SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

(Autonomous)

[An Autonomous College Affiliated to Periyar University, Salem, Tamil Nadu]
[Accredited by NAAC with 'A' Grade with CGPA of 3.27]
[Recognized 2(f) & 12(B) Status under UGC Act of 1956]
Katteri – 636 902, Uthangarai (Tk), Krishnagiri (Dt)
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DEGREE OF MASTER OF SCIENCE IN PHYSICS

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS AND SYLLABUS FOR

M.Sc. PHYSICS PROGRAMME

(SEMESTER PATTERN)

(For Students Admitted in the College from the Academic Year 2021-2022 Onwards)

Programme Outcomes (POs)

PO1	A graduate with Master degree has in depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in respective discipline.
PO2	Engage in self direct continuous learning, aimed at global competency, which will promote professional and personal growth
PO3	Students will show that they have learnt laboratory skills, enabling them to take measurements in laboratories and analyze the measurements to draw valid conclusions.
PO4	Combining various academic disciplines and professional specializations to cross borders and redefine problems in order to explore solutions based on the new understanding of complex situation.
PO5	Acquiring knowledge at a higher level that would help to develop the necessary skills and recognize the need for the preparation and ability to engage in independent life long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1	Apply the fundamental knowledge of Physics to appreciate, develop and test physical concepts, for applications in materials, analytical tools in medicine, engineering, technological devices, digitalized space communication etc.,
PSO2	Identify and access the diverse applications of Physics through the utilization of mathematical concepts to solve complex issues of environmental and safety requirements, enriching towards career advancement.
PSO3	Formulate the expertise in various domains of Physics acquired through the knowledge of experimental principles to demonstrate, innovate, design and develop the skills towards the futuristic needs of the industry/society.
PSO4	Compile research based knowledge and methods including design of experiments, analysis, interpretation and evaluation of information, to provide valid critique to the society.
PSO5	Communicate explicitly and exchange ideas with regard to theoretical and experimental aspects, the impacts of Physics on environment and society.
PSO6	Apply reasoning, informed by the contextual knowledge to access societal, health, safety, legal, ethical and cultural issues and consequent responsibilities relevant to Physics.

SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

(Autonomous)

Master of Science (M.Sc.) in Physics

Programme Pattern and Syllabus (CBCS)

(For Students Admitted in the College from the Academic Year 2021-2022 Onwards)

Sl. No.	Nature of the Course	Course Code	Name of the Course	Hours/ Week	Credits	Marks		
						CIA	ESE	Total
SEMESTER I								
1	Core – I	21PPH1C01	Mathematical Physics	6	4	25	75	100
2	Core – II	21PPH1C02	Classical Mechanics	6	4	25	75	100
3	Core – III	21PPH1C03	Linear and Non Linear Integrated Circuits and Applications	5	4	25	75	100
4	Elective – I	21PPH1E01	Energy Physics	5	4	25	75	100
5	Core Practical– I	21PPH2P01	General and Advanced Physics Experiments	4	Credit and Marks are carried to Core Practical – I of Semester II			
6	Core Practical– II	21PPH2P02	Electronics Experiments	4	Credit and Marks are carried to Core Practical – II of Semester II			
Total				**30**	**16**	**100**	**300**	**400**
SEMESTER II								
7	Core – IV	21PPH2C04	Quantum Mechanics - I	5	4	25	75	100
8	Core – V	21PPH2C05	Thermodynamics and Statistical Physics	5	4	25	75	100
9	Core – VI	21PPH2C06	Microprocessor 8085 and Microcontroller 8051	5	4	25	75	100
10	Elective – II	21PPH2E02	Optoelectronic Devices and its Applications	5	4	25	75	100
11	Core Practical– I	21PPH2P01	General and Advanced Physics Experiments	4	4	40	60	100
12	Core Practical– II	21PPH2P02	Electronics Experiments	4	4	40	60	100
13	Common Course	21P2HR01	Human Rights	2	2	25	75	100
Total				**30**	**26**	**205**	**495**	**700**

SEMESTER III								
14	Core – VII	21PPH3C07	Quantum Mechanics - II	6	4	25	75	100
15	Core – VIII	21PPH3C08	Electromagnetic Theory	6	4	25	75	100
16	Core – IX	21PPH3C09	Spectroscopy	6	4	25	75	100
17	Elective – III (Any one)	21PPH3E03	Nanoscience and Nano Technology	4	4	25	75	100
		21PPH3E04	Synthesis of Materials and Characterizations					
18	Core Practical– III	21PPH3P03	Microprocessor 8085 and Microcontroller 8051 Experiments	4	4	40	60	100
19	EDC	----	Extra Disciplinary Course (EDC) – I (Other than Physics Major Subject)	4	4	25	75	100
Total				**30**	**24**	**165**	**435**	**600**
20	Core – X	21PPH4C10	Condensed Matter Physics	6	4	25	75	100
21	Core – XI	21PPH4C11	Nuclear and Particle Physics	6	4	25	75	100
22	Core – XII	21PPH4C12	Computational Methods and C Programing	6	4	25	75	100
23	Core Practical– IV	21PPH4P04	Computational Methods	4	4	40	60	100
24	Project	21PPH4PR01	Project	8	8	-	100	100
Total				**30**	**24**	**115**	**385**	**500**
CUMULATIVE TOTAL				**120**	**90**	**585**	**1615**	**2200**
Sl. No.			**Extra Disciplinary Course (EDC) (Other than Physics Major students)**					
1	EDC	21PPH2EDC01 /21PPH3EDC0 1	Electronic Appliances	4	4	25	75	100

Note:

CBCS – Choice Based Credit system

CIA – Continuous Internal Assessment

ESE – End Semester Examinations

PROGRAMME SYLLABUS

Program: M.Sc. Physics				
Core – I		**Course Code:** 21PPH1C01		**Course Title:** Mathematical Physics
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	6	90	4	100

COURSE OBJECTIVES

1. To enable the students to understand the basic principles and importance of matrix and tensor analysis, group theory and appreciate their applications in the field of Physics.
2. To provide an insight into complex analysis, special functions, transform techniques which form the back bone of all higher physics and to apply these techniques to solve Physics problems.

UNIT I : VECTOR, TENSORS AND MATRIX

Linear vector spaces, Gram - Schmidt Orthogonalization Process – Orthogonal curvilinear coordinates – Gradient, divergence, Curl and Laplacian – Evaluation of line, surface, volume integrals.

Introduction to tensors – Tensor transformation - Contravarient, Covariant tensors – Rank of a tensor – Symmetric and Anti-symmetric tensor.

Matrices – Types of matrices – Inverse of Martix – Cayley-Hamilton's theorem - Eigen values and Eigen vectors – Diagonalization of matrices.

UNIT II : INTEGRAL TRANSFORM

Fourier transform: Fourier sine and cosine transform **–** Properties of Fourier transforms - Linear property, change of scale property, shifting property and modulation theorem - Convolution theorem – Time and frequency domain.

Laplace Transform: Laplace formulae – Properties of Laplace transforms (Linear property – Change of scale property, first and second shifting theorems) – Inverse Laplace Transforms .

UNIT III : COMPLEX ANALYSIS

Complex function – Analytic function – Limit, Continuity – Differentiability – Cauchy-Riemann conditions-Cauchy's integral theorem - Simply and multiply connected regions – Cauchy's integral formula -Taylor and Laurent expansion – Residues – Cauchy's residue theorem –Evaluation of definite integrals – Contour integration.

UNIT IV : SPECIAL FUNCTIONS

Bessel, Legendre, Laguerre and Hermite differential equations - Generating functions- orthogonality properties - Recurrence relations - Rodrigue's formula - Polynamials.

UNIT V : GROUP THEORY

Groups and their basic Properties: Group – Basic properties – Abelian group – Isomorphic group – Similarity transformation and classes – Group multiplication tables

Representation of Groups: Symmetric elements – Transformation, Matrix representation – Point groups – Reducible and irreducible representations – Great orthogonality theorem – Construction of character tables for point groups C_{2V} - XY_2 bent symmetrical type molecule - and C_{3V} - XY_3 Pyrimdal type molecule- Structure of character tables.

BOOKS FOR STUDY:

1. Satya Prakash, Mathematical Physics, Sultan Chand & Sons, New Delhi (2004).
   [Unit Covered: 1 – 5: Pages: 2 - 117, 231 - 301, 514 – 606, 820 - 881, 998 - 1034].
2. B.D. Gupta, Mathematical Physics, Vikas publishing house, New Delhi (2010).
   [Unit Covered: 1 – 5: Sections: 1.1 – 1.188, 3.1 – 3.86, 4.1 – 4.86, 5.1 – 5.155, 9.1 – 9.64, 10.1 – 10.62].

BOOKS FOR REFERENCE:

1. A.W. Joshi, Matrices and Tensors in Physics, New Age, New Delhi (2006).
2. G. Arfken and H.J. Weber, Mathematical methods for Physicists, Academic Press (1995).
3. K.F. Riley, M.P. Hobson and S.J. Bence, Mathematical Methods for Physics and Engineering, Cambridge University Press (1998).
4. R.V. Churchill, Complex variables and applications, McGraw Hill (1990).
5. W. Bell, Special functions for Scientists and Engineers, Dover Publications, Inc., Mineola, New York (2004).
6. A.W. Joshi Elements of Group Theory for Physicists, Wiley Eastern (1997).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Use the complex derivatives function, use and operate analytic functions, demonstrate knowledge of integration in the complex plane, use the Cauchy integral theorem and formula, understand residues and their use in integration.	K1 & K2
CO2	Gain a working knowledge of know elementary ideas in Gamma and Beta functions, series solutions and special functions, will be able to apply to solve problems in classical, statistical and quantum mechanics as well as electromagnetism	K2
CO3	Evaluate the Fourier transform of a continuous function, and be familiar with its basic properties and convolution theorem and also learn Laplace transform, properties and special functions will help the students to critically analyze physical problems.	K2 & K3
CO4	Understand Tensors and its importance in physics because they provide a concise mathematical framework for formulating and solving physics problems in areas such as elasticity, fluid mechanics, and general relativity.	K4
CO5	The basic ideas of Group Theory and the closely related representation theory have many important applications in physics, chemistry, and materials science.	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6–Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – II	**Course Code:** 21PPH1C02		**Course Title:** Classical Mechanics	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	6	90	4	100

COURSE OBJECTIVES

1. To acquire basic concept and knowledge relevant to methods of Lagrangian and Hamiltonian Dynamics.
2. To apply the Lagrangian Dynamics method for the study of small oscillations and motion of rigid bodies.
3. To solve problems pertaining to physical bodies using Canonical transformation and Hamilton Jacobi method.

