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 2020-2021 Onwards)

REGULATIONS AND SYLLABUS FOR M.Sc. PHYSICS PROGRAMME

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 2020-2021 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	20PPH1C01	Mathematical Physics	6	4	25	75	100
2	Core – II	20PPH1C02	Classical Mechanics	6	4	25	75	100
3	Core – III	20PPH1C03	Linear and Non Linear Integrated Circuits and Applications	5	4	25	75	100
4	Elective – I	20PPH1E01	Energy Physics	5	4	25	75	100
5	Core Practical– I	20PPH2P01	General and Advanced Physics Experiments	4	Credit and Marks are carried to Core Practical – I of Semester II			
6	Core Practical– II	20PPH2P02	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	20PPH2C04	Quantum Mechanics - I	5	4	25	75	100
8	Core – V	20PPH2C05	Thermodynamics and Statistical Physics	5	4	25	75	100
9	Core – VI	20PPH2C06	Microprocessor 8085 and Microcontroller 8051	5	4	25	75	100
10	Elective – II	20PPH2E02	Optoelectronic Devices and its Applications	5	4	25	75	100
11	Core Practical– I	20PPH2P01	General and Advanced Physics Experiments	4	4	40	60	100
12	Core Practical– II	20PPH2P02	Electronics Experiments	4	4	40	60	100
13	Common Course	20P2HR01	Human Rights	2	2	25	75	100
Total				**30**	**26**	**205**	**495**	**700**
SEMESTER III								
14	Core – VII	20PPH3C07	Quantum Mechanics - II	6	4	25	75	100
15	Core – VIII	20PPH3C08	Electromagnetic Theory	6	4	25	75	100
16	Core – IX	20PPH3C09	Spectroscopy	6	4	25	75	100
17	Elective – III	20PPH3E03	Nanoscience and Nano Technology	4	4	25	75	100

	(Any one)	20PPH3E04	Synthesis of Materials and Characterizations					
18	Core Practical– III	20PPH3P03	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**
SEMESTER IV								
20	Core – X	20PPH4C10	Condensed Matter Physics	6	4	25	75	100
21	Core – XI	20PPH4C11	Nuclear and Particle Physics	6	4	25	75	100
22	Core – XII	20PPH4C12	Numerical and Computational Methods	6	4	25	75	100
23	Core Practical– IV	20PPH4P04	Computational Methods	4	4	40	60	100
24	Project	20PPH4PR01	Project	8	6	-	100	100
Internship				-	2	-	-	-
Total				**30**	**25**	**115**	**385**	**500**
Cumulative Total				**120**	**90**	**585**	**1635**	**2200**
Sl. No.			**Extra Disciplinary Course (EDC) (Other than Physics Major students)**					
1	EDC	20PPH2EDC01	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:** 20PPH1C01		**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 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 ANALYSIS AND TENSORS

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

Introduction to tensors – Transformation of coordinates – Summation convention – Tensor transformation (contravarient, covariant tensors) – Rank of a tensor – Quotient law – Kronecker and Livi-Civita symbol – Symmetric and Anti-symmetric tensor

UNIT II : INTEGRAL TRANSFORM

Fourier transform: Fourier sine, cosine and complex integrals – Fourier sine and cosine transform (finite and infinite) – Properties of Fourier transforms (Linear property, change of scale property, shifting property and modulation theorem) - Convolution theorem – Boundary value problems.

Laplace Transform: Laplace formulae – Properties of Laplace transforms (Linear property – Change of scale property, first and second shifting theorems) – Special functions of Laplace transforms (Gamma, Bessel, and Dirac delta)

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 formulae -Taylor and Laurent expansion – Singularities of an analytic function – Residues – Cauchy's residue theorem –Evaluation of definite integrals – Contour integration.

