Study Scheme & Syllabus

(Choice Based Credit System)

For

M.Sc. PHYSICS

1st TO 4th SEMESTER

(w.e.f. Session 2016-17)

Program Code: PHY-H 401

DEPARTMENT OF PHYSICS

SCHOOL OF BASIC AND APPLIED SCIENCES

RIMT UNIVERSITY, MANDIGOBINDGARH, PUNJAB

TABLE OF CONTENTS

S. No.	Content	Page No.
1.	**Section 1**: Vision and Mission of the University	3
2.	**Section 2**: Vision and Mission of the Department	4
3.	**Section 3**: About the Program	5
4.	**Section 4**: Program Educational Objectives (PEOs) , Program Outcomes (POs) and Program Specific Outcomes (PSOs)	6-7
5.	**Section 5**: Curriculum / Scheme with Examination Scheme	8-14
6.	**Section 6**: Detailed Syllabus with Course Outcomes	15-67

SECTION 1

Vision & Mission of the University

VISION

To become one of the most preferred learning places and a centre of excellence to promote and nurture future leaders who would facilitate the desired change in the society.

MISSION

- To impart teaching and learning through cutting-edge technologies supported by the world class infrastructure
- To empower and transform young minds into capable leaders and responsible citizens of India instilled with high ethical and moral values.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities

SECTION 2

Vision and Mission of the Department

VISION

To build a foundation for Excellence and encourage the development of the institution as premier institution by igniting and promoting enthusiasm, interest and passion, in the study of physics, in professional courses, as a part of curriculum.

MISSION

- To awaken the young minds and discover their talents both in theory and practical physics through dedication to teach, commitment towards students and the responsibility towards the department.
- To support the development activities of the university and make the department vibrant.
- To demonstrate a high level of competence in the study of applied physics.
- To develop strategy in the deptt. for continuous improvement.
- Department of Physics achieves its mission by trying to evenly represent the underlying sub-disciplines of physics in research and teaching, but also to promote new areas of research, with an emphasis on interdisciplinary and applied research.

SECTION 3

About the Program

M.Sc. Physics is a postgraduate course based on the study of all branches of Physics. It is a 2 year,4 semester full time program of 91 credit hours. This program comprises of foundational courses, core courses, specialization electives courses, enrichment courses and experimental learning. A candidate has to be a B.Sc. graduate in Physics from a recognized university in order to become eligible for this course. M.Sc. Physics is a two-year program. A Master of Science (M.Sc.) in Physics is a degree that can open up many career doors for students interested in a wide range of applications. The coursework for this degree focuses on the fundamentals of physics.

SECTION 4

Program Educational Objectives (PEOs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PROGRAM EDUCATION OBJECTIVES

PEO1	To impart high quality education in Physical Sciences.
PEO2	To prepare students to take up challenges as globally competitive physicists/researchers in diverse areas of theoretical and experimental physics.
PEO3	To make the students technically and analytically skilled.
PE04	To provide opportunity of pursuing high end research as project work
PEO5	To give exposure to a vibrant academic ambience.

PROGRAMME OUTCOMES (POs)

PO 1	Comprehend the adequate knowledge about the concepts, principles and tools required for effective scientific, social and economic skills which the students can apply in individual and professional life.
PO 2	Demonstrate high standards of actuarial ethical conduct, professional behavior, interpersonal and communication skills as well as a commitment to lifelong learning through pure and applied sciences.
PO 3	Apply and demonstrate the basic physics in environmental context for sustainable development
PO 4	Be initiated into the basics of scientific and applied research which will be helpful for the students to generate employability
PO 5	Attained the skills of observations and drawing logical inferences from the scientific experiments
PO 6	Learnt the art of teaching and acquired the ability to deal with the students based on their individual differences in various classroom situations
PO 7	Enhance and adopt new skills for future employability in teaching and research through seminar, internship.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Understanding the basic concepts of physics particularly in classical mechanics, quantum mechanics, electronics and solid state physics to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws.
PSO 2	Learn to carry out experiments in basic as well as certain advanced areas of physics such as nuclear physics, electronics and lasers.
PSO 3	A research oriented learning that develops analytical and integrative problem solving approaches.