UNIT I: LAGRANGIAN FORMULATION, APPLICATIONS AND HAMILTON PRINCIPLE

Mechanics of a system of particles: Constraints and its classifications – Generalized coordinates – Degrees of freedom – Principle of Virtual work - D'Alembert's principle – Cyclic coordinates - Lagrange's Equations – Applications of Lagrange's formulation – Compound pendulum – Simple pendulum – Particle moving on the surface of the earth – Bead sliding on a uniformly rotating wire in a force free space – Calculus of variations: Hamilton's principle – Lagrange's equation from Hamilton's principle.

UNIT II: HAMILTONIAN FORMULATION-APPLICATIONS

Hamiltonian of a system – Generalised Momentum and Cyclic coordinates – Integrals of Hamilton’s equations – Hamilton’s canonical equations of motion, significance – Deduction of canonical equations from a variational principle – Harmonic Oscillator –-Particle moving near the surface of the earth – Particle in a central field of force – Hamiltonian for a charged particle in an electromagnetic field – Principle of least action.

UNIT III: CANONICAL TRANSFORMATION AND HAMILTON-JACOBI THEORY

Canonical transformation – Advantage – Examples of Canonical transformations – Condition for a transformation to be Canonical – Infinitesimal Canonical transformation – Hamilton–Jacobi method – Hamilton–Jacobi partial differential equation – Hamilton–Jacobi equation for principal function, and characteristic function – Harmonic oscillator problem by Hamilton – Jacobi method – Kepler's problem solution by Hamilton–Jacobi method.

UNIT IV: ACTION ANGLE VARIABLE, POISSON BRACKET-LAGRANGE'S BRACKET

Action angle variables – Harmonic oscillator in action-angle variables – Poisson brackets – Properties of Poisson bracket – Invariance of Poisson brackets to Canonical transformations – Equation of motion in Poisson bracket form – Infinitesimal contact transformations – - Angular momentum and Poisson bracket - Lagrange brackets – Properties of Lagrange brackets - Invariant of Lagrange bracket under Canonical transformation – Relation between Lagrange and Poisson brackets.

UNIT V: MECHANICS OF SMALL OSCILLATIONS, RIGID BODY'S KINEMATICS

Lagrangian equations of motion for small oscillations – Normal coordinates and normal frequencies of vibration – Vibrations of a linear triatomic molecule – Euler's angles rotating coordinate system – Coriolis force – Angular momentum – Kinetic energy of a rigid body – Moments and products of inertia – Euler equations of motion – Torque free motion of rigid body – Motion of symmetrical top under the action of gravity.

BOOKS FOR STUDY:

1. S. L. Gupta, V. Kumar, H.V. Sharma, Classical Mechanics, Pragati Prakashan Educational Publishers, Meerut (2007).
[Unit Covered: 1–5: Pages : 6–19, 25–40, 50–65, 100–115, 340–343, 125–140, 150–185, 245–290, 325–348].
2. G. Aruldhas, Classical Mechanics, Prentice - Hall of India Pvt. Ltd., New Delhi (2008).
[Unit Covered: 1–5: Pages: 1–20, 39–50, 60–85, 78–96, 137–167, 173–189, 196–219, 231–251].

BOOKS FOR REFERENCE

1. K.C. Gupta, Classical Mechanics of Particles and Rigid Bodies, New Age International, New Delhi (1997).
2. J.C. Upadhaya, Classical Mechanics, Himalaya Publishing House Pvt. Ltd., Bangalore Second Edition (2017).
3. H. Goldstein, C. Poole and J. Safko, Classical Mechanics, Pearson Education Asia, New Delhi (2002).
4. S.N. Biswas, Classical Mechanics, Books and Allied Ltd., Kolkata (1998).
5. N.C. Rana and P.S. Joag, Classical Mechanics, Tata McGraw Hill Publishing Company Ltd., New Delhi (1991).
6. R.G. Takwa, Introduction to Classical Mechanics, Himalaya Publishing House Pvt. Ltd., Bangalore (2010).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Formulate and solve classical mechanics problems using Lagrangian and Hamiltonian methods.	K1 & K2
CO 2	Find constants of motion according to the Hamilton Jacobi theory using Canonical transformations.	K3 & K4
CO 3	Study periodic motion by action-angle variables and find derivatives in phase space using Poisson brackets.	K3 & K4
CO 4	Apply methods of classical mechanics, including normal modes, to a continuum system such as a fluid.	K5 & K6
CO 5	Use symmetries of a system to identify conserved quantities and predict the nature of normal modes of its linearization.	K5 & K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, **M – Medium,** **L – Low**

Program: M.Sc. Physics				
Core – III	**Course Code:** 21PPH1C03		**Course Title:** Linear And Non-Linear Integrated Circuits And Applications	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	5	75	4	100

COURSE OBJECTIVES

1. To acquire knowledge about operational amplifiers and waveform generators.
2. To understand the theories of combinational and sequential logic circuits.
3. To habituate the concepts of data converter and active filters.

UNIT I: OPERATIONAL AMPLIFIER AND ANALOG COMPUTATION

Operational Amplifier –Definition and Block diagram of Operational Amplifier - Electrical Parameters – Offset and Null Connection – Offset Error and Correction - Inverting Single Input Summing Amplifier – Three Input Averaging Amplifier - Differential Amplifier - General Linear Applications – Voltage to Current Converter – Current to Voltage Converter- Simultaneous equations and differential equations- Instrumentation amplifier- Log and Antilog amplifiers- Analog multiplication and division – Internal circuitary of operational amplifier (Only for Study).

UNIT II: LINEAR IC'S - WAVEFORM GENERATORS

Sine wave Oscillator - Wien's Bridge Oscillator and Phase shift oscillator – Square wave generator – Triangular wave generator - Saw-tooth generator – Quadrature Oscillator - Pulse generator — 555 Timer IC - Internal Architecture and working – Astable multi vibrator - Voltage controlled oscillator - Monostable multi vibrator - Schmidt trigger – Squarer - Phase Locked Loop (PLL) - Application of PLL in Television Transmission.

UNIT III: COMBINATIONAL LOGIC CIRCUITS

NAND/ NOR as Universal building blocks – Half and Full Adders - Half and Full Subtractors – 4 bit binary Adder and Subtractor - 4 bit BCD Adder and Subtractor - Encoder and Decoder- Multiplexer and Demultiplexer - Memory Devices – ROM – RAM – EPROM.

UNIT IV: SEQUENTIAL LOGIC CIRCUITS

Flip Flops- RS Flip flop, Clocked RS Flip flop, D-type Flip flop, JK Flip flop, T Flip flop and M/S JK Flip flop, Counters- Synchronous, Asynchronous (Up and Down) and Modulus counters- BCD counters- Shift registers- Ring counter as divide by N counter- Johnson counter - Applications.

UNIT V: DATA CONVERTERS AND ACTIVE FILTERS

Digital to analog converter - Binary weighted and R/2R ladder type- Accuracy and resolution - Dual slope digital to analog converter – Analog to digital converter - Simultaneous conversion - Counter method - Successive approximation method.

Active filters – Low pass, High Pass, Band pass, Band stop - Second order Butter worth design – Multiple Feedback filter circuit.

BOOKS FOR STUDY:

1. Ramakant A Gayakwad, Op-Amps and Linear Integrated Circuits, Fourth Edition, Pearson, Prentice Hall (2000).
2. Anil K Maini, Digital Electronics, Principles, Devices and Appications, John Wiley and Sons Limited (2007).
3. Donald P Leach & Albert Paul Malvino, Digital Principles and Applications, Seventh Edition, Tata McGraw Hill Education Private Limited, New Delhi (2011).

BOOKS FOR REFERENCE:

1. Jacob Millman, Christes C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Second Edition, Mc-Graw Hill, Kogakusha, Japan (2011).
2. Thomas L. Floyd, David Buchla, Basic Operational Amplifiers and Linear Integrated Circuits, Second Edition, Prentice Hall (1999).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire elaborate knowledge about operational amplifier and its applications	K1 & K2
CO2	Understand the concepts of oscillators & multivibrators and its applications in electronic devives.	K2 & K3
CO3	Gain the knowledge of basic digital circuits and memory devices.	K3 & K4
CO4	Develope the practical knowdege in the field of registers and counters.	K5 & K6
CO5	Understand the working principles of data converting circuits and active filters.	K5

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 – Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Elective – I	**Course Code:** 21PPH1E01		**Course Title:** Energy Physics	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	5	75	4	100

COURSE OBJECTIVES

1. To gain knowledge relevant to Physics aspects of different energy sources.
2. To understand technological aspects of renewable energy devices and their application potentials.

UNIT - I: ENERGY SOURCES

Energy sources–Renewable energy sources and their types – Non-renewable energy sources and their types –Advantages and disadvantages–Solar radiation: Extra-terrestrial and terrestrial radiation – World energy futures.