UNIT IV : SPECIAL FUNCTIONS

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

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 (COs)

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:** 20PPH1C02		**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 – D'Alembert's principle – Cyclic coordinates and Lagrange's Equations – Applications of Lagrange's formulation – Compound pendulum – Spherical pendulum – Simple pendulum– Isotropic oscillator – 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 – Cyclic coordinates and conservation of theorems – Integrals of Hamilton’s equations – Hamilton’s canonical equations of motion, significance – Deduction of canonical equations from a variational principle – Simple pendulum – Compound pendulum –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 – Particle falling freely in a uniform magnetic field – 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 – 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 : 6–16, 30–40, 50–65, 100–115, 340–343, 120–140, 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: 6–14, 39–50, 57–74, 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 (COs)

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:** 20PPH1C03		**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 - Electrical Parameters – Offset and Null Connection – Offset Error and Correction - Inverting Single Input Summing Amplifier – Three Input Averaging Amplifier - Differential Amplifier - General Linear Applications - Simultaneous equations and differential equations- Instrumentation amplifier- Log and Antilog amplifiers- Analog multiplication and division

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 as divide by 2N counter.

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 (COs)

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:** 20PPH1E01		**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: INTRODUCTION TO 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

Base principles of wind energy conversion – Wind data and energy estimation – Basic components of wind energy conversion systems – Types: Vertical axis and horizontal axis

wind machines – Scheme for electric generation – Generator control – Load control – 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 (COs)

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:** 20PPH2P01		**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 *twelve* Experiments)

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

16. Solar constant.
17. Solar spectrum – Hartmann's formula. Edser and Butler fringes – Thickness of air film.
18. Band gap energy- Thermistor

SEMESTER – II

I (b). ADVANCED PHYSICS EXPERIMENTS

(Any *twelve* Experiments)

1. Specific charge of an electron – Thomson's method.
2. e/m by Millikan's method.
3. Ultrasonics – Compressibility of a liquid.
4. Miscibility measurements using ultrasonic diffraction method.
5. Michelson Interferometer – Wavelength, Separation of wavelengths.
6. Michelson Interferometer – Thickness of thin film.
7. GM counter – characteristics, inverse square law, absorption coefficient.
8. GM counter – Feather's analysis: Range of Beta rays.
9. Conductivity measurement using four probe methods.
10. Arc spectrum – Iron.
11. Iodine absorption spectra.
12. Molecular spectra – AlO band.
13. Molecular spectra – CN bands.
14. Laser Experiments: Study of Laser beam parameters.
15. Laser Experiments : (i) Diffraction at straight edge, (ii) Interference of laser beams – Lloyds single mirror method, (iii) Interference using an optically plane glass plate, (iv) Diffraction at a straight wire and (v) Diffraction at a circular aperture.
16. Experiments on optical fibres.
17. Microwave test bench - Standing wave Measurements and standing wave co-efficient, , Law of Inverse square – Receiver end transmitter behavior – Radiation Pattern
18. Dielectric measurements in Microwave test bench.
19. Hall Effect.

20. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
21. Interpretation of vibrational spectra of a given material

Course Outcomes (COs)

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:** 20PPH2P02		**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. Design of UJT relaxation oscillator for a given frequency – Generation of positive and negative triggering pulses.
2. FET CS amplifier- design, Frequency response, input impedance, output impedance
3. Study of important electrical characteristics of IC741.
4. Design of 3 input summing and average amplifier – Design of differential amplifier to solve $2V_2 – 5V_1$.
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. Designs of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
8. Design of square wave oscillator using IC741- Triangular wave oscillator using IC 741- Triangular wave generator
9. Design of a quadrature wave using IC324
10. Construction of pulse generator using the IC 741 – application as frequency divider

11. Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
12. Study of R-S, clocked R-S and D-Flip flop using NAND gates
13. Study of J-K, D and T flip flops using IC 7476/7473
14. Arithmetic operations using IC 7483- 4 bit binary addition and subtraction.
15. Design of Arithmetic logic unit using IC 74181

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. Design of second order butterworth multiple feedback narrow band pass filter
5. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
6. Construction of square wave generator using IC 555 – Study of VCO.
7. Design of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer.
8. Construction of pulse generator using the IC 555 – Application as frequency divider.
9. IC 7476 / IC7473 – Study of binary up / down counters
10. IC 7476 – Shift register, ring counter and Johnson counter (twisted ring counter).
11. Design of synchronous parallel 4-bit binary up/down counter using IC 74193
12. Design of asynchronous parallel 4-bit binary up/down counter using IC 7493
13. Construction of 4-1 multiplexer using basic gates AND, OR and NOT operations.
14. Study of 16-1 multiplexer using IC 74150
15. Construction of 1-4 demultiplexer using basic gates AND and NOT operations.
16. Study of 1-16 demultiplexer using IC 74154.