SECTION 5

Curriculum / Scheme with Examination Grading Scheme

SEMESTER WISE SUMMARY OF THE PROGRAMME: M.Sc. PHYSICS

S. No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	27	700	23
2.	II	26	600	23
3.	III	27	700	23
4.	IV	31	700	25
	Total	111	2700	94

COURSE CATEGORY-WISE CREDIT DISTRIBUTION

S. No.	Category	Number of Credits	Percentage Weightage
1	University Core	-	-
2	University Open	3	3.3
3	Program Core	76	80.2
4	Program Elective	12	13.2
5	Program Specialization	-	-

6	MOOCs	-	-
7	Project / Research Projects	-	-
8	Thesis/Dissertation	3	3.3
9	Training/Internships/Field Trips	-	-
10	Professional Skills	-	-
11	Any Other(Fundamental)	-	-
TOTAL CREDITS		**94**	**100**

EXAMINATION GRADING SCHEME

Marks Percentage Range	Grade	Grade Point	Qualitative Meaning
80.00 - 100.00	O	10	OUTSTANDING
70.00 - 79.99	A+	9	EXCELLENT
60.00 - 69.99	A	8	VERY GOOD
55.00 - 59.99	B+	7	GOOD
50.00 - 54.99	B	6	ABOVE AVERAGE
45.00 - 49.99	C	5	AVERAGE
40.00 - 44.99	P	4	PASS
0.00 - 39.99	E	0	FAIL
ABSENT	AB	0	Absent

Percentage Calculation: CGPA *10

First Semester:

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
MPHY-1101	Electronics-1	3	1	0	4	16	-	24	60	100	3
MPHY-1102	Mathematical Physics	3	1	0	4	16	-	24	60	100	3
MPHY-1103	Classical Mechanics	3	1	0	4	16	-	24	60	100	3
MPHY-1104	Quantum Mechanics-I	3	1	0	4	16	-	24	60	100	3
MPHY-1105	General Physics Lab-1	0	0	6	3	-	60	-	40	100	3
MCOP-1101	Basics of Computer Prog.	3	0	0	3	16	-	24	60	100	3
MCOP-1102	Basics of Computer Prog. Lab	0	0	2	1	-	60	-	40	100	3
Total		15	4	8	23					**700**	

Second Semester:

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
MPHY-1201	Electronics-II	3	1	0	4	16	-	24	60	100	3
MPHY-1202	Electrodynamics-I	3	1	0	4	16	-	24	60	100	3
MPHY-1203	Atomic and Molecular Spectra	3	1	0	4	16	-	24	60	100	3
MPHY-1204	Quantum Mechanics –II	3	1	0	4	16	-	24	60	100	3
MPHY-1205	Statistical Mechanics	3	1	0	4	16	-	24	60	100	3
MPHY-1206	General Physics Lab-II	0	0	6	3	-	60	-	40	100	3
Total		15	5	6	23					600	

Third Semester

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
MPHY-2301	Electrodynamics-II	3	1	0	4	16	-	24	60	100	3
MPHY-2302	Condensed Matter Physics-I	3	1	0	4	16	-	24	60	100	3
MPHY-2303	Nuclear Physics	3	1	0	4	16	-	24	60	100	3
MPHY-2304	Computational Methods in Physics	3	0	0	3	16	-	24	60	100	3
MPHY-2305	Computational Methods in Physics Lab	0	0	2	1	-	60	-	40	100	3
MPHY-2306	General Physics Lab-III	0	0	6	3	-	60	-	40	100	3
Departmental Elective Subject-I (Choose any one)											
MPHY-2311	Radiation Physics	3	1	0	4	16	-	24	60	100	3
MPHY-2312	Fibre optics & Laser Technology	3	1	0	4	16	-	24	60	100	3
MPHY-2313	Advanced Quantum Mechanics	3	1	0	4	16	-	24	60	100	3
Total		15	4	8	23					**700**	

Fourth Semester:

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
MPHY-2401	Particle Physics	3	1	0	4	16	-	24	60	100	3
MPHY-2402	Condensed Matter Physics-II	3	1	0	4	16	-	24	60	100	3
MPHY-2403	Advanced Physics Lab-IV	0	0	6	3	-	60	-	40	100	3
MPHY-2404	Dissertation#	0	0	6	3	-	-	-	100	100	3
Departmental Electives-II (Choose any one)											
MPHY-2411	Physics of Nanostructured Materials	3	1	0	4	16	-	24	60	100	3
MPHY-2412	Plasma Physics	3	1	0	4	16	-	24	60	100	3
Departmental Electives-III(Choose any one)											
MPHY-2413	Optoelectronics	3	1	0	4	16	-	24	60	100	3
MPHY-2414	Advanced Electronics	3	1	0	4	16	-	24	60	100	3
MPHY-2415	Physics of Materials	3	1	0	4	16	-	24	60	100	3
Open Elective (Choose any one)											
MSRM-2401	Research Methodology	3	-	-	3	16	-	24	60	100	3
MLAB-2401	MATLAB	2	-	2	3	16	-	24	60	100	3
Total		15	4	6	25					**700**	

