

Course Objectives

To enable the learners to

1. Know about Solar thermal and photovoltaic energy
2. Understand hydrogen energy, wind energy and ocean thermal energy
3. Understand energy auditing and carbon credits.

Course Outcomes (CO)

K1 to K5	**CO1**	Understand Solar thermal energy
	CO2	Gain knowledge on solar photovoltaic energy
	CO3	Understand wind and ocean thermal energy
	CO4	Know about Hydrogen energy and Fuel cells
	CO5	Understand energy auditing and carbon credits

Syllabus

UNIT I **15 hrs**

Solar thermal energy

Solar radiation : solar constant - solar radiation at the earth surface - physical principles of conversion of solar radiation into heat – Solar energy collectors : flat plate collectors - concentrating collector - parabolic reflectors and mirror - strip reflector - advantages and disadvantages of concentrating collectors over flat plate collectors - solar energy storage - solar pond - principle of operation and description of non-convective solar pond - **applications of solar ponds***.

UNIT II **15 hrs**

Solar photovoltaic energy

Fundamentals of photovoltaic conversion - semiconductor materials - photon energy - electron hole concentration - Fermi level – pn junction – light absorption in a semiconductor - solar cell materials - efficiency of solar cells - silicon solar cell - polycrystalline and amorphous silicon cells - photovoltaic applications.

UNIT III **15 hrs**

Wind and Ocean thermal energy

Basic principles of wind energy conversion – nature and power of wind - forces on the blades and thrust on turbines - wind energy conversions (WEC) - site selection conservations - basic components of the wind energy conversion system - classification of WEC systems - advantages and disadvantages of WECs - energy storage - applications of wind energy.

Ocean thermal energy

Ocean thermal energy conversion (OTEC) – methods of ocean thermal electric power generation - open cycle OTEC system - heat exchangers - bio-fouling – site selection – energy utilization - hybrid Cycle.

UNIT IV **15 hrs**

Hydrogen energy and Fuel cells

Hydrogen energy

Hydrogen production - electrolysis or electrolytic production of hydrogen - solar energy methods - biophotolysis and photoelectrolysis - hydrogen storage - hydrogen transformation - utilization of hydrogen gas - electric power generation - hydrogen in fuel cells - hydrogen as an alternative fuel for motor vehicles - safety and management.

Fuel Cells

Principle of operation - classification -hydrogen fuel cells - Advantages and disadvantages of fuel cells - applications of fuel cells.

Unit V **15 hrs**

Energy Auditing and Carbon Credit

Economic concept of energy – Principles of Energy conservation and Energy Audit - types of energy Audits – **Global Climate change - Greenhouse effect*** – Emissions from Combustion of Natural gas - Emission trading - carbon credits – carbon currency – carbon credits under Kyoto Protocol - Trading of Carbon Credits and India's perspectives – Implementing of CDM projects in India - Potential CDM projects in India.

***Self-study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. H.P.Garg, J. Prakash, (2016), Solar energy fundamentals and applications-McGraw Hill, India.
2. G.D.Rai, (2017), Non-Conventional Energy Sources - Khanna Publishers, New Delhi.

Reference Books:

1. Fahrebruch, Bube, (2012), Fundamentals of solar cells- Academic Press Inc. New York
2. Winter, Nitch, (2012), Hydrogen as an Energy Carrier- Springer, India.
3. Albert Thumann, (1984), Fundamentals of Energy Engineering - Fairmont Press Inc.

E-Resources:

1. https://nptel.ac.in/courses/103103206
2. https://youtu.be/VdYtTWOQrNs
3. https://youtu.be/DD0Y6Snxpdk
4. https://youtu.be/L2VSOccUrSk
5. https://youtu.be/CNgVv2bBj00

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	S	H	S
CO 3	S	H	S	S	H
CO 4	S	H	S	H	H
CO 5	H	S	H	S	S

S- Strong **H-High** **M-Medium** **L - Low**

Programme code : 03		M.Sc. Physics		
Title of the Paper		Major Elective Paper - Industrial Physics		
Batch 2022-2023	Semester 1 / 2	Hours/Week 5	Total Hours 75	Credits 5