UNIT -II: SOLAR CELLS

Solar photovoltaics – Principle of photovoltaic conversion of solar energy– Solar cell parameters, Solar cell electrical characteristics – Efficiency of solar cell – Types of solar cells and their fabrication: Silicon, Thin-film and Dye-sensitized solar cells – Applications of solar cells.

UNIT -III: APPLICATIONS OF SOLAR ENERGY

Solar water heating – Solar space heating–Solar space cooling– Solar dryer –Solar distillation – Solar pumping – Solar furnace – Solar cooker – Solar greenhouse– Solar photocatalysis.

UNIT -IV: WIND ENERGY

Basic principles and components of wind energy conversion systems - Wind data and energy estimation –Types: Vertical axis and horizontal axis wind machines – Scheme for electric generation – Safety system – Environmental aspects - Applications of wind energy.

UNIT -V: ENERGY FROM BIOMASS

Biomass conversion technologies – Wet and dry process – Photosynthesis –Biogas generation: Basic processes and energetics – Factors affecting biodigestion and generation of gas – Classification of biogas plants: Continuous and batch types, done and drum types – Properties of biogas –Applications of biogas.

BOOKS FOR STUDY:

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi (2009).
[Unit Covered: 1–5: Pages: 1–72, 146–223,227–310, 311–384]

BOOKS FOR REFERENCE:

1. F. Kreith and J.F. Kreider, Principles of Solar Engineering, Tata McGraw Hill (1978).
2. A.B. Meinel and A.P.Meinel, Applied Solar Energy, Addison Wesley Publishing Co. (1976).
3. M.P.Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
4. S.P.Sukhatme, Solar Energy, Tata McGraw Hill (1997).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge about origin and types of diverse energy sources	K1 & K2
CO2	Understand properties of energy sources and identify their application potentials	K2 & K3
CO3	Gather research-based knowledge about principal, construction and operation of different energy conversion technologies	K3&K4
CO4	Acquire information pertaining to application potential of various energy sources through appropriate technologies	K5
CO5	Develop skills to design portable energy conversion devices and their demonstration	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, **M – Medium,** **L – Low**

Program: M.Sc. Physics				
Core Practical – I	**Course Code:** 21PPH2P01		**Course Title:** General and Advanced Physics Experiments	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I and II	4	120	4	100

COURSE OBJECTIVES

1. To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
2. To calculate the thermodynamic quantities and physical properties of materials.
3. To analyze the optical and electrical properties of materials.

SEMESTER – I

I(a). GENERAL PHYSICS EXPERIMENTS

(Any *ten* Experiments)

1. Determination of Young's Modulus and Poison's ratio by Elliptic fringes - Cornu's Method
2. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
3. Detrmination of Viscosity of the given liquid – Meyer's disc.
4. Determination of Stefan's constant of radiation from a hot body.
5. Measurement of Coefficient of linear expansion- Air wedge Method
6. Determination of Permittivity of a liquid using an RFO
7. Measurement of Susceptibility of liquid - Quincke's method.
8. B-H loop using Anchor ring.
9. B-H curve using CRO.
10. Measurement of Magnetic Susceptibility - Guoy's method.
11. Determination of Thickness of the enamel coating on a wire by diffraction
12. Determination of Rydberg's Constant - Hydrogen Spectrum
13. FP Etalon
14. LG Plate.

15. Arc spectrum: Copper
16. Determination of Solar constant.
17. Detrmination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes
18. Measurement of Band gap energy- Thermistor
19. Determination of Planck Constant – LED Method

SEMESTER – II

I (b). ADVANCED PHYSICS EXPERIMENTS

(Any *twelve* Experiments)

1. Detrmination of Specific charge of an electron – Thomson's method.
2. Determination of e/m - Millikan's method.
3. Determination of Compressibility of a liquid using Ultrasonics .
4. Miscibility measurements using ultrasonic diffraction method.
5. Detrmination of Wavelength, Separation of wavelengths - Michelson Interferometer
6. Determination of Thickness of thin film. - Michelson Interferometer
7. GM counter – Characteristics, inverse square law and absorption coefficient.
8. GM counter – Feather's analysis: Range of Beta rays.
9. Measurement of Conductivity - Four probe method.
10. Arc spectrum – Iron.
11. Iodine absorption spectra.
12. Molecular spectra – AlO band.
13. Molecular spectra – CN bands.
14. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
15. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
16. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
17. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser.
18. Determination of Numerical Aperature and Acceptance angle of optical fibres using Laser Source.

19. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square ,Receiver end transmitter behavior, Radiation Pattern - Microwave test bench
20. Measurement of Dielectricity - Microwave test bench.
21. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility.
22. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
23. Interpretation of vibrational spectra of a given material.
24. Detrmination of I – V Characteristics and efficiency of solar cell.

BOOKS FOR REFERENCE:

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. Practical Physics, Gupta and Kumar, PragatiPrakasan.
3. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences.
4. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd:
5. A course on experiment with He-Ne Laser, R.SSirohi, John Wiley & Sons (Asia) Pvt.ltd

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the strength of material using Young's modulus.	K1 & K2
CO2	Acquire knowledge of thermal behaviour of the matetials.	K2 & K3
CO3	Understand theoretical principles of magnetism through the experiments.	K4
CO4	Acquire knowledge about arc spectrum and applications of laser	K5 & K6
CO5	Improve the analytical and observation ability in Physics Experiments	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core Practical – II	**Course Code:** 21PPH2P02		**Course Title:** Electronics Experiments	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I and II	4	120	4	100

COURSE OBJECTIVES

1. To observe the applications of FET and UJT.
2. To study the different applications of operational amplifier circuits.
3. To learn about Combinational Logic Circuits and Sequential Logic Circuits

SEMESTER – I

II(a). ELECTRONICS EXPERIMENTS

(Any *twelve* Experiments)

1. Construction of relaxation oscillator using UJT
2. FET CS amplifier- Frequency response, input impedance, output impedance
3. Study of important electrical characteristics of IC741.
4. V- I Characteristics of different colours of LED.
5. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
6. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
7. Construction of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
8. Construction of square wave oscillator using IC 741- Triangular wave oscillator using IC 741- Triangular wave generator
9. Construction of a quadrature wave using IC 324
10. Construction of pulse generator using the IC 741 – application as frequency divider
11. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
12. Study of Binary to Gray and Gray to Binary code conversion.
13. Study of R-S, clocked R-S and D-Flip flop using NAND gates

14. Study of J-K, D and T flip flops using IC 7476/7473
15. Arithmetic operations using IC 7483- 4 bit binary addition and subtraction.
16. Study of Arithmetic logic unit using IC 74181
17. Construction of Encoder and Decoder circuits using ICs.

SEMESTER – II

II(b). ELECTRONICS EXPERIMENTS

(Any *twelve* Experiments)

1. IC 7490 as scalar and seven segment display using IC7447
2. Solving simultaneous equations – IC 741 / IC LM324.
3. Op-Amp –Active filters : Low pass, High pass and Band pass filters (Second Order) Batter worth filter.
4. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
5. Construction of second order butterworth multiple feedback narrow band pass filter
6. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
7. Construction of square wave generator using IC 555 – Study of VCO.
8. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer.
9. Construction of pulse generator using the IC 555 – Application as frequency divider.
10. BCD to Excess- 3 and Excess 3 to BCD code conversion.
11. Study of binary up / down counters - IC 7476 / IC7473
12. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
13. Study of synchronous parallel 4-bit binary up/down counter using IC 74193
14. Study of asynchronous parallel 4-bit binary up/down counter using IC 7493
15. Study of Modulus Counter.
16. Construction of Multiplexer and Demultiplexer using ICs.

BOOKS FOR REFERENCE:

1. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
2. Electronic Laboratory Primer a design approach, S. Poornachandra, B.Sasikala, Wheeler Publishing, New Delhi.
3. Electronic lab manual Vol I, K ANavas, Rajath Publishing.

4. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition
5. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.
6. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd.

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Conduct experiments on applications of FET and UJT	K1 & K2
CO2	Analyze various parameters related to operational amplifiers.	K2 & K3
CO3	Understand the concepts involved in arithmatic and logical circuits using IC's	K4
CO4	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	K5
CO5	Analyze the applications of counters and registers	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with Pos

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – IV	**Course Code:** 21PPH2C04		**Course Title:** Quantum Mechanics - I	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	5	75	4	100

COURSE OBJECTIVES

1. To familiarize basic concepts of Quantum Mechanics and its features.
2. To understand procedures involved in perturbation process and its applications.
3. To acquire knowledge about angular momentum and representation of matrix.

UNIT –I: FORMALISM OF QUANTUM MECHANICS

Physical Interpretation of Wave Functions Expectation Values of Dynamical Quantities – Probability Current Density - Ehrenfest Theorem, Schrodinger Equation in Momentum Representation - Momentum Operator – Hamiltonian Operator – Hermitian Operator and its Properties, Dirac Delta Function – Completeness Property of Eigen Functions Superposition of Eigen States – Parity Operator, Commutator Algebra –Schwarz Inequality, Heisenberg's Uncertainty Relation Derived from Operators and its Applications.

UNIT -II: MATRIX REPRESENTATION

Hilbert Space – Unitary Transformation and their Properties, Representation of State Vector and Equation of Motion: Schrodinger Picture – Heisenberg Picture – The Interaction Picture, Dirac's BRA and KET Vector Notation, Coordinate and Momentum Representation, Matrix Theory of Harmonic Oscillator.

UNIT –III: ANGULAR MOMENTUM

Angular Momentum in Position Representation, Spin Angular Momentum – Total Angular Momentum, Commutation Relations for Angular Momentum Operators, Eigen Value Spectrum $J^2$and J_z, J_x and J_y, Raising and Lowering Operators: J+ and J-,Addition of Angular Momenta – Clebsch-Gordon Co-efficient –its Properties and its Evaluation.