#For Dissertation, the student is to carry out literature survey on the topic assigned to him/her by his/her supervisor. The student has to carry out survey 15-20 papers, out of which at least 10 should be international repute. The student is to write a review paper and present to his/her supervisor in the form of soft and hard copy. He/she will also have to give 30 minutes presentation through power point slides in the front of 3 teachers as decided by Head of department including supervisor. Evaluation is to be done on his/her performance.

CWA	**Class Work Assessment**
LWA	**Lab Work Assessment**
MTE	**Mid Term Exam**
ETE	**End Term Exam**

NC	**Non Credit**

EVALUATION

1. There shall be two Mid Term Examination (MTE) of 24% Marks (24 marks) in each semester. Average of two is considered for final internal assessment.
2. There shall be continuous class work assessment (CWA) of 16% (16 Marks) of theory subjects
3. End Term examination (ETE) will be of 60% of total marks (60 marks).
4. Each practical examination shall be of 3 hours duration.
5. There shall be continuous lab work assessment (LWA) for practical of 60% marks (60 marks). The final examination will be of 40% marks (40 marks).

Pattern of end-semester question paper

The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.

SECTION 6

Detailed Syllabus with Course Outcomes

SYLLABUS

SEMESTER-I

COURSE TITLE: ELECTRONICS-I (SEMICONDUCTOR DEVICES & ANALOGUE ELECTRONICS)
SUBJECT CODE: MPHY-1101
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The objective of this course is to equip the students with the knowledge of Semiconductor materials, semiconductors devices and applications, and operational amplifier.

Sr. No.	Contents	Contact Hours
UNIT I	**Semiconductor Materials:** Energy bands and charge carrier in semiconductors, Direct and Indirect band gap semiconductors, Degenerate and compensated semiconductors, Carrier Transport in Semiconductors: Carrier Drift under low and high fields in (Si and GaAs), Saturation of drift velocity, High field effects in two valley semiconductors, Carrier diffusion, Carrier injection, Generation and recombination processes, Minority carrier life time, Drift and diffusion of minority carriers, Hall effect	**15**
UNIT II	**Junction Diodes:** Energy band diagrams for homo and hetero junctions, Current flow mechanism in p-n junction, Metal-semiconductor (Schottky Junction) junction and their applications: Energy band diagram, current flow mechanisms in forward and reverse bias, effect of interface states, Zener diode, switching diodes, Tunnel diode, Photodiodes and solar cells, Metal-Oxide-Semiconductor (MOS) diodes, Energy band diagram, depletion and inversion layer, Applications of MOS diode	**15**
UNIT III	**Transistors and Other Devices:** JFET, MOSFET and MESFET Transistors: Structure, working and characteristics, Charge Coupled Devices (CCD), Unijunction transistor (UJT), Four layer (PNPN) devices, DIAC, TRIAC, Semiconductor Controlled Rectifier (SCR), Regulated power supplies, Gunn diode, IMPATT devices, Liquid crystal displays.	**15**
UNIT IV	**Electronic Circuits:** Multivibrators (Bistable, Monostable, Astable), Differential amplifier, common mode rejection ratio, Transfer characteristics, Ideal operational amplifier; Open loop operational amplifier Operational amplifier (OP-AMP), OP-AMP as inverting, Non-inverting, Scalar, Summer, Integrator, Differentiator, Comparator, Schmitt trigger and Logarithmic amplifier, Square wave and triangular wave generators	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1101.1**	Get the knowledge about semiconductor materials

CO2	**MPHY -1101.2**	Understand the working of semiconductor devices which makes the base of student in the electronic field.
CO3	**MPHY -1101.3**	Learn about BJT, Field Effect Transistors, their principles and applications.
CO4	**MPHY -1101.4**	Basic operational amplifier characteristics, OPAMP parameters ,applications as inverter, integrator, differentiator etc

Reference Books:

1. Streetman, B.G., and Banerjee, S. Solid State Electronics Devices. New Jersey: Prentice Hall, 2006.
2. Millman, J. and Halkias, C.C. Electronic Devices and Circuits. New Delhi: Tata McGraw Hill, 2010.
3. Principle of Electronics, V K Mehta and Rohit Mehta S Chand & Company, 2012

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: MATHEMATICAL PHYSICS
SUBJECT CODE: MPHY-1102
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The course on Mathematical Physics is introduced to familiarize the students with the mathematical techniques that will be useful in understanding theoretical treatment in other courses.