Course Objectives

To enable the learners to

1. Understand power electronic devices
2. Understand voltage regulators, switching and counting circuits
3. Understand industrial heating system and production of vaccum

Course Outcomes (CO)

K1 to K5	**CO1**	Understand power electronic devices
	CO2	Understand voltage regulators
	CO3	Gain knowledge on switching and counting circuits
	CO4	Know about industrial heating system
	CO 5	Acquire knowledge on production of vacuum

Syllabus

UNIT I **15 hrs**

Power electronic devices

Time delay action – RC time constant - direct coupling of transistor- Darlington circuit – differential amplifier, Uni junction transistor (UJT)– Silicon Controlled Rectifiers (SCR) - SCR in simple AC circuits – phase control of the SCR – firing by UJT- phase control by pedestal and ramp – turn off of SCR - Jones circuit - Triac circuits – **Zero voltage switching circuit*.**

UNIT II **15 hrs**

Voltage regulators

Regulators of voltage and motor speed – voltage compensator - DC regulated Power supplies - Inverters – multivibrator inverter – SCR inverter - Closer loop systems – Servomechanisms – basic part of a serve – complete serve diagram – loop gain – PID controllers.

UNIT III **15 hrs**

Switching and counting circuits

Flip-flops – shift register – serial to parallel converter - MOS gates – complementary MOS – digital to analog converter – sample and hold information conversion – parallel to serial converter – multiplexer – addressing – BCD and octal binary codes – numeric displays - microprocessor and its operation.

UNIT IV **15 hrs**

Industrial heating systems

Electron beam heating – microwave heating – induction heating - measurement of light, PMT – photodiode – IR detectors – thermocouple amplifiers - optical pyrometer – strain – strain gauges – electrochemical transducers.

UNIT V

Production of vacuum **15 hrs**

Rotary pumps – diffusion pumps – ion getter pumps – design of high vacuum units – ultra high vacuum units - measurement of pressure – pirani gauge – penning gauge – hot cathode ionization gauges – **UHV gauges***.

*** Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Book:

1. G.M. Chute and R.D. Chute, (1985), Electronics in Industry - McGraw Hill, India.

Reference Book:

1. Roth, Alexander, (1994), Vacuum Sealing Techniques – Springer Science & Business Media, UK.

e-Resources:

1. https://www.youtube.com/watch?v=R9dQ875hkfg
2. https://youtu.be/iXSXIJn_Xwc
3. https://youtu.be/djbJm-xWo2w
4. https://www.youtube.com/watch?v=tas2eUavhRE
5. https://www.youtube.com/watch?v=FJknBjBJrOM

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	S	H	S
CO 3	S	H	S	S	H
CO 4	S	H	S	H	H
CO 5	H	S	S	H	S

S- Strong **H-High** **M-Medium** **L - Low**

NON-MAJOR ELECTIVE PAPERS

(2 papers are to be chosen from the following 4 papers)

1. **Nanotechnology: Principles and Applications**
2. **Information Security**
3. **Intellectual Property Rights**
4. **Research Ethics**

Programme: 03		M.Sc. Physics		
Title of the Paper		Non Major Elective Paper – Nanotechnology : Principles and Applications		
Batch 2022-2023	Semester 3	Hours/Week 4	Total Hours 60	Credits 4

Course Objectives

To enable the learners to

1. Understand the concepts in nanomaterials
2. know about different synthesis processes of nanomaterials
3. know about characterization techniques and applications of nanomaterials

Course Outcomes (CO)

K1 to K5	CO1	Understand the concepts in nanomaterials
	CO2	Know the synthesis methods of 0-D, 1-D, 2-D and 3-D nanomaterials
	CO3	Know the various characterization methods
	CO4	Gain knowledge on properties of nanomaterials
	CO5	Understand the applications of nanomaterials

Syllabus

UNIT I **12 hrs**

Concepts in Nanomaterials

Classification of nanomaterials – Quantum confinement in semiconductor nanostructures: quantum well, quantum wires and quantum dots - Electronic density of states - Surface to volume ratio versus shape - quantum Hall effect - Resonant tunneling – Inter band and Intra band absorption in semiconductor nanostructures - Light emission processes in nanostructures - phonon bottleneck in quantum dots.