Course Outcomes (COs)

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:** 20PPH2C04		**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: 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 -III: 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 –IV: PERTURBATION THEORY FOR STATIONARY STATES

First and Second Order Perturbation Theory in Non– Degenerate and Degenerate Cases, Application to Perturbed Harmonic Oscillator- The Perturbation Energy Term is Proportional to X and X^2, 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 (COs)

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:** 20PPH2C05		**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: BASIC OF THERMODYNAMICS AND APPLICATIONS

Concept of entropy: Entropy of a system – Entropy and probability – Change in entropy of a solid/Liquid – Thermodynamic potentials and the reciprocity relations – Gibb's Helmholtz relation – Thermodynamic equilibria – Nernst's heat theorem – Blackbody radiation and Planck's radiation distribution law.

UNIT II: SPECIFIC HEAT OF SOLIDS

Specific heat of solids: Dulong and Petit's law – Einstein's theory of the specific heat of solid – Debye's theory of specific heat capacity of solids – Criticism of Debye theory – Negative temperature – Specific heat anomaly of metals and its solution – Liquid helium – Bose-Einstein condensation.

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 – Thermodynamical quantities by partition function – 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 – 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: 10–22, 33–40, 72–80, 100–156, 210–227, 235–241,252–260,307–310, 317–326].
2. Sathya Prakash, Statistical Mechanics, Pragati Prakashan, Meerut (2004).
   [Unit Covered: 1–5: Pages: 28–34, 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 (COs)

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:** 20PPH2C06		**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].

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 (COs)

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:** 20PPH2E02		**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: INTRODUCTION

Propagation of electromagnetic waves in dielectric wave guides–Boundary conditions– Phase velocity and group velocity–Fibers and dispersion in fibers– Cut off frequency– Electromagnetic field in core and cladding–Types of fibers: Single mode and multimode fibers – Step index and graded index fibers.

UNIT – II: LASERS

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

UNIT - III: FIBER OPTICS COMMUNICATION

LED and lasers source– Transmitter modulator – 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

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

UNIT – V: INTERFEROMETRIC FIBER OPTIC SENSORS

Basic principles– Interferometric configurations: 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 (COs)

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:** 20PPH2EDC01	**Course Title:** Electronic Appliances	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	4	60	4	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 (COs)

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:** 20PPH3C07		**Course Title:** Quantum Mechanics - II
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	90	4	100

Course Objectives

1. To familiarize basic concepts of quantum mechanics and its features.
2. To understand procedures involved in emission and absorption of radiation.
3. To acquire knowledge about atomic, molecular structure and relativistic wave equation.

UNIT –I: SYSTEMS OF IDENTICAL PARTICLES

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

UNIT – II: SCATTERING THEORY

Definitions of cross sections - Differential and Total 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, Exponential, Gaussian potential, Partial wave analysis, Phase Shifts, 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 polarizability, 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, Meaning of 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 (COs)

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:** 20PPH3C08		**Course Title:** Electromagnetic Theory
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	90	4	100

Course Objectives

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

UNIT – I : ELECTROSTATICS

Coulomb's law and Gauss' law–Application of Gauss' law– Divergence and curl of electrostatic field–Electric field intensity– Field due to point and continuous charges– Dielectric polarization and strength– Electric field in multiple dielectrics–Molecular polarisability and electric susceptibility– Electrostatic energy in dielectric medium–Clausius-Mossotti equation– Laplace and Poisson equations–Boundary value problems.

UNIT – II : MAGNETOSTATICS

Lorentz Law of force– 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 flux density in free space–Magnetic force– Magnetic dipole – Boundary conditions.