Sr. No.	Contents	Contact Hours
UNIT I	**Vector Spaces & Matrices:** Definition of a linear vector space, Linear independence, Orthonormal basis, Gram-Schmidt, Orthogonalization process, Linear operators, Matrices, Unitary and Hermitian matrices, Cayley-Hamilton Theorem, Eigen values and eigenvectors of matrices **Tensors:**Coordinate transformations, scalars, contravariant and covariant vectors, definition of contravarient, mixed and covariant tensor of second rank, Addition, subtraction and contraction of tensors, quotient rule **Group Theory**: Definition of a group, Multiplication table, Conjugate elements and classes of groups, directs product, Isomorphism, homeomorphism, permutation group, Definitions of the three dimensional rotation group and SU(2), O(3)	15
UNIT II	**Complex Analysis:** Functions of complex variable, Analytical functions, Cauchy-	10

	Riemannn conditions, Cauchy Integral theorem, Cauchy integral formula, Derivatives of analytical functions, Power series Taylor's theorem, Laurent's theorem, Calculus of residues –poles, essential singularities and branch points, residue theorem, Jordan's lemma, singularities on contours of integration, evaluation of definite integrals.	
UNIT III	**Differential equations and Special functions:** Second order linear differential equation with variable coefficients, ordinary point, singular point, series solution around an ordinary point, series solution around a regular singular point; the method of Frobenius, Solution of Legendre's equation, Solution of Bessel's equation, Solution of Laguerre and Hermite's equations. Bessel functions of first and second kind, Generating Function, Integral representation and recurrence relations and orthogonally, Legendre functions: Generating functions, recurrence relations and special properties, orthogonality, Associated Legendre functions: recurrence relations, parity and orthogonality, Hermite and Laguerre functions, generating function and Recurrence relations	**15**
UNIT IV	**Integral Transforms:** Integral transform, Laplace transform, some simple properties of Laplace transforms such as first and second shifting property, Inverse Laplace Transform by partial fractions method, Laplace transform of derivatives, Laplace Transform of integrals, Fourier series, Evaluation of coefficients of Fourier series, Cosine and Sine series, Fourier Transforms, Fourier sine Transforms, Fourier cosine Transforms, Simple Application of Fourier Transform	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1102.1**	Demonstrate competence with the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations, basis and dimension, eigenvalues, eigenvectors and Normalization.
CO2	**MPHY -1102.2**	Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.
CO3	**MPHY -1102.3**	Solve a Cauchy problem for the wave or diffusion equations using the Fourier Transform and use complex analysis in solving physical problems
CO4	**MPHY -1102.4**	Solve ordinary and partial differential equations of second order that are common in the physical sciences; use the orthogonal polynomials and other special functions

Reference Books:

1. Mathematical Methods for Physicists by G. Arfken and H.J. Weber (Academic Press, San Diego) , 2012
2. Mathematical Physics by P.K. Chattopadhyay (Wiley Eastern, New Delhi), 2004
3. Mathematical Physics by B.S. Rajput (Pragati Prakashan, Meerut, 2005)

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question* *carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: CLASSICAL MECHANICS
SUBJECT CODE: MPHY-1103
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objectives: The aim and objective of the course on Classical Mechanics is to provide the knowledge of Lagrangian and Hamiltonian formalisms to an extent that they can use these in the modern branches like Quantum Mechanics, quantum Field Theory, Condensed Matter Physics, and Astrophysics.