UNIT II **12 hrs**

Synthesis of Nanoscale materials and structures

Methods of making 0-D Nanomaterials: Inert gas condensation - Inert gas expansion - Sonochemical processing - Spray pyrolysis - Sol-gel deposition and molecular self-assembly - Methods of making 1-D and 2-D Nanomaterials: Foil beating – Electrodeposition – Physical Vapor Deposition (PVD) – Chemical Vapor Deposition (CVD) -Methods of making 3-D Nanomaterials: Top down processes: Milling and mechanical alloying - Methods of nanoprofiling -Micromachining – **Photolithography*.**

UNIT III **12 hrs**

Characterization of Nanomaterials

X-ray Diffraction - UV-Vis Spectrophotometer - Scanning Electron Microscope – Transmission Electron Microscope, HR-TEM – Atomic Force Microscope – Scanning Tunneling Microscope – Laser Raman Spectrometer – x ray Photoelectron Spectroscopy.

UNIT IV **12 hrs**

Properties of Nanomaterials

Mechanical properties of nanostructured materials: nanodispersions - nanocrystalline solids - Thermal properties: melting point, thermal transport - Electrical properties – Magnetic properties: GMR - Optical properties - Surface plasmon resonance - photocatalytic properties.

UNIT V **12 hrs**

Applications of Nanotechnology

Biosensors: Silicon nanowire biosensor, Cantilever biosensor - drug delivery - photovoltaics: dye sensitized solar cell - quantum dot sensitized solar cell – nanocatalysis – QDLED display - batteries – supercapacitors.

*** Self Study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Micheal F. Ashby, Paulo J. Ferreira, Daniel L. Schodek, (2009), Nanomaterials, Nanotechnologies and An Introduction for engineers and Design Architects- Elsevier Science, USA
2. Robert Kelsall, Ian Hamley, Mark Geoghegan, (2005), Nanoscale Science and Technology - John Wiley & Sons, UK.

Reference Books:

1. Guozhong Cao, (2004), Nanostructures and Nanomaterials: Synthesis, Properties and Applications-Imperial College Press, UK.
2. Masuo Hosokawa, Kiyoshi Nogi, Makio Naito, Toyokazu Yokoyama, (2008), Nanoparticle Technology Handbook - Elsevier Science, UK.
3. Hari Singh Nalwa, (2000), Handbook of Nanostructured Materials and Nanotechnology - Academic Press, USA.

e-Resources:

1. https://youtu.be/ayHfS_RCGaw
2. https://youtu.be/Z51R49OOqAA
3. https://youtu.be/RNpP-PUBno8
4. https://www.youtube.com/watch?v=YZnGnvn3qrM
5. https://www.youtube.com/watch?v=kQ6CY1qpGjY&t=385s

Programme code : 03		M.Sc. Physics		
Title of the Paper		Non Major Elective Paper - Intellectual Property Rights		
Batch 2022-2023	Semester 3	Hours/Week 4	Total Hours 60	Credits 4

Course Objectives

To enable the learners to

1. Understand the aspects of Intellectual Property Rights
2. Know about Patents, Copyrights, Trademarks and Registration aspects
3. Know about Design and Geographical Indication of IPR

Course outcomes (CO)

K1 to K5	CO1	Acquire knowledge about Intellectual Property Rights
	CO2	Understand about patents and patent registration
	CO3	Acquire knowledge on copyrights and registration
	CO4	Gain knowledge on trademarks and registration
	CO5	Understand the design and geographical indication of IPR

Syllabus

UNIT I **12 hrs**

Overview of Intellectual Property

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad.

UNIT II **12 hrs**

Patents

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties- Patent office and Appellate Board

UNIT – III **12 hrs**

Copyrights

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights.

UNIT - IV **12 hrs**

Trademarks

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board.

UNIT – V **12 hrs**

Design and Geographical Indication

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI).

Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference Books:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

e-Resources:

1. Cell for IPR Promotion and Management (http://cipam.gov.in/)
2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
4. https://nptel.ac.in/courses/110/106/110106081/
5. https://youtu.be/TaDfxrTo0HE

Sub. Code: 22PGI4N2

Programme Code: 03		M.Sc Physics		
Title of the Paper		Non-Major Elective Paper: Information Security		
Batch 2022-2023	Semester 4	Hours/Week 4	Total Hours 60	Credits 4

Course Objectives

1. Students will identify the core concepts of Information security.
2. To examine the concepts of Information Security.
3. To design and implement the security features for IT and Industrial sectors.

Course Outcomes (CO)

K1 – K5	CO1	To Learn the principles and fundamentals of information security.
	CO2	To Demonstrate the knowledge of Information security concepts
	CO3	To Understand about Information Security Architecture.
	CO4	To Analyze the various streams of security in IT and Industrial sector.
	CO5	To know about Cyber Laws and Regulations.

Syllabus

UNIT I **12 hrs**

Information Security basics: Definition of Information Security - History of Information Security - Characteristics of Information Security - Components of Information Security - Security System Development Life Cycle (SDLC).

Information Security for technical administrators: Server Security – Network security- Social Media Security.

UNIT II **12 hrs**

Cryptography: Basic concepts - plain text - Cipher text - Encryption Principles - CRYPT Analysis - Cryptographic Algorithms - Cryptographic Tools – Authentication -**Biometrics*** - passwords - Access Control Devices - Physical Security - Security and Personnel.

Language-based Security: Analysis of code for security errors, Safe language and sandboxing techniques.

UNIT III **12 hrs**

Firewalls, Viruses & Worms & Digital Rights Management : Viruses and Worms-Worms - Digital Rights Management – Firewalls - Application and Circuit Proxies - Stateful Inspection - Design Principles of Firewalls.

Logical Design: Access Control Devices- Physical Security-Security and Personnel - NIST Models-VISA International Security Model- Design of Security Architecture-Planning for Continuity.

UNIT IV **12 hrs**

Hacking : Introduction – Hacker Hierarchy – Password cracking – Phishing - Network Hacking - Wireless Hacking - Windows Hacking - **Web Hacking*-** Ethical Hacking.

Security Investigation: Need for Security- Business Needs-Threats- Attacks- IP Addressing and Routing - Social Media

Sub. Code: 22PGI4N2

UNIT V **12 hrs**

Cyber Laws : What is Cyber Law? - Need for Cyber laws - Common Cyber Crimes and Applicable Legal Provisions: A Snapshot - Cyber Law (IT Law) in India – The Information Technology Act of India 2000 - Cyber Law and Punishments in India - Cyber Crime Prevention guide to users – Regulatory Authorities.

***Self study.**

Teaching Methods:

Chalk and Talk, Power point presentation, Seminar, Brainstorming, Assignment, Google Classroom.

Text Book:

'Information Security' (2022), Textbook is prepared by Kongunadu Arts and Science College, Coimbatore.

Reference Books:

1. Charles P Pfleeger and Shai Lawrence Pfleeger, "Security in Computing", Fourth & Third Edition, Prentice Hall, 2007 & 2011.
2. Ross J. Anderson and Ross Anderson, "Security Engineering: A guide to building Dependable Distributed System", Wiley,2009.
3. Thomas R. Peltier, Justin Peltier and John Bleckley, "Information Security Fundamentals",2nd Edition, Prentice Hall 1996.
4. Gettier, Urs E. Information Security: Strategies for Understanding and Reducing Risks John Wiley & Sons, 2011.
5. "Principles of information security". Michael Whiteman and Herbert J. Mattord,2012.
6. Information security -Marie wright and John kakalik,2007.
7. Information security Fundamentals- Thomas R. Peltier, Justin Peltier and John Blackley-2005.
8. Information Security theory and practical PHI publication, Dhiren R. Patel-2008.
9. Debby Russell and Sr.G.T. Gangemi," computer Security Basics,2nd edition, O'Reilly Media,2006.