UNIT –IV: PERTURBATION THEORY FOR STATIONARY STATES

First and Second Order Perturbation Theory in Non– Degenerate and Degenerate Cases - Stark Effect in Hydrogen Atom, Variation Method – Application to Ground State of Helium Atom, Application to Ground State of Hydrogen Atom, WKB Approximation – Probability of Penetration of Barrier.

UNIT – V: TIME DEPENDENT APPROXIMATION METHODS

Time Dependent Perturbation Theory, Fermi Golden Rule, Constant and Harmonic Perturbations, Adiabatic and Sudden Approximation, A Charged Particle in an Electromagnetic Field.

BOOKS FOR STUDY:

1. Satya Prakash, Quantum Mechanics, Kedar Nath Ram Nath, Meerut (2009).
   [Units Covered: 1– 5: Pages: 90-93, 95, 96, 113, 114, 240 – 249, 252, 253, 256, 257, 260 – 265, 270 – 274, 276, 277, 328 – 330, 334 – 338, 339 – 349, 351 – 355, 396, 397, 400 – 407, 415 – 419, 441- 456, 469 – 478, 489 – 493, 497 – 500, 518 – 532]
2. G. Aruldhas, Quantum Mechanics, Prentice- Hall of India, New Delhi (2006).
   [Units Covered: 1– 5: Pages: 24, 33 – 38, 49 – 52, 54 – 56, 63 – 68, 148 – 150, 170 – 184, 195 – 204, 215, 216, 218 – 222, 229 -231, 242 – 246]

BOOKS FOR REFERENCES:

1. R.K. Srivastava, Quantum Mechanics, Prentice- Hall of India, New Delhi (2007)
2. P. M. Mathews and K. Venkatesan , A Text Book of Quantum Mechanics, Tata McGraw Hill, New Delhi (1987)
3. Pauling and E.B.Wilson, Quantum Mechanics, McGraw Hill, New York (1935).
4. Leonard I. Schiff, Quantum Mechanics, McGraw, Hill (1968).
5. E. Merzbacher, Quantum Mechanics, Third Edition, John Wiley and Sons (2004).
6. David J.Griffiths, Introduction to Quantum Mechanics, Second Edition, Addison Wesley (1999).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand fundamental, principles of quantum mechanics	K1 & K2
CO2	Understands about different perturbation and variation methods	K2 & K3
CO3	Gather knowledge about time dependent and independent theories.	K3&K4
CO4	Gain knowledge regarding methods of determining lower level of Hydrogen and Helium atom.	K5
CO5	Learn about the Angular momentum and its rules.	K3, K4 &K6

K1– Remember,K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, **M – Medium,** **L – Low**

Program: M.Sc. Physics				
Core – V		**Course Code:** 21PPH2C05		**Course Title:** Thermodynamics and Statistical Physics
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	5	75	4	100

COURSE OBJECTIVES

1. To understanding laws of thermodynamics and a systematic definition of thermodynamic potentials as the general formalism of thermodynamics.
2. To overview foundations of equilibrium statistical physics as the microscopic theory of matter and fields.

UNIT I: THERMODYNAMICS AND APPLICATIONS

Laws of Thermodynamics - Entropy and probability – Change in entropy of a solid/Liquid – Thermodynamic potentials and the reciprocity relations – Thermodynamic equilibria – Nernst's heat theorem – Blackbody radiation and Planck's radiation distribution law – Experimental Verification of Planck's radiation Law.

UNIT II: SPECIFIC HEAT OF SOLIDS

Specific heat of solids: Dulong and Petit's law – Varaiation Specific heat and atomic heat with temperature – Einstein's theory of the specific heat of solid – Debye's theory of specific heat capacity of solids – Criticism of Debye theory – Negative temperature – Liquid helium I and II – Bose-Einstein condensation - Superfludity

UNIT III: ENSEMBLES AND PARTITION FUNCTION

Ensembles: Microcanonical ensemble, Canonical ensemble and Grand canonical ensemble – Comparison of various ensembles – Partition function and its correlation with thermodynamic quantities – Helmholtz free energy – Entropy of a system – Probability of one-dimensional random walk – Brownian movement.

UNIT IV: CLASSICAL STATISTICS

Phase space – Microstate and macrostate of a system – Application – Harmonic Oscillator –A free Particle - Liouville's Theorem – Entropy of a perfect gas: Gibbs' paradox – Removal of

paradox – Perfect gas in Micro Canonical ensemble – Ideal gas in Canonical ensembles – Ideal gas in Grand Canonical ensembles.

UNIT V: QUANTUM STATISTICS

Stirling's approximation – Thermodynamical probability – Maxwell Boltzmann statistics – Bose-Einstein quantum statistics – Fermi Dirac statistics – Comparison of three distribution statistics – Thermionic emission – Van der Waals gas equation – Phase transition: Second order phase transition – Ising model in one dimension.

BOOKS FOR STUDY:

1. Gupta and Kumar, Elementary Statistical Mechanics, Pragati Prakashan, Meerut (2011).
[Unit Covered: 1–5: Pages: 10–28, 33–40, 72–80, 100–156, 210–227, 235–241,250–265,310–326].
2. Sathya Prakash, Statistical Mechanics, Pragati Prakashan, Meerut (2004).
[Unit Covered: 1–5: Pages: 10–34, 65–80, 100–105, 118–120, 191–197, 225–238, 245–252, 272–275, 288–335, 370–415, 435–445, 536–540, 558–570]
3. B. K. Agarwal and M. Eisner, Statistical Mechanics, New Age International, New Delhi (1998).
[Unit covered: 1–5: Pages: 2–13, 18–25, 45–55, 61–80, 119–125, 147–158, 204–210, 215–225, 259–263].

BOOKS FOR REFERENCE:

1. K. Huang, Statistical Mechanics, John Wiley and Sons, New Delhi (1975).
2. R.K. Pathria and Paul D Beale, Statistical Mechanics, Academic Press (2000).
3. F. Reif, Statistical and Thermal Physics, McGraw Hill, International Edition, Singapore (1975).
4. B.B. Laud, Fundamentals of Statistical Mechanics - New Age International Publishers, Second Edition (2012).
5. C. Kittel, Elementary Statistical Physics, John Wiley & Sons, (2004).
6. R.P. Feynman, Statistical Mechanics, Addison Wesley, First Edition, (1998).
7. R.K. Pathria, Statistical Physics, Pergamon, Oxford, Third Edition, (2011).
8. S.R.A. Salinas, Introductory Statistical Physics, Springer (2000).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Understand laws and concepts of thermodynamics	K1 & K2
CO2	Apply statistical physics methods to solve problems in physical systems.	K2 & K3
CO 3	Apply concepts and principles of black body radiations and thermodynamics to analyze radiation phenomena in thermodynamic systems.	K3 & K4
CO 4	Analyze phase equilibrium condition and identify types of phase transitions of physical systems.	K3 & K4
CO 5	Understand phase space, micro and macro states; Quantum statistical mechanics and Distribution laws.	K5 & K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, **M – Medium,** **L – Low**

Program: M.Sc. Physics				
Core – VI	**Course Code:** 21PPH2C06		**Course Title:** Microprocessor 8085 and Microcontroller 8051	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	5	75	4	100

COURSE OBJECTIVES

1. To provide an understanding of the architecture and functioning of microprocessor 8085A and to the methods of interfacing I/O devices and memory to microprocessor.
2. To introduce 8085A programming and applications and the architecture and instruction sets of microcontroller 8051.

UNIT I: 8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING

Instruction set - Adressing modes - Programming techniques - Memory mapped I/O scheme- I/O mapped I/O scheme - Memory and I/O interfacing- Data transfer schemes - Interrupts of 8085 - Programmable peripheral interface (PPI) - Control group and control word- Programmable DMA controller - Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer.

UNIT II: 8085 INTERFACING APPLICATIONS

Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities(Temperature an strain).

UNIT III: 8051 MICROCONTROLLER HARDWARE

Introduction – Features of 8051 – 8051 Microcontroller Hardware : Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/Output pins, Ports and Circuits – External data memory and program memory : External program memory, External data memory.

UNIT IV: 8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING

Addressing modes – Data moving (Data transfer) instructions : Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions : byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions : Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions : Jump and Call program range, Jump, Call and subroutines – Programming.

UNIT V: INTERRUPT PROGRAMMING AND INTERFACING TO EXTERNAL WORLD

8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051 : Nested interrupts , Software triggering of interrupt.

LED Interface Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities(Temperature an strain).

BOOKS FOR STUDY:

1. A. Nagoor Kani, Microprocessors & Microcontrollers, RBA Publications (2009).
[Unit Covered: 1 – 5: Pages: 1 - 42,53 - 87, 97 – 159, 299 - 328, 333 - 397].
2. A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009).
[Unit Covered: 1: Pages: 1 - 84].
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with *8085*, Penram International Publishing (2013).
[Unit Covered: 1 - 5] [Pages: 1 - 25,54 - 85, 446 – 477, 497 - 501].
4. B. Ram, Fundamentals of Microprocessors & Microcontrollers, Dhanpat Rai publications New Delhi (2016).

BOOKS FOR REFERENCE:

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge of architecture and working of 8085 microprocessor.	K1 & K2
CO2	Get knowledge of architecture and working of 8051 Microcontroller.	K3
CO3	Be able to write simple assembly language programs for 8085A microprocessor.	K3 & K4
CO4	Able to write simple assembly language programs for 8051 Microcontroller.	K5
CO5	Understand the different applications of microprocessor and microcontroller.	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6–Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Elective – II	**Course Code:** 21PPH2E02		**Course Title:** Optoelectronic Devices and its Applications	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	5	75	4	100

COURSE OBJECTIVES

1. To acquire basic principle and knowledge about optoelectronics and optical fiber communication systems.
2. To understand technological aspects of diverse optoelectronic devices and their applications.