Sr. No.	Contents	Contact Hours
UNIT I	**Lagrangian Mechanics:** Newton's law of motion, mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange's equations of motion. Velocity dependent potentials and dissipation function, Some applications of Lagrangian formulation, Hamilton's principle, derivation of Lagrange's equations from the Hamilton's principle, Conservation theorems and symmetry properties	15
UNIT II	**Central Force Problem:** Two body central force problem, reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one dimensional problem, and classification of orbits, The differential equation for the orbit and integrable power-law potential, The Kepler problem, Scattering in a central force	15
UNIT III	**Rigid Body Dynamics:** The independent co-ordinates of a rigid body, orthogonal transformation, the Euler's angles. Euler's theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energy about a point for a rigid body, the inertia tensor and moment of inertia, the eigen values of the inertia tensor and the principal axis transformation. Euler's equations of motion, torque free motion of a rigid body.	15
UNIT IV	**Canonical Transformations:** Legendre transformation and Hamilton's equations of motion, cyclic co-ordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action, The equation of canonical transformation, examples of canonical transformations, Poission brackets, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poission bracket formulation.	15

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1103.1**	Learn about Lagrangian and Hamiltonian formulation of Classical Mechanics.
CO2	**MPHY -1103.2**	State the conservation principles involving momentum, angular momentum and energy and understand that they follow from the fundamental equations of motion
CO3	**MPHY -1103.3**	Learn about motion of a particle under central force field.
CO4	**MPHY -1103.4**	The classical background of Quantum mechanics and get familiarized with Poisson brackets and Hamilton -Jacobi equation

Reference Books:

1. Classical Mechanics: Herbert Goldstein- Pearson India, 3rd Edition, 2011
2. Classical Mechanics: Rana and Joag-Tata Mc Graw Hill, New Delhi,2015
3. Classical Mechanics: J.C Upadhyaya, Himalaya Publishing House, 2007

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: QUANTUM MECHANICS-I
SUBJECT CODE: MPHY-1104
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: This course introduces the students with the basic formulation of the quantum mechanics. The basic equation of quantum mechanics is derived in this course. The students are provided the knowledge about angular momentum formulation so that they can use these in various branches of physics as per their requirement.

Sr. No.	Contents	Contact Hours
UNIT I	**Basic Formulation and Quantum Kinematics:** Linear vector spaces, Hilbert space, Ket space, Bra space and inner product, Eigenkets of an observable, Eigen kets as base kets, completeness (closure property), orthonormal set of vectors, operators, eigenvalues and eigenvectors of an operator, Matrix representation of states and operators, projection operator, unitary operator, Hermitian operators, Schwarz Inequality, commutator and uncertainty relations, simultaneous eigenvectors, Change of basis and unitary transformations, wave function in coordinate &	**15**

	momentum representation	
UNIT II	**Quantum Dynamics and One Dimensional problems:** Time evolution operator and Schrödinger equation, special role of the Hamiltonian operator, energy eigen kets, time dependence of expectation values, Schrödinger vs. Heisenberg picture, unitary operators, state kets and observable in Schrödinger and Heisenberg pictures, Heisenberg equations of motion, Ehrenfest's theorem, Solution of linear harmonic oscillator problem by operator method, energy eigen states, wave functions and coherent states.	**15**
UNIT III	**Spherical Symmetric Systems and Angular Momentum: Solution of** Schrödinger equation for hydrogen atom, hydrogen atom wave function & energy levels, angular momentum, Orbital, Spin and total angular momentum operators, Eigen value problem for L^2 and L_z operators, Ladder operator L_+ and L_-, Pauli spin matrices, Matrix representation of Angular momentum operators, commutation relations, Eigen vectors and eigen functions of J^2 and Jz. Addition of angular momentum and C.G. coefficients, Computation of Clebsch-Gordan coefficients in simple cases (j_1= j_2=1/2), Three dimensional harmonic oscillator, 3-D potential well problem.	**15**
UNIT IV	**Identical Particles:** Schrodinger equation for many electron atom, Identical particles: Physical meaning of identity, Principle of indistinguishability and its consequences, Exchange operator, Symmetric and anti-symmetric wave functions, connection between spin, symmetry and statistics, Statistics of identical particles: Fermions and bosons, Spin and total wave function for a system of two spin ½ particles, Pauli exclusion principle and Slater determinant, Application to the electronic system of the helium atom (para- and orthohelium), Collision of identical particles.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1104.1**	Introduce quantum mechanics through Stern-Gerlach experiment
CO2	**MPHY -1104.2**	Know all types of representations of operators and ways to apply them in different problems
CO3	**MPHY -1104.3**	Apply Ket and Bra notation to solve quantum mechanical problems and Angular momentum algebra
CO4	**MPHY -1104.4**	Solve problem of harmonic oscillator, hydrogen atom and quantum mechanics of identical particles

Reference Books:

1. Modern Quantum Mechanics by J. J. Sakurai, Pearson Education Pvt. Ltd., New Delhi, 2014
2. Quantum Mechanics by L I Schiff-Tata Mc Graw Hill Education, 2010
3. Quantum Mechanics by Powel and Craseman, Dover Publication 2015