UNIT – III : ELECTRODYNAMIC FIELDS

Faraday's laws of induced EMF– Transformer and motional EMF– Maxwell's equations in differential and integral forms–Maxwell's equations in free space and linear isotropic media– Displacement current –Relation between field theory and circuit theory – 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– Wave parameters: velocity, intrinsic impedance and propagation constant–Electromagnetic waves in free space, dielectrics and conductors – Reflection, refraction and polarization– Fresnel's Law–Skin depth– Wave guides–Propagation of waves in a rectangular wave guide– 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

Definition of plasma: It's occurrence in nature– Dilute and dense plasma– Uniform buttime-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]

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 (COs)

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

PO / 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:** 20PPH3C09		**Course Title:** Spectroscopy	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	90	4	100

Course Objectives

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

UNIT 1: NORMAL CO-ORDINATE ANALYSIS

Selection rules for Raman and IR vibrational normal modes – Raman and IR activity - C_2V and C_3V point groups – Representation of Molecular Vibrations in Symmetry co-ordinates – Normal coordinate analysis for H_2O molecule - Construction of kinetic constant matrix elements-Wilson's FG matrix method-force constants-potential energy distribution.

UNIT 2: INFRARED SPECTROSCOPY

FTIR Instrumentation-sampling methods-attenuated Total Internal reflection techniques-Advantages of FTIR-ATR Spectroscopy-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 3: 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 4: 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 5: 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).

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 (COs)

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

PO / 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:** 20PPH3E03		**Course Title:** Nanoscience and Nanotechnology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	4	60	4	100

Course Objectives

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

UNIT I: BASIC PROPERTIES OF NANOPARTICLE

Introduction to Nanoscience and Nanotechnology - Definition of Nano – Size dependent properties of nanomaterials - Classification of nanomaterials- Top down and bottom up ideas- Properties of nano-particles; Mechanical properties; Electrical properties; Magnetic properties; Optical properties- Chemical properties

UNIT II: QUANTUM PHENOMENON

One dimensional quantum leak; Quantum Tunneling- Time dependent perturbation theory; Transition to continuum (Fermi's Golden rule); Density of states (DOS); Spin effects (Zeeman splitting)

UNIT III : NANOFABRICATION AND NANOPATTERNING

Sol-Gel synthesis, Hydrothermal Growth - Chemical Vapour Deposition (CVD) - Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM) – Scanning Electron Microscope (SEM) - Transmission Electron Microscopy (TEM)- Lithography (X-ray beam lithography- electron beam lithography)

UNIT IV: NANO SYSTEMS

One dimensional (1D), Two-dimensional (2D) and Three dimensional (3D) nanostructured materials, Quantum Dots - Quantum wire; Quantum well; Tunnel diode; Molecular transistor; Single electron transistor; Spin polarized transistor; Thin films technology.

UNIT V: APPLICATIONS OF NANOMATERIAL

Nanotechnology devices: OLED (Organic Light Emitting Diodes), OTFTs (Organic field-effect transistor) - Bioelectronics and Biosensors- Application of Nanomaterial: Electrical and electronic devices, Biological applications - Energy applications - Carbon nano-tube – Properties of Carbon nano tube -Types of Carbon nano (single and multi-wall nanotubes) and its applications

BOOKS FOR STUDY:

1. K. K. Chattopadhyay, A. N. Banerjee, Introduction to Nanoscience and Technology, New Delhi, PHI learning Pvt. Ltd., (2009)
2. S. Shanmugam, Nanotechnology, MJP Publishers (2010).
3. T. Pradeep, Nano: The Essentials, Tata Mc Graw- Hill Publishers Company Ltd., New Delhi (2007).
4. K. Ravichandran; Introduction to the characterization of nanomaterials and thin films, Jazym Publications, Trichy, India (2015).

BOOKS FOR REFERENCE:

1. A. K. Bandyopadhyay, Nanomaterials, New Age International (P) Ltd., New Delhi (2009).
2. Joseph Goldstein, Scanning Electron Microscopy and X-ray microanalysis, Springer, London (2003).
3. Charles. P. Poole, Frank. J. Owens, Introduction to nanotechnology, New Jerssey, A John Wiley & Sons publications (2003).
4. K. Ravichandran; Introduction to thin films Spectroscopy, Research India Publications, New Delhi (2013).