UNIT – I: PHYSICS OF LIGHT AND FIBER OPTICS

Propagation of electromagnetic waves in dielectric wave guides– Wave nature of light, basic optical laws and definition - Introduction to optical fibers-Principles of light propagation through optical fiber- Structure and properties of optical fiber. Types of fibers: Single mode and multimode fibers – Step index and graded index fibers.

UNIT – II: OPTICAL SOURCES

LED Structures–efficiency –Lasers–Principles of lasers: Absorption of radiation, spontaneous and stimulated emission –Three level and four level lasers– He-Ne laser– Ruby laser – Diode laser: Homojunctioin and heterojunction diode lasers.

UNIT - III: OPTICAL MODULATORS AND DETECTORS:

Introduction – Analog and Digital Modulator– Electro-optic modulators– Acousto and electro-optic modulators– Modulation types: Amplitude, frequency and pulse code modulation– Detection and demodulation– Detection and demodulation– PIN– Avalanche photodetector– Photomultiplier tube.

UNIT - IV:FIBER OPTIC SENSORS

Introduction –Types: Intrinsic and extrinsic sensors– Intensity modulated sensors–Fiber based sensors for displacement, temperature and pressure measurements– Fiber Bragg grating based sensors.

UNIT – V: INTERFEROMETRIC FIBER OPTIC SENSORS

Basic principles– Interferometric Sensors: Mach-Zehnder, Michelson and Fabry-Perot interferometers – Sagnac interferometer– Fiber-optic gyroscope– Applications of interferometric fiber optic sensors.

BOOKS FOR STUDY:

1. Dr. M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies Publishers, Kumbakonam (2002).

[Unit Covered: 1–5 : Sections: 2.1–2.32, 4.1–4.11, 5.1–5.6.2, 5.7–5.7.3, 5.8–5.8.2, 8.10–8.11.3, 5.7–5.7.3, 10.5–10.5.7]

BOOKS FOR REFERENCE:

1. H.G. Unger, Planar Optical Waveguides and Fibres, Oxford University Press, Oxford (1977).
2. A. Yariv, Principles of Optical Electronics, John Wiley, New York (1984).
3. H.A. Haus, Waves and Fields in Optoelectronics, Prentice Hall, New Jersey (1984).
4. AjoyGhatak, Optics, Second Edition, Tata McGraw Hill (2013).
5. B.P. Pal, Fundamentals of Fiber Optics in Telecommunications and Sensor Systems, New Age International, New Delhi (1992).
6. P. K. Rastogi, Optical Measurement Techniques and Applications, Artech House (1997).
7. Dave Birtalan, William Nunley, Optoelectronics: Infrared-Visible-Ultraviolet Devices and Applications, Second Edition, CRC Press (2009).
8. Michael A. Parker, Physics of Optoelectronics, CRC Press (2005).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic knowledge and concepts of optoelectronics	K1 & K2
CO2	Gain knowledge and importance of fibers and their types	K2 & K3
CO3	Know research-based knowledge about principal, construction and operation of different optoelectronic devices	K3 & K4
CO4	Develop skills pertaining to application potential of diverse optoelectronic devices	K5
CO5	Share ideas with respect to theoretical and experimental aspects of optoelectronic devices	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

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

S – Strong, **M – Medium,** **L – Low**

Program: M.Sc. Physics				
EDC		**Course Code:** 21PPH2EDC01/ 21PPH3EDC01	**Course Title:** Electronic Appliances	
Semester II/III	**Hours/Week** 4	**Total Hours** 60	**Credits** 4	**Total Marks** 100

COURSE OBJECTIVES

1. To understand the basics about electronic devices.
2. To learn the working principles and operation of electronic appliances.

UNIT I: ELECTRONIC COMPONENTS

Components – Resistors – Resistance Value – Types of Resistance – Capacitor – Capacitor Value – Types of Resistance – Construction and working of Diodes and Transistors – IC's.

UNIT II: ELECTRICAL APPLIANCES

Basic of UPS – Stabilizers – Voltage regulators – Iron Box – Microwave Oven – Refrigerators – Air Conditioners – Washing Machines.

UNIT III: ELECTRONIC APPLIANCES

Basics of Radio – TV – LCD Projectors – Digital Camera – Scanners – Video Conferencing.

UNIT IV: COMPUTERS

Generation of computer – Block diagram of a Computer – Input Device – Memory Device – Control Unit – Arithmetic logic unit – Output device – RAM – ROM.

UNIT V: COMMUNICATION ELECTRONICS

Basics of Mobile Phones – Wireless Phones – Antenna – Internet – Satellites.

BOOKS FOR STUDY AND REFERENCE:

1. S. S. Kamble, Electronics & Mathematical Data Book, Allied Publishers Ltd., (1997).
2. William David Cooper, Electronic Instrumentation and Measurement Technique, Second Edition, Prentice Hall, New Delhi (2007).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Utilize the basic knowledge in electronics field	K1 & K2
CO2	Examine the fundamental of electronic devices	K2
CO3	Gain knowledge on electrical and electronic appliances	K2 & K3
CO4	Demonstrate the working function of home appliances	K4
CO5	Apply research based knowledge to design electronic appliances	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6–Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – VII	**Course Code:** 21PPH3C07		**Course Title:** Quantum Mechanics - II	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	90	4	100

COURSE OBJECTIVES

- To familiarize the concepts of identical particles and scattering.
- To understand theory and expression involved in emission and absorption of radiation.
- To acquire knowledge about atomic, molecular structure and relativistic wave equation.

UNIT –I: SYSTEMS OF IDENTICAL PARTICLES

Identical particles - Symmetric and anti Symmetric wave function - Bosons and Fermions – Symmetric and Anti symmetric wave function of hydrogen molecule - Particle Exchange operator - Pauli's Exclusion principle - Connection with Statistical Mechanics - Pauli Spin Matrices for electron - Commutation relations - Pauli's operators,

UNIT – II: SCATTERING THEORY

Scattering cross sections - Differential and Total Scattering cross-section, Scattering amplitude Green's function - Formal expression for scattering cross section, Born approximation and its validity - Scattering by Screened coulomb potentials, Square-well potential, Partial wave analysis -Phase Shifts – Optical theorem - Scattering amplitude in terms of phase shift - Low energy scattering - Scattering length and effective range.

UNIT – III: EMISSION AND ABSORPTION OF RADIATION

Semi – Classical theory of radiation: Einstein coefficients - Atom field interaction - Transition probabilities for stimulated emission and absorption and spontaneous emission of radiation- Electric dipole transition - Selection rules and polarisability - Quantum theory of radiation: Radiation field Hamiltonian - Radiation field as an assembly of oscillators.

UNIT – IV: ATOMIC AND MOLECULAR STRUCTURE

Approximations in atomic structure – Central field approximation – Thomas Fermi Statistical model – Hartree - Fock Equation - The method of self consistent field – Residual

electrostatic and spin orbit interaction – Alkali atoms – Doublet separation – Coupling schemes .

UNIT –V: RELATIVISTIC WAVE EQUATION

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

BOOKS FOR STUDY:

1. Satya Prakash, Quantum Mechanics, Kedar Nath Ram Nath, Meerut (2009).
[Units Covered: 1– 5: Pages: 141, 365 – 379, 383, 384, 388 – 391,392, 412 532 – 539, 542 – 579,598 – 604, 609, 619, 624]
2. G. Aruldhas, Quantum Mechanics, Prentice- Hall of India, New Delhi (2006)
[Units Covered: 1– 5: Pages: 244 - 253, 260 – 264, 283 – 291, 294, 298 – 300, 310 – 332]

BOOKS FOR REFERENCES:

1. Ajoy K. Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Macmillan Publishers India Limited, Fifth Edition (2004).

2. Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications (2003).

3. P.M. Mathews & K. Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill (2002).

4. L.I. Schiff, Quantum Mechanics, McGraw Hill, Third Edition (1968).

5. Eugen Merzbacher, Quantum Mechanics, John Wiley & Sons, Third Edition (1998).

7. Franz Schwabl, Quantum Mechanics, Springer Science & Business Media, Fourth Edition (2007).

8. Peter W. Atkins and Ronald S. Friedman, Molecular Quantum Mechanics, Oxford University Press, Fifth Edition (2011).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand fundamental concepts of identical particles and Scattering theory	K1 & K2
CO2	Understands about atomic and molecular structure	K2 & K3
CO3	Gather knowledge about time dependent and independent theories.	K3&K4
CO4	Gain knowledge regarding atomic and molecular structure	K5
CO5	Learn about the relativistic wave equation.	K3, K4 &K6

K1– Remember,K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – VIII		**Course Code:** 21PPH3C08		**Course Title:** Electromagnetic Theory
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	90	4	100

COURSE OBJECTIVES

- To understand fundamental laws and concepts of electromagnetic field theory.
- To gain scientific and mathematical concepts of electromagnetic field theory.

UNIT – I : ELECTROSTATICS

Electric Flux - Coulomb's law and Gauss' law–Application of Gauss' law– Electric Potential - Relation between field theory and circuit theory – Continuity of Current - Conduction and displacement current – Energy density - Electric field intensity– Field due to point and continuous charges– Electric field in multiple dielectrics–Molecular polarisability and electric susceptibility– Electrostatic energy – Clausius-Mossotti equation –Boundary conditions

UNIT – II : MAGNETOSTATICS

Lorentz Law of force– Magnetic flux and density – Magnetic Torque - Magnetic field intensity– Biot-Savart law– Applications– Ampere's law–Divergence and curl of magnetic induction–Magnetic field due to straight conductor, circular loop and infinite sheet of current Magnetic dipole – Boundary conditions.