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: GENERAL PHYSICS LAB-I
SUBJECT CODE: MPHY-1105
SEMESTER: 1
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Internal Assessment: 60
End Term Exam: 40
Duration of Exam; 3 Hrs

Objective: The aim of the course on Physics Laboratory is to train students in handling the basic tools of experimental physics, and their use in laboratory demonstration of important physical phenomenon and the underlying principles of physics

Note: Students will be required to perform at least 15 experiments from the given list of experiments

1. To study characteristics of a PN junction with varying temperature and to find the energy band gap of a semiconductor.
2. To Study the D C characteristics and applications of DIAC
3. To study the D C characteristics and applications of SCR
4. To study the D C characteristics and applications of TRIAC
5. To study the characteristics oh Unijunction Transistor(UJT)
6. To study the characteristics of Tunnel diode
7. To study the characteristics of FET/MOSFET characteristics, biasing & its application as an amplifier
8. Study of bi-stable, mono-stable and astable, multivibrators
9. Study of Op-Amps and their applications such as an amplifier (inverting, non-inverting), scalar, summer, differentiator and integrator
10. To study the characteristics of a regulated power supply and voltage multiplier circuits.
11. To study the temperature effect on a transistor amplifier
12. To determine hybrid parameters of a transistor
13. To study characteristics of Photo Diode, Photo Transistor, LDR, LED
14. Design & study of triangular wave generator.
15. To study the frequency response of an operational amplifier.
16. To study the characteristics of Colpitts oscillator.
17. 11. To study the characteristics of Hartley oscillator

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1105.1**	Analyze the physical principle involved in the various instruments; also relate the principle to new application.
CO2	**MPHY-1105.2**	Demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.

Recommended Books:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, Mc-Graw Hill, 2001
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 2011, Kitab Mahal
3. B.Sc Practical Physics, C L Arora, S. Chand & Company, 2010

COURSE TITLE: BASICS OF COMPUTER PROGRAMMING
SUBJECT CODE: MCOP-1101
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students in computer language and its applications.

Sr.No	Contents	Contact Hours
UNIT I	**Overview of C++ Language:** Introduction to C++ language, Structure of C++ program, concept of compiling and linking, IDE and its features; basic terminology-character set, tokens, identifiers, keywords, fundamental data types, literal and symbolic constants, declaring variables, initializing variables, type modifiers. **Operators and expressions:** Operators in C++, precedence and associativity of operators, expressions and their evaluation, type conversions.	**10**
UNIT II	**Beginning with C++ program:** Input/output using extraction (>>) and insertion	**10**

	(<<) operators, write simple C++ programs, Comments in C++. **Control Structures:** Decision making statements: if, nested if, if-else. Else if ladder, switch, Loops and iteration: while loop, for loop, do-while loop, nesting of loops, break statement, continue statement, go to statement, use of control structures trough illustrative programming examples.	
UNIT III	**Functions:** Advantages of using functions, structure of function, declaring and defining functions, return statement, formal and actual arguments, 'const' argument, default arguments, concept of reference variable, call by value, call by reference, recursion, Use of functions through illustrative programming examples. **Arrays:** Declaration of arrays, initialization of array, accessing elements of array, I/O of arrays, passing arrays as arguments to function, multidimensional arrays, Use of arrays through illustrative programming example	**12**
UNIT IV	**Concepts of Object Oriented Programming:** Introduction to Classes, objects, data abstraction, data encapsulation, inheritance and polymorphism **Classes and Objects:** Defining classes and declaring objects, public and private keywords, constructor and destructors, defining member functions inside and outside of class, accessing members of class, Use of classes and objects through illustrative programming examples	**10**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MCOP-1101.1**	To learn how to write inline functions for efficiency and performance.
CO2	**MCOP-1101.2**	To learn how to overload functions and operators in C++.
CO3	**MCOP-1101.3**	To understand the concept of data abstraction and encapsulation.
CO4	**MCOP-1101.4**	To learn how to implement copy constructors and class member functions.
CO5	**MCOP-1101.5**	To learn how to design C++ classes for code reuse.
CO6	**MCOP-1101.6**	To learn the syntax and semantics of the C++ programming language.

Reference Books

1. E. Balaguruswamy,Object Oriented Programming with C++,Tata McGraw Hill.
2. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.
3. R.S. Salaria, Computer Concepts and Programming in C++,Salaria Publishing House.