Course Outcomes (COs)

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

PO / 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				
Elective – III		**Course Code:** 20PPH3E04		**Course Title:** Synthesis of Materials And Characterization
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	4	60	4	100

Course Objectives

1. To understand basic theories and concepts of crystal growth.
2. To gain knowledge about the material properties through diverse characterization techniques.

UNIT - I: NUCLEATION

Nucleation and Growth The crystalline state - concept of crystal growth – historical review – Importance of crystal growth – crystal growth theory : classical theory – Gibbs – Thomson equation- kinetic theory of nucleation – Energy of formation of a nucleus – kinetics of thin film formation – Film growth– Nucleation theories – Incorporation of defects and impurities in films – Deposition parameters and grain size – structure of thin films.

UNIT – II: CRYSTAL GROWTH TECHNIQUE

Techniques Solution growth technique: Low temperature solution growth: solution – Solubility – constant temperature bath an crystallizer – seed preparation and mounting – slow cooling and solvent evaporation methods. Gel growth technique: Principle – various types – structure of gel – Importance of gel – Experimental procedure – Advantage of gel method. Melt technique: Bridgman technique – Czochralski technique – Experimental arrangement – Growth process. Vapour technique: Physical vapour deposition – chemical vapour deposition (CVD.

UNIT- III: THIN FILMS

Thin Film Deposition Techniques Thin films – Introduction to vaccum technology – deposition techniques – physical methods – resistive heating, electron beam cun and laser gun

evaporation – sputtering: Reactive sputtering, radio frequency sputtering – chemical methods – spray pyrolsis – preparation of transport conducting oxides.

UNIT - IV: CHARACTERIZATION TECHNIQUES

X-ray Diffraction (XRD) – power and single crystal – Fourier transform infrared analysis – FT-Raman analysis – Elemental dispersive x-ray analysis (EDA–X) – scanning electron microscopy (SEM) – UV –VIS Spectrometer Vickers micro hardness – Auger emission spectroscopy. Photo luminance (PL) – UV-Vis-IR spectrometer – AFM – Hall effect – SIMS – X-ray – photoemission spectroscopy (XPS) .

UNIT V: FABRICATIONS

Applications Micro electrochemical systems (MEMS) – optoelectronic devices: LED, LASER and solar cell – polymer films – Fabrication and characterization of thin film transistor, capacitor, resistor, inductor and FET – Sensor– Applications of ferromagnetic and super conducting films: Data storage, Giant magneto resistance (GMR).

BOOKS FOR STUDY:

1. P. Santhana Ragavan , P.Ramasamy, Crystal Growth and Processes, KRU Publications, Kumbakonam (2000)
2. J.C.Brice, Crystal Growth Process, John Wiley Publications, New York (1996)
3. L.I. Maissel and R. Clang, Hand book of Thin Films Technology, McGraw Hill (1970).
4. J. L. Vossen and W. Kern, Thin Films Process, Academic Press (1978).
5. H.H. Williard, L.L. Merritt, M.J. Dean, and F.A. Settle, Instrumental Methods of Analysis, Sixth Edition, CBS Publishers and distributors, New Delhi (1986).

BOOKS FOR REFERENCE:

1. K. Sangawal, Elementary Crystal Growth, Shan Publisher, UK (1994).
2. M. Ohring, The Materials Science of Thin Films, Academic Press (1992).
3. M. William and D. Steve, Instrumental Methods of Analysis, CBS publishers, New Delhi (1986).
4. R.W.Berry, P.M.Hall and M.T.Harris, Thin Film Technology, Van Nostrand, New York (1968).