UNIT – III : ELECTRODYNAMIC FIELDS

Faraday's laws of induced EMF– Self and mutual inductance – Maxwell's equations in differential and integral forms–Maxwell's equations in free space and linear isotropic media– Magenetic Circuits - Scalar and vector potentials– Gauge transformation: Lorentz gauge and Coulomb gauge – Conservation of energy - Poynting theorem.

UNIT – IV : ELECTROMAGNETIC WAVES

Generation of electromagnetic waves– Electromagnetic wave equations - Electromagnetic waves in free space, conducting media, good dielectrics and good conductors –Skin depth– Wave guides–Propagation of waves in a rectangular and Cylindrical Waveguides – Inhomogeneous wave equation and retarded potentials– Field and radiation due to an

oscillating electric dipole– Dynamics of charged particles in static and uniform electromagnetic fields.

UNIT - V: PLASMA PHYSICS

Plasma - Definition - Occurrence in nature – Dilute and dense plasma– Uniform but time-dependent magnetic field: Magnetic pumping– Static non-uniform magneticfield: Magnetic bottle and loss cone– Magnetohydrodynamics equations– Magnetic Reynold's number– Pinched plasma: Bennett's relation.

BOOKS FOR STUDY:

1. Bo Thidé, Electromagnetic Field Theory, Upsilon Books, Sweden (2004).
   [Unit Covered: 1 and 3: Sections: 1–22, 25–45]
2. Costas J. Papachristou, Introduction toElectromagnetic Theoryand the Physics of Conducting Solids, Manuscript of Textbook Published by Springer (2020).
   [Unit Covered: 1– 4:Sections: 68–80, 91–98, 102–108, 113–124, 127–144]

3.Guptha Kumar Sharma, Electrodynamics, Pragathi Publications(2017)
   [Unit Covered: 1– 4]

4.Tai L. Chow, Introduction to electromagnetic Theory, Jones & Barlette India Pvt.(2012)
   [Unit Covered: 1 & 2]

BOOKS FOR REFERENCE:

1. Mathew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press Inc., First India Edition (2007).
2. Ashutosh Pramanik, Electromagnetism, Theory and Applications, Prentice-Hall of India Private Limited, New Delhi (2006).
3. J.A. Bittencourt, Fundamentals of Plasma Physics, Third Edition, Springer Publication (2004).
4. David J Griffiths, Introduction to Electromagnetics, Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi (2002).
5. T.V.S. Arun Murthy, Electromagnetic Fields, S. Chand, New Delhi (2008).
6. J.A. Edminister, Electromagnetics, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi (2009).
7. William. H. Hayt, Engineering Electromagnetics, Tata McGraw Hill (2001).
8. John R. Reitz, Foundations of Electromagnetic Theory, Sixth Edition, Narosa Publishing House, New Delhi (2000).

9. Satya Prakash, Relativistic Mechanics, Pragati Prakashan, Uttar Pradesh (2012).
10. K.L. Goswami, Introduction to Plasma Physics, Central Book House, Calcutta (2000).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand fundamental laws and concepts of electromagnetic field theory	K1 & K2
CO2	Identify and utilization of scientific and mathematical concepts of electromagnetic field theory	K2 & K3
CO3	Gather basic knowledge about electrodynamic fields and electromagnetic waves through relevant laws, theory and equations	K3 & K4
CO4	Develop skills and ideas to solve problems in free space and different materials pertaining to electromagnetic field	K5
CO5	Understand concepts and theory of plasma physics	K1 & K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – IX	**Course Code:** 21PPH3C09		**Course Title:** Spectroscopy	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	90	4	100

- To gain basic concepts of molecular vibrations.
- To understand the theory and applications of vibrational, rotational and resonance spectroscopy.

UNIT -I: INFRARED SPECTROSCOPY

IR Spectroscopy – Theory and Principle – FTIR Spectroscopy - FTIR Instrumentation-sampling methods – Issues surrounding the KBr Pellet Method – Transmittance and Reflectance Techniques - Attenuated Total Internal Reflection Techniques – Single bounce ATR and Multiple Bounce ATR - Advantages of FTIR- ATR Spectroscopy – Applications.

UNIT - II: RAMAN SCATTERING

Vibrational and Rotational Raman spectra – Mutual Exclusion principle – Raman spectrometer - Polarization of Raman Scattering light - Structure Determination through IR and Raman spectroscopy – Phase transitions – Resonance Raman Scattering - A brief description – SERS-CARS-remote sense Raman Spectroscopy.

UNIT - III: VIBRATIONAL ANALYSIS

Selection rules for Raman and IR vibrational normal modes – Raman and IR activity - C_{2V} and C_{3V} point groups – Distribution of normal modes among the active species – Projection Operator - Representation of Molecular Vibrations in Symmetry co-ordinates

Interpretation of vibrational spectra: External factors - Internal factors: Hydrogen bonding, Coupling of vibrations, Fermi resonance, Electronic effects, Solid state effects, Group vibrations, Finger print regions, Stretching and bending vibrations

UNIT - IV: MICROWAVE SPECTROSCOPY

Rotational spectra of diatomic molecules – Polyatomic molecules – Linear and symmetric top molecules – Hyperfine structure and quadrapole moment of linear molecules – Experimental techniques – Stark effect.

UNIT - V: NMR, ESR AND MB SPECTROSCOPY

Quantum theory of NMR – Bloch equations – Design of CW NMR Spectrometer – Principle and block diagram of PT NMR – Chemical Shift – Application to molecular structure.

Quantum Theory of ESR – Design of ESR Spectrometer – Hyperfine Structure – Anisotropic systems – Triplet State study of ESR – Applications – Crystal defects - Biological studies, MBS – Brief description and application.

BOOKS FOR STUDY:

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, Tata Mc Graw Hill, Fourth Edition, New Delhi (1994).
2. G. Aruldas, Molecular Structure and Spectroscopy, Prentice Hall of India Pvt, Ltd. New Delhi (2001).
3. D. N. Satyanarayana, Vibrational Spectroscopy and Applications, New Age International Publication (2004).
4. Puranik, Group Theory Applications to Molecular Vibrations, Chand & Co Publications

BOOKS FOR REFERENCE:

1. D. D. Jyaji and M.D Yadav, Spectroscopy, Amol Publications (1991).
2. Attaur Rahman, Nuclear Magnetic Resonance, Spinger Verlag (1986).
3. D. A. Lang, Raman Spectroscopy, Mc Graw- Hill International (1977).
4. Raymond Chang, Basic Principles of Spectroscopy Mc Graw-Hill Kogakusha, Tokyo (1980).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire knowledge of Raman and Vibrational Modes of Vibration.	K1 & K2
CO2	Acquire knowledge about Infrared spectroscopy.	K2
CO3	Understand IR And RamanSpectroscopy .	K2 & K4
CO4	Analyse the Diatomic and Polyatomic Molecule	K4
CO5	Acquire Knowledge of NMR and ESR Spectroscopy.	K5 & K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Elective – III	**Course Code:** 21PPH3E03		**Course Title:** Nanoscience and Nanotechnology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	4	60	4	100

COURSE OBJECTIVES

- To provide an introduction to nanomaterials, their synthesis, properties and applications.
- To introduce to various applications and characterization techniques.

UNIT – I: BACKGROUND AND EMERGENCE OF NANOTECHNOLOGY

Nanotechnology – Emergence of nanotechnology – Nanomaterials – Classification ofnanomaterials based on composition, number of dimensions in nanoscale and morphology –Characteristics of nanomaterials – Surface area to volume ratio – Its effect on properties of nanomaterials – Nanoparticles – Nanoclusters – Nanocomposites – Nanohybrids – An overviewon the applications of nanomaterials.

UNIT – II: QUANTUM DOTS AND CARBON NANOTUBES

Quantum dots (QDs) – Quantum confinement – Production and applications of QDs – Quantum wires – Quantum wells – Carbon allotropes – Discovery of C60 – Fullerenes – Types of fullerenes – Bucky balls – Carbon nanotubes (CNTs) – Single walled CNTs – Multi-walled CNTs – Properties of CNTs – Synthesis of CNTs – Plasma-arc discharge method –Laser ablation technique – Chemical vapour deposition method – Potential applications ofCNTs.

UNIT – III: PREPARATION OF NANOMATERIALS

Nanomaterials – Preparation – Top-down method – Ball milling – Photolithography–Electron beam lithography – Molecular beam epitaxy – Bottom-up technique – Soft-chemicalmethod – Sol-gel synthesis – Electro chemical deposition – Atomic layer deposition - Molecular selfassembly – Langmuir - Blodgett film (2D nanostructure) preparation – green synthesis.

UNIT – IV: ANALYTICAL TECHNIQUES FOR NANOMATERIALS CHARACTERIZATION

Structural characterization: Principle of X-ray powder diffraction – Determination ofstructural parameters – Optical studies : UV-Vis-NIR spectrometry – Band gap determination by Tauc's plot method – Photoluminescence spectroscopy –FTIR spectroscopy – Surface morphological analysis:– Scanning electron microscopy (SEM) – Scanning tunnelling microscope (STM) –Transmission Electron Microscope (TEM) –X-ray photoelectron spectroscopy (XPS).

UNIT – V: APPLICATIONS OF NANOMATERIALS

Nanoelectronics – Molecular diodes and transistors – Quantum electronic devices – Nanophotonics – Photonic crystals – Nano electromechanical systems (NEMS) – Nanomaterials in energy conversion and storage – Nanomaterials as antibacterial agents – Nanomaterials as photocatalysts – Energy efficient windows – Nanomaterial in industrialapplications – Bio-medical applications : Targeted drug delivery – Nanomaterial basedradiation therapy – Photodynamic therapy (PDT) – Tissue engineering – Bio imaging.