Instructions to Question Paper Setter: *The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of*

12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.

COURSE TITLE: Basics of Computer Programming Lab
SUBJECT CODE: MCOP-1102
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60
End Term Exam: 40
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to teach the students about the practical use of computer language and create the programs .

List of Programmes:

1.	Write a program using C++ to solve the Quadratic equation.
2.	Write a program using C++ to solve the various expression
3.	Write a program using C++, user has to enter 10 natural numbers using arrays and display as output.
4.	Write a program using C++ to Add and Multiply two matrixes using an array.
5.	Write a program using C++, which takes two integer operands and one operator form user, performs the operation and then prints the result. (Consider the operators +, -, *, /,% and use switch statement). For example, the input should be in the form: 5 + 3the output should come Result = 8
6.	Write a program using C++ to find the factorial of a number using functions.
7.	Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a program to generate the first ***n*** terms of the sequence. Write a program to print all the prime numbers between m and n, where the value of m and n is supplied by the user.
8.	The number such as 1991, is a palindrome because it is same number when read forward or backward. Write a program to check whether the given number is palindrome or not.
9.	Create a class named ***Student*** with the appropriate data members and member functions to generate output comprising student's ***admission no.***, ***name***, ***marks in five subjects*** and the ***%age of marks obtained***. Write a program to use the ***Student*** class.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MCOP-1102.1**	Understand the difference between object oriented programming and procedural oriented language and data types in C++.
CO2	**MCOP-1102.2**	Simulate the problem in the subjects like Operating system, Computer networks and real world problems
CO3	**MCOP-1102.3**	Program using C++ features such as composition of objects, Operator overloading, inheritance, Polymorphism etc

Reference Books

1. E. Balaguruswamy,Object Oriented Programming with C++,Tata McGraw Hill.
2. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.
3. R.S. Salaria, Computer Concepts and Programming in C++,Salaria Publishing House.

SYLLABUS

SEMESTER-II

COURSE TITLE: ELECTRONICS-II (DIGITAL ELECTRONICS)
SUBJECT CODE: MPHY-1201
SEMESTER: II
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: This course covers revisit of binary arithmetic, Logic gates, sequential and combinational circuits, Logic families and semiconductor memories, Inter-conversion of analog and digital signals, basics of integrated circuit technology, Microprocessor 8085 Architecture, instruction set, interfacing with memory and I/O devices.

Sr. No.	Contents	Contact Hours
UNIT I	**Digital Principles:** Binary, octal and Hexadecimal number system, BCD and ASCII code system, Binary arithmetic, Logic gates, Boolean equation of logic circuits, De Morgans theorem, Karnaugh map, Encoders & Decoders, Multiplexers and Demultiplexers, Parity generators and checkers, Adder-Subtractor circuits.	15
UNIT II	**Sequential Circuits:** Flip-Flops–RS, JK, D, clocked, preset and clear operation, race-around conditions in JK Flip-flops, master-slave JK flip-flops, Shift registers, Asynchronous and Synchronous counters, D/A converter, A/D converter using counter, Successive approximation A/D converter.	15
UNIT III	**Microprocessor:** Buffer registers, Bus organized computers, SAP-I, Microprocessor (μP) 8085 Architecture, memory interfacing, interfacing I/O devices. Assembly language programming: Instruction classification, addressing modes, timing diagram, Data transfer, Logic and Branch operations Programming examples, Basics of Microcontrollers	15
UNIT IV	**Semiconductor Memories:** ROM, PROM and EPROM, RAM, Static and Dynamic Random Access Memories (SRAM and DRAM), content addressable memory, other advanced memories.	15

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1201.1**	Develop a digital logic and apply it to solve real life problems.
CO2	**MPHY -1201.2**	Analyze, design and implement combinational logic circuits.
CO3	**MPHY -1201.3**	Classify different semiconductor memories.
CO4	**MPHY -1201.4**	Analyze, design and implement sequential logic circuits

Reference Books:

1. Malvino, A.P.and Leach, D. P. Digital Principles and Applications. New Delhi: Tata McGraw Hill, 2011
2. Malvino, A.P. Digital Computer Electronics. New Delhi: Tata McGraw Hill, 2008
3.Gaonkar, R.S. Microprocessor Architecture, Programming and Applications with 8085, Prentice Hall, 2002