Programme Code : 03		M.Sc. Physics		
Title of the Paper		Non Major Elective Paper - Research Ethics		
Batch 2022-2023	Semester 4	Hours/Week 4	Total Hours 60	Credits 4

Course Objectives

To enable the learners

1. To understand the philosophy of science and ethics,
2. To know about research integrity and publication ethics.
3. To understand indexing, citation databases and the usage of plagiarism tools.
4. At the end of the course the student will have awareness about the publication ethics and publication misconducts

Course Outcomes (CO)

K1 - K5	**CO1**	understand the philosophy of science and ethics, research integrity and publication ethics
	CO2	identify research misconduct and predatory publications
	CO3	Know about indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.)
	CO4	Understand the usage of plagiarism tools
	CO5	Gain knowledge on the publication ethics and publication misconducts

Syllabus

Unit I 12hrs

Philosophy and Ethics

Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions.

Unit II **12hrs**

Scientific Conduct

Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data.

Unit III **12hrs**

Publication Ethics

Publication ethics: definition, introduction and importance - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributorship - Identification of publication misconduct, complaints and appeals - Predatory publisher and journals.

Unit IV **12hrs**

Open Access Publishing and Plagiarism tools

Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc. Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit V **12hrs**

Databases and Research Metrics

Databases: Indexing databases, Citation databases: Web of Science, Scopus, etc.
Research Metrics: Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics.

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003

Reference Books:

1. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
2. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
3. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
4. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
5. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
6. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

e- Resources:

1. https://youtu.be/LmMDIBENHhU (NPTEL)
2. https://youtu.be/AgRcZaqMPfc
3. https://youtu.be/6E-NrR8jANk
4. https://youtu.be/iXGbH2hRsUw
5. https://youtu.be/tssM9hXw8xQ
6. https://youtu.be/6mxfEYQiGdg

EXTRA DEPARTMENTAL COURSE (EDC)

Biomedical Instrumentation

Subject Code: 22PPH3X1

Programme: 03		M.Sc. Physics		
Title of the Paper		**EDC - Biomedical Instrumentation**		
Batch	**Semester**	**Hours/Week**	**Total Hours**	**Credits**
2022-2023	**3**	**2**	**30**	**2**

Course Objective

To enable the learners to

1. Gain knowledge on bioelectric signals and transducers
2. Understand blood gas analyzers, pulmonary function analyzers and Oximeters
3. Understand the modern imaging systems and electrical safety

Course outcome (CO)

K1 to K5	**CO1**	Gain knowledge on bioelectric signals and transducers
	CO2	Understand Blood gas analyzers, pulmonary function analyzers and Oximeters
	CO3	Acquire knowledge on blood cell counters and audiometer
	CO4	Acquire knowledge on bio-medical recorders
	CO5	Gain knowledge on modern imaging systems and electrical safety

Syllabus

UNIT I **6 hrs**

Bioelectric signals and transducers

Origin of bioelectric signals – Electromyogram – Physiological transducers – classifications – characteristics – variable resistance, capacitance, inductance transducers – LVDT – Piezoelectric transducers – pressure transducers – LVDT and strain gauge transducers – electrical resistance thermometer – Photoelectric transducers – Photovoltaic and Photoemissive cells – **Silicon diode detectors and diode arrays*.**

UNIT II **6 hrs**

Blood gas analyzers, Pulmonary function analyzers and Oximeters

Blood pH measurements – electrodes for blood pH measurements – Measurement of blood pCO_2 - blood pO_2 measurements - complete blood gas analyzer - Pulmonary function analyzers – ventilation - distribution and diffusion – Respiratory volumes and capacities – basic spirometer and ultrasonic spirometer. Oximeters**:** Ear oximeter and pulse oximeter.

UNIT III **6 hrs**

Blood cell counters, audiometer and Bio-medical recorders

Types of blood cells - Methods of cell counting- Automatic optical method - Electrical conductivity method - Hearing Aids – conventional and digital hearing aids. Bio-medical Recorders: Electrocardiograph (ECG) – Electroencephalograph (EEG).

UNIT IV **6 hrs**

Modern imaging systems

Principle of X-ray Computed Tomography - Magnetic Resonance Imaging**:** Principles of NMR imaging systems – Fourier transformation of free induction decay (FID) - Basic NMR components – block diagram – biological effects of NMR imaging.

Subject Code: 22PPH3X1

UNIT V **6 hrs**

Electrical safety of medical instruments

Physiological effects due to 50 Hz current passage – micro shock – macro shock – electrical accidents in hospitals – devices to protect against electrical hazards – hospital architecture.