BOOKS FOR STUDY

1. K. Ravichandran, K. Swaminathan, P. K. Praseetha, P. Kavitha 'Introduction tonanotechnology', Jazym Publications, Tiruchirappalli.

2. Nanostructures and Nanomaterials, synthesis, properties and applications, Imperialcollege press, London.

3. Nanoscience and nanotechnology K.P. Mathur, 1st Edition 2007, Rajat Publications,NewDelhi

BOOKS FOR REFERENCE

1. M. Ratner, Nanotechnology; A Gentle introduction, Prentice – Hall, 2003.

2. Nanotechnology; Basic Science and Emergining Technologies, CRC Press

3. Charles P.Poole Jr and Frank J. Owens. "Introduction to Nanotechnology" Wiley, 2003.

4. A.S.Edelstein and R.C. Cornmarata, Nanomaterials; synthesis, Properties andApplications, 2 Ed, Iop (U.K), 1996.

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire the knowledge about introduction to nanomaterials, their synthesis, properties and applications	K1 & K2
CO2	Understanding of one dimensional and two dimensional nano system	K2 & K3
CO3	Acquire the knowledge in the rapid development of nanoscience and technology	K4
CO4	Learn the different methods of characterizing the Nanomaterials	K5
CO5	Gain knowledge in the development of application of the nanomaterials	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core Practical – III		**Course Code:** 21PPH3P03		**Course Title:** Microprocessor 8085 and Microcontroller 8051 Experiments
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	4	60	4	100

COURSE OBJECTIVES

- To understand the theory and working of Microprocessor, Microcontroller and their applications.
- To use microprocessor and Microcontroller in different applications

MICROPROCESSOR 8085

(*ANY TEN EXPERIMENTS*)

1. 8-bit addition and subtraction, multiplication and division
2. Sum of a set of N data (8 bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending order.
3. Code conversion (8 bit number):a) Binary to BCD b) BCD to binary.
4. Addition of multi byte numbers, Factorial
5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters
6. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter
7. Interfacing of seven segment display.
8. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves.
9. DAC 0800/ DAC 1048 interface and wave form generation (Unipolar/ Bipolar output).
10. ADC 0809 interface.
11. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action.
12. Interfacing of Temperature Controller and Measurement
13. Water level detector.
14. Elevator

15. Traffic Light Controller
16. Key board Interface

MICROCONTROLLER 8051

(*ANY TEN EXPERIMENTS*)

1. Addition, Subtraction, Multiplication and Division of 8-bit numbers.
2. Sum of a series of 8-bit numbers,
3. Average of N numbers.
4. Factorial of number.
5. Fibonacci series of N terms.
6. Multi byte Addition / Subtraction.
7. Sorting in ascending and descending order – Picking up smallest and largest number.
8. LED interface – Binary up/down counter, BCD up/down counter, Ring and twisted ring counter.
9. Interfacing seven segment displays.
10. DAC 0800 / 1408 interface and wave form generation.
11. ADC interfacing.
12. Stepper motor interfacing.
13. Temperature controller and Measurements.
14. Traffic light controller
15. Elevator

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Develop the programming skills of Microprocessor	K1 & K2
CO2	Appreciate the applications of Microprocessorprogramming	K2 & K3
CO3	Understand the structure and working of 8085 microprocessor and apply it.	K4
CO4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor.	K5
CO5	Acquire knowledge about the interfacing 8051 microcontroller with various peripherals.	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with Pos

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – X	**Course Code:** 21PPH4C10		**Course Title:** Condensed Matter Physics	
Semester IV	**Hours/Week** 6	**Total Hours** 90	**Credits** 4	**Total Marks** 100

COURSE OBJECTIVES

- To study basic properties of the condensed matter Physics.
- To develop a deep understanding of condensed matter at atomic scale.
- To understand the role of quantum effects in micro- and meso-scopic systems and acquire a fundamental understanding of a range of physical phenomena in condensed matter systems.

UNIT I: BONDING AND CRYSTALLOGRAPHY

Bonding: Ionic bonding – Calculation of lattice energy – Calculation of Madelung constant in ionic crystals – Born Haber cycle – Crystals of inert gases – Van der Waal's interaction – Compressibility and bulk modulus.

Crystallography: Reciprocal lattices – Vector development of reciprocal lattice – Properties of the reciprocal lattice – Reciprocal lattice to bcc lattice and fcc lattice – Bragg's condition in terms of the reciprocal lattice.

UNIT II: LATTICE VIBRATIONS AND THERMAL PROPERTIES

The vibration of monatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons – Lattice heat capacity – Einstein model of the lattice heat capacity – Density of mode in one dimension and three dimensions – Debye model of the lattice heat capacity.

UNIT III: FREE ELECTRON THEORY, ENERGY BANDS AND SEMICONDUCTOR CRYSTALS

Band theory of solids – Free electron gas in one dimension – Energy levels and density of states – Free electron gas in three dimensions –Thermal conductivity of metals –

Wiedemann–Franz law – Hall effect – Motion of electrons in a one dimensional periodic potential – Effective mass of the electron.

UNIT IV: DIAMAGNETISM, PARAMAGNETISM AND FERROMAGNETISM

Cooling by adiabatic demagnetization – Determination of susceptibilities of para and diamagnetic materials: Guoy method – Quincke's method – Ferromagnetism – Spontaneous magnetization in ferromagnetic materials – Quantum theory of ferromagnetism – Weiss Molecular field – Temperature dependence of spontaneous magnetism – Domain Theory – Antiferromagnetism – Ferrimagnetism – Structure of ferrites.

UNIT V: SUPERCONDUCTIVITY

Superconductivity – Thermodynamic effects: Entropy – Specific heat – Energy gap – Thermodynamics of Superconductors – Electrodynamics of superconductors - London equations – Josephson tunnelling – Theory of DC Josephson's effect and AC Josephson's effect – SQUID –High Temperature Superconductors – Application of superconductors.

BOOKS FOR STUDY:

1. S.L.Gupta and V. Kumar,Solid State Physics, Pragati Prakashan (2002).
   [Unit covered: 1–5: Pages: 60–74, 79–90, 108–120, 123–134, 161–165, 171–178, 183–186, 189–203, 219–223, 226–245, 281–289, 305–310, 333–335, 410–420, 424–430, 437–463, 475–488, 520–525, 532–544].
2. S.O. Pillai, Solid State Physics, New Age International Pvt. Ltd., New Delhi (1999).
   [Unit covered: 1–5: Pages: 51–65, 136–147, 230–236, 261–265, 291–310, 334–350, 358–365, 370–375, 385–412, 430–510, 577–580,647–660].

BOOKS FOR REFERENCE:

1. Fundamentals of Solid State Physics, B. S. Saxena, R. C. Gupta and P. N. Saxena, Pragati Prakashan, Meerut (2010).
2. Solid-state Physics, A. J. Dekker, MacMillan India Limited, Prentice Hall Edition (1999).
3. Solid-state Physics, R.L. Singhal, Kedar Nath and Ram Nath & Co., Publishers, Meerut, India (2003).
4. Introduction to Solid State Physics, C. Kittel, Fifth Edition, Wiley Eastern, New Delhi (1977).

5. Solid State Physics, N. W. Ashcroft and N. D. Mermin, Harcourt Asia Pvt. Ltd., Singapore (2001).
7. Solid State Physics, J. S. Blakemore, Second Edition, Cambridge University Press, Cambridge, London (1974).
8. An Introduction to X-ray Crystallography, M.M. Woolfson, Cambridge University Press, Cambridge, London (1991).
9. Introduction to High-Temperature Superconductors, Thomas P. Sheahen, Plenum Press, New York (1994).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Differentiate Lattice types and explain concepts of reciprocal lattice and crystal diffraction.	K1 & K2
CO2	Predict electrical and thermal properties of solids and explain their origin.	K2 & K3
CO3	Explain concept of energy bands and effect of the same on electrical properties.	K3 & K4
CO4	Explain various types of magnetic phenomenon, physics behind them, their properties and applications.	K5 & K6
CO5	Explain superconductivity, its properties and important parameters related to possible applications	K5 & K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, **M – Medium,** **L – Low**

Program: M.Sc. Physics				
Core – XI		**Course Code:** 21PPH4C11		**Course Title:** Nuclear and Particle Physics
Semester IV	**Hours/Week** 6	**Total Hours** 90	**Credits** 4	**Total Marks** 100

COURSE OBJECTIVES

- To familiarize basic concepts of nucleus and its features.
- To understand about types of nuclear reactions and nuclear forces.
- To acquire knowledge about radioactive radiations and elementary particles.

UNIT –I: STRUCTURE OF NUCLEUS AND NUCLEAR MODELS

Types of Nuclei - Nuclear Size, Shape, Mass and Measurement of Charge, Spin, Parity and Magnetic Moment - Binding Energy, Average Binding Energy and Deuteron Binding Energy - Semi Empirical Mass Formula- Mass Defect, Packing Fraction- Nuclear Stability - Liquid Drop Model, Shell Model, Optical Model, Collective Model.

UNIT – II: NUCLEAR FORCES

Exchange Forces and its Types - Yukawa's Meson Theory- Yukawa Potential - Ground State of Deuteron - Low Energy N-P Scattering –Spin Dependence of Nuclear Forces - Charge Independence of Nuclear Forces.

UNIT –III: NUCLEAR REACTIONS

Types of Reactions - Conservation Laws - Q – Value Equation - Energetic of Nuclear Reactions - Compound Nucleus - Reciprocity Theorem - Breit and Wigner Dispersion Formula - Alpha Particle Scattering and Rutherford's Formula.