Course Outcomes (COs)

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

CO Number	CO Statement	Knowledge Level
CO 1	Formulate the ideas to grow the crystal and get the knowledge of types of nucleation.	K1 & K2
CO 2	Find the different methods to grow the crystal in different techniques.	K2& K4
CO 3	Study about thin film and find the methods to develop the various method to develop the thin film.	K3 & K4
CO 4	Apply various methods to analyse the developed thin film and crystal materials.	K4& K6
CO 5	Get the knowledge of laser and its types and also knowledge of fabrication of ICs.	K5 & K6

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

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	S
CO2	M	S	M	S	S
CO3	M	S	M	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:** 20PPH3P03		**Course Title:** Microprocessor 8085 and Microcontroller 8051 Experiments
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	4	60	4	100

Course Objectives

1. To understand the theory and working of Microprocessor, Microcontroller and their applications.
2. 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
6. Interfacing of seven segment display.
7. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation.
8. DAC 0800/ DAC 1048 interface and wave form generation (Unipolar/ Bipolar output).
9. ADC 0809 interface.
10. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action.
11. Interfacing of Temperature Controller and Measurement
12. Water level detector.
13. Elevator
14. Traffic Light Controller
15. 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 (COs)

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

PO / 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:** 20PPH4C10		**Course Title:** Condensed Matter Physics	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	6	90	4	100

Course Objectives

1. To study basic properties of the condensed matter Physics.
2. To develop a deep understanding of condensed matter at atomic scale.
3. 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 (COs)

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

PO / 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:** 20PPH4C11		**Course Title:** Nuclear and Particle Physics
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	6	90	4	100

Course Objectives

1. To familiarize basic concepts of nucleus and its features.
2. To understand about types of nuclear reactions and nuclear forces.
3. 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, Effective Range, Scattering Length, Spin Dependence of Nuclear Forces, Charge Independence of Nuclear Forces.

UNIT –III: NUCLEAR REACTIONS

Types of Reactions, Energetic of Nuclear Reactions, Conservation Laws, Q – Value Equation 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.

UNIT – V: ELEMENTARY PARTICLES

Types of Fundamental Forces, Classifications Elementary Particles, Elementary Particles Quantum Numbers (Charge, Spin, Parity, isoSpin, Strangeness), Conservation Laws and Symmetry (C, P and T invariance), Quark Model – Colours and Flavour.

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 (COs)

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

PO / 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:** 20PPH4C12		**Course Title:** Numerical And Computational Methods
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	6	90	4	100

Course Objectives

1. To understand applications of programs for the development of Physics and for theoretical applications.
2. 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 (interpolation with equal intervals) – Lagrange's interpolation for equal and unequal intervals and inverse form of Lagrange's interpolation polynomial – Divided differences (central difference): important theorems on divided difference.

UNIT- II: SOLUTIONS OF LINEAR AND NONLINEAR EQUATIONS

Simultaneous Linear Equations:Gauss elimination method –Gauss Jordan's modification-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 DIFFERENTIATION

Newton-Cotes quadrate formula –Trapezoidal rule for single integral and Simpson's rule for single Integral (1/3 and 3/8 rules) –Numerical differentiation;test of numerical differentiation.

UNIT - IV: NUMERICAL SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS

Euler's method:modified and improved Euler's method – Taylor's series method – Runge - Kutta method: second, third and fourth order method– Geometric descriptionof the formula – Local andglobal truncation errors– Solving simultaneous equation and second-order equations by Runge-Kutta method

UNIT - V: C PROGRAMMING

Basic History, Versions and Applications of C– Operators in C:Arithmetic, Relational, Logical, Bitwise Assignment and Misc Operators– Constants, variables and their declarations – Input, output and comparison operators– if, if. else, switch, while, do-while, for and break statements– Main, void, exit and swap functions

BOOKS FOR STUDY:

1. Dr.B.S.Goel and Dr.S.K.Mittal, Numerical Analysis Pragati Prakasham, Meerut, (1999).
   [Units Covered 1-4: Pages: 43-97, 120-214 and 308-458].
2. E. Balagrusamy, Numerical methods, Tata McGraw Hill, New Delhi (1999).
   [Units Covered 1-4: 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 (COs)

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

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

PO / 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:** 20PPH4P04		**Course Title:** Computational Methods
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	4	60	4	100

Course Objectives

1. To use computer programming for simulation and data analysis.
2. To develop C programs for numerical problems.
3. 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 (COs)

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

PO / 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				
EDC		**Course Code:** 20PPH2EDC01	**Course Title:** Electronic Appliances	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	4	60	4	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 (COs)

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

PO / 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**