*** Self study**

Teaching Methods: Smart Class Room / Power point presentation / Seminar / Quiz / Discussion / Flipped Class

Text Books:

1. R.S Kandpur, (2014), Hand book of biomedical instrumentation - Tata McGraw Hill, India
2. M.Arumugam, (2013), Biomedical Instrumentation- Anuradha Agencies, Chennai.

Reference Books:

1. Leslie Crombwell, Fred.J.Weibell, Trich.A.Pfeiffer, Biomedical Instrumentation and Measurements, (2011) - Prentice Hall India, New Delhi.
2. H.S.Kalsi, (2016), Electronic Instrumentation - Tata Mc Graw Hill, India.

e-Resources:

1. https://www.youtube.com/watch?v=iK-6q4 nnmtA
2. https://www.youtube.com/watch?v=JD-x-3OwEZs
3. https://www.youtube.com/watch?v=FEAQBDiHYPk
4. https://www.youtube.com/watch?v=W8-rOxQBbPA
5. https://www.youtube.com/watch?v=--meT13GtBs

Mapping

CO PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S	H	H	S	H
CO 2	H	S	H	H	H
CO 3	H	S	H	H	S
CO 4	S	H	S	H	H
CO 5	H	S	H	H	S

S- Strong **H-High** **M-Medium** **L – Low**

ADVANCED LEARNERS COURSE (ALC)

Advanced Experimental Techniques

Programme: 03	M.Sc. Physics
Title of the Paper	ALC - Advanced Experimental Techniques
Batch	2022-2023
Extra Credits	2

Course Objective

To enable the learners to

1. Understand different types of structural and surface morphological and spectroscopic characterization techniques
2. Gain knowledge about magnetic techniques
3. Understand thermal analytical techniques

Course outcome (CO)

K1 to K5	**CO1**	Gain knowledge on structural characterization
	CO2	Acquire knowledge on spectroscopic analysis
	CO3	Gain knowledge on morphological techniques
	CO4	Acquire knowledge on magnetic properties of materials
	CO5	Gain knowledge on thermal analytical techniques

Unit I

Structural Characterization

Atomic Absorption Spectroscopy (AAS): Instrumentation - Sample preparation - Analysis – limitations. Inductively Coupled Plasma (ICP): Instrumentation and measurement techniques. Atomic Emission Spectroscopy (AES): Instrumentation and measurement techniques.

Unit II

Spectroscopic analysis

InfraRed (IR) – Fourier Transform Infra-Red (FTIR) – Ultraviolet-Visible (UV-VIS), Diffused Reflectance Spectroscopy (DRS) – X-ray Absorption (XPS) – Electron Spin Resonance (ESR) – Nuclear Magnetic Resonance (NMR).

Unit III

Morphological techniques

Confocal microscope - Field Emission Scanning Electron Microscope (FESEM) – Advantages FESEM over SEM - TEM - Selected Area Electron Diffraction (SAED) – Atomic Force Microscope (AFM).

Unit IV

Magnetic properties

Vibrational Magnetometer - Cyclic Voltammetry - SQUID Magnetometer - Magnetic Force Microscopy – Magneto optical (MO) technique - Magnetic resonance imaging technique.

Unit V

Thermal analytical techniques

Thermo gravimetric (TGA) – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC) – Graphical analysis affecting various factors.

Text Books:

1. John B. Wachtman, Zwi. H. Kalman, (1993), Characterization of Materials - Butterworth Heinemann, UK.
2. H. H. Willard, (1991), Instrumental Methods of Analysis-CBS Publishers, New Delhi.

Reference Books:

1. Banewall, (2017), Fundamentals of Molecular Spectroscopy - McGraw Hill, India.
2. B.K. Sharma, (2007), Spectroscopy - GOEL Publishing House- Krishna Prakashan, Meerut.

e-Resources:

1. https://www.digimat.in/nptel/courses/video/103108138/L01.html
2. https://www.youtube.com/watch?v=SbSS130KoCs
3. https://www.youtube.com/watch?v=9Mv1MEKLAhQ
4. https://www.youtube.com/watch?v=VvZk_gIQJRo
5. https://www.youtube.com/watch?v=sy47Jp22gYY

***