UNIT –IV: RADIOACTIVE DECAYS

Properties of Alpha, Beta and Gamma Rays - Alpha Decay, Geiger – Nuttal Law, Range of Alpha Particle Experiment, Gamow's Theory of Alpha Particles, Beta Decay, Neutrino Hypothesis, Fermi theory of Beta Decay, Gamma decay, Internal Conversion.- Selection rules

UNIT – V: ELEMENTARY PARTICLES

Types of Fundamental Forces, Classifications Elementary Particles - Conservation Laws and Symmetry (C, P and T invariance) - CPT Theorem - Quark Model – Colours and Flavour – SU(2) and SU(3) Multiplets - Gell - Mann- Okubo Mass formula for octet and decaplet –- Gell-Mann- Nishijima formula.

BOOKS FOR STUDY:

1. Dr. V.W. Kulkarni, Atomic and Nuclear Physics, Himalaya Publishing house, Mumbai (2004).
   [Unit Covered: 1: Pages: 661 – 666 & 680-689].
2. N. Subrahmanyam, Brijlal revised by Jivan Seshan, Atomic and Nuclear Physics, S. Chand & Company Ltd (1984).
   [Unit Covered: 1, Page No: 204 – 211 & 231 - 237].
3. Dr. M. L. Pandya, R. P. S. Yadav, Elements of Nuclear Physics, Kedar Nath Ram Nath, Meerut (2000).
   [Units Covered: 2, 3 and 5: Pages: 152-205, 433-442, 457-464, 525-530, 550- 551]
4. D. C. Tayal, Nuclear Physics, Himalaya Publishing House, Mumbai (2004).
   [Units Covered: 1 &3: Pages: 373-377, 411-415].
5. R. Murugasen, Kiruthiga Sivaprasath, Modern Physics, S. Chand & Company Ltd, New Delhi (2007).
   [Units Covered: 1, 3, 4, 5, Page No: 391-405, 443-454,458-461,483-486, 534-544].

BOOKS FOR REFERENCE:

1. R.P. Roy and B.P. Nigam, Nuclear Physics, Age International Ltd, New Delhi (2005).
2. B.L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill, New Delhi (1983).
3. H. Semat, Introduction to Atomic and Nuclear Physics, Chapman and Hall, New Delhi(1983).
4. W.S.C. Williams, Nuclear and particle Physics Claredon Press, London (1981).
5. K.S. Krane, Introductory Nuclear Physics, John Wiley, New York (1 9 8 7) .
6. S.B. Patel, Nuclear Physics: An Introduction, Wiley- Eastern, New Delhi (1991).
7. D. Griffiths, Introduction to Elementary particles, Wiley International Edition, New York (1987).

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand fundamental concepts of nucleus, nuclear reactions and nuclear models	K1 & K2
CO2	Understands about nuclear forces, reactions and elementary particles	K2 & K3
CO3	Gather knowledge about decays in radioactivity and different elementary particles	K3&K4
CO4	Gain knowledge regarding nucleus, forces, reactions	K5
CO5	Learn about the models of nucleus	K3, K4 &K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core – XII	**Course Code:** 21PPH4C12		**Course Title:** Computational Methods and C – Programming	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	6	90	4	100

COURSE OBJECTIVES

- To understand applications of programs for the development of Physics and for theoretical applications.
- To acquire knowledge about curve fitting, Linear and nonlinear equations, Numerical integration and differentiation, C programming, and etc.

UNIT -I: CURVE FITTING AND INTERPOLATION

Curve Fitting: Method of least squares – Normal equations, straight line fit, exponential, parabola and power-law fits.

Interpolation: Newton - Gregory formula for forward and backward interpolation – Lagrange's interpolation for equal and unequal intervals and inverse form of Lagrange's interpolation polynomial – Divided differences - Important theorems on divided difference.

UNIT- II: SOLUTIONS OF LINEAR AND NONLINEAR EQUATIONS

Simultaneous Linear Equations:Gauss elimination method –Gauss Jordan's method-inverse of a matrix by Gauss–Jordon method. Nonlinear Equations: Approximate solutions of algebraic and transcendental equations –Newton-Raphson method - Method of iteration and successive approximation method.

UNIT - III: NUMERICAL INTEGRATION AND NUMERICAL SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS

Newton - Cotes quadrate formula –Trapezoidal rule for single integral and Simpson's rule for single Integral - 1/3 and 3/8 rules

Euler's method:modified and improved Euler's method – Taylor's series method – Runge - Kutta method: second and fourth order method– Geometric descriptionof the formula –Local andglobal truncation errors.

UNIT - IV: C FUNDAMENTALS, OPERATORS AND EXPRESSIONS

Introduction - Importance of C - Basic structure of C programs - character set - C Tokens - Keywords and Identifiers - Constants - Variables –Expressions - Data types - Declaration of variables – Assigningvalues to variables - Defining symbolic constants. Operators: Arithmetic, Relational, Logical, Assignment, Increment and Decrement - Input output statements: getchar - putchar - formatted input (scanf) - formatted output (printf).

UNIT - V:CONTROL STRUCTURES, ARRAYS AND FUNCTIONS

Control structures: Decision making with simple if - if-else - nesting of if-else - else-if ladder -switch - goto statement - Looping with while - do-while - for statements - break and continue statements- flowchart symbols.

Arrays: One dimensional and two dimensional arrays – Declaration and initialization of arrays

Functions: Library functions - User-defined functions - Definition of functions - function declaration - function calls - nesting of functions – recursion – simple programs.

BOOKS FOR STUDY:

1. Dr.B.S.Goel and Dr.S.K.Mittal, Numerical Analysis Pragati Prakasham, Meerut, (1999).
   [Units Covered 1-3: Pages: 43-97, 120-214 and 308-458].
2. E. Balagrusamy, Numerical methods, Tata McGraw Hill, New Delhi (1999).
   [Units Covered 1-3: Pages: 121-251, 275-387and 408-456]
3. P. Satyaprakash,Mathematical Physics with Classical Mechanics, Sultan Chand & Sons, Educational Publishers, New Delhi, (2004).
   [Unit Covered 1-4: Pages: 855- 894]
4. E. Balagrusamy, Programming in ANSI, Tata McGraw Hill, New Delhi (2010).
   [Units Covered 5: Pages: 1-45, 51-72 and 110-200].
5. R. Hubbard, McGraw-hill, Programming with C++, J. New Delhi (2006).
   [Unit Covered 5:Pages: 274- 354]
6. T. Veerarajan and T. Ramachandran,Numerical Methods with Programming in C, Tata McGraw Hill, New Delhi (2006).
   [Unit Covered: 5: Pages: 50- 160]
7. Dr. A.Singaravelu, Numerical Methods, Meenakshi Agency (2012).

[Unit Covered: 3 and 4: Sections: 1.19, 1.93, 4.27-4.67, and 3.1-3.98].

BOOKS FOR REFERENCE:

1. Byron S. Gottfried Schaum's, Outline of Theory and Problems of Programming with C, Tata McGraw-Hill (1991).
2. Suresh Chandra,Application of Numerical Techniques with C, New Delhi: Narosa Publishing House (2006).
3. A.K. Ghattak, T.C. Goyal and S.J. Chua,Mathematical Physics, Macmillan (1995).
4. M. K. Jain S.R.K Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi (1993).
5. H. Mathews,Numerical Methods for Mathematics, Science and Engineering, Prentice–Hall of India, New Delhi (1998).

COURSE OUTCOME: (COB)

After completion of this course, the students will be able to:

COB No.	Course Objectives	Knowledge Level
COB 1	Understand the numerical error analysis,curve fittings, Newton's and Lagrange's Interpolation formula.	K1 & K2
COB 2	Apply solutions to various types of ordinary differential and integral equations.	K2 & K3
COB 3	Analyze linear and nonlinear solutions to demonstrate the accurate algebraic and transcendental equation	K3 & K4
COB 4	Learn how to obtain numerical solution of ordinary differential equation using power series approximation, Euler's, and Runge-Kutta method.	K4
COB 5	Explore the familiar computer programming and implement to the numerical and computational methods.	K5

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with Pos

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

S – Strong, M – Medium, L – Low

Program: M.Sc. Physics				
Core Practical – IV	**Course Code:** 21PPH4P04		**Course Title:** Computational Methods	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	4	60	4	100

COURSE OBJECTIVES

- To use computer programming for simulation and data analysis.
- To develop C programs for numerical problems.
- To create C programs to to solve differential equations.

LIST OF EXPERIMENTS

1. Lagrange interpolation with Algorithm, Flow chart, C PROGRAM and output.
2. Newton forward interpolation with Algorithm, Flow chart, C PROGRAM and output.
3. Newton backward with Algorithm, Flow chart, C PROGRAM and output.
4. Curve-fitting : Least squares fitting with Algorithm, Flow chart, C PROGRAM and output.
5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart, C PROGRAM and output.
6. Numerical integration by Simpson's rule with Algorithm, Flow chart, C PROGRAM and output.
7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart, C PROGRAM and output.
8. Numerical solution of ordinary first-order differential equations by the Runge-Kutta method with Algorithm, Flow chart, C PROGRAM and output.
9. Computer Simulation – Simple Pendulum.
10. Computer Simulation – Projectiles.
11. Computer Simulation – Compound Pendulum.
12. Computer Simulation – Diode & Zener diode characteristics.
13. Computer Simulation – FET Characteristics.

COURSE OUTCOMES (CO)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Develope C programs for Newton forward and backward interpolation formula.	K1 & K2
CO2	Create C program to fit appropriate curve to a given set of data	K2 & K3
CO3	Develop C program to solve trapezoidal and Simpson's rule	K4
CO4	Create C program to solve first-order differential equations by the Runge-Kutta method	K5
CO5	Develop computer stimulation program to solve basic Physics experiments	K6

K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create

Mapping of COs with POs

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

S – Strong, M – Medium, L – Low