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: ELECTRODYNAMICS-I
SUBJECT CODE: MPHY-1202
SEMESTER: II
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: This course covers Electrostatics and Magnetostatics including Boundary value problems, Maxwell equations and their applications to propagation of electromagnetic waves in dielectrics, metals and plasma media

Sr. No.	Contents	Contact Hours
UNIT I	**Electrostatics:** Coulomb's law, Gauss's law, Poisson's and Laplace equation, uniqueness theorem, Formal solution of boundary value problem, Greens function, Method of images and calculation of Green's function for the image charge problem in the case of a sphere, Multipole expansion, Multipole expansion of the energy of charge distribution in an external field, Dielectrics and boundary conditions, Boundary value problems with dielectrics; molecular polarisability and electric susceptibility, Electrostatic energy in dielectric media.	15
UNIT II	**Magnetostatics:** Biot and Savart's law, differential equation of Magnetostatics and Ampere's law, vector potential, Magnetic field of a localized current distribution, Magnetic moment, Force and torque on a magnetic dipole in an external field, Magnetic materials, Microscopic equations, uniformly magnetized sphere, magnetized sphere in an external field, permanent magnet	15
UNIT III	**Time Varying Fields:** Faraday's law of induction, Energy in a magnetic field, Maxwell's displacement current, Maxwell's equations, vector and scalar potential, Gauge transformations, Lorentz gauge, Coulomb Gauge, Poynting theorem, Conservation laws	12
UNIT IV	**Electromagnetic Waves:** Plane waves in non-conducting medium, Polarization, linear and circular polarization, Superposition of waves in one dimension, Group velocity, Propagation of a pulse in dispersive medium, frequency dependence of	15

	ε, μ, σ , dispersion in non conductors, free electrons in conductors and Plasmas, Reflection and refraction of electromagnetic waves at a plane surface between dielectrics, Polarization by reflection and total internal reflection, Waves in conductive medium, Simple model for conductivity	

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1202.1**	Appreciate the need and necessity of four vector notation. They have applied it for Lorentz transformation and written the dual field tensor which is one of the major aspects of theoretical physics.
CO2	**MPHY -1202.2**	They have understood the difference between covariance and invariance of various quantities and applied it.
CO3	**MPHY -1202.3**	One of the major advantages of this course is that it is very much related to the real life where the ionosphere is playing very important part.
CO4	**MPHY -1202.4**	Students now know the basics of scattering and absorption and relate them to real life phenomena.

Reference Books:

1. Classical Electrodynamics - J.D. Jackson-John Wiley & Sons Pvt. Ltd., New York, 2007
2. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd.,2015
3. Electrodynamics-Gupta, Kumar, Sharma-Pragati Prakashan, Merrut, 2015

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: ATOMIC & MOLECULAR SPECTRA
SUBJECT CODE: MPHY-1203
SEMESTER: II
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: This course aims at providing the student with knowledge about the spectrum of atoms and Molecules. It introduces to atomic and molecular physics using both traditional lectures and exercise sessions for a better involvement of the students.

Sr. No.	Contents	Contact Hours
UNIT I	**Atomic Spectra: Vector model of a one electron atom**: Space quantization, Quantum numbers for complete atom, angular momentum of an atom, Magnetic moments of an atom and Lande'g factor, Larmor, theorem, Hydrogen atom spectrum, Spin-orbit Coupling, Hydrogen fine structure Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift Spectroscopic terms and their notations, Spectra of alkali and alkaline earth metals, Selection and Intensity rules for doublets and triplets **Two valence electron atom:** Coupling Schemes: L-S and J-J coupling, Interaction energy for LS coupling, interaction energy for J-J coupling.	**15**
UNIT II	**Atoms in External Fields and Resonance Spectroscopy:** The Doppler effect; Natural breadth from classical theory; natural breadth and quantum mechanics; External effects like collision damping, asymmetry and pressure shift and stark broadening, The Zeeman Effect for two electron systems; Intensity rules for the zeeman effect, Paschen-Back effect, LS coupling and Paschen-Back effect, Lande's factor in LS coupling, Stark effect, NMR: basic principles, classical and quantum mechanical description, spin-spin and spin-lattice relaxation times, magnetic dipole coupling, chemical shift, ESR: basic principles, nuclear interaction and hyperfine structure, g-factor, zero field splitting.	**15**
UNIT III	**Microwave and Infra-Red Spectroscopy:** Types of molecules, Rotational spectra of diatomic molecules as a rigid and non-rigid rotator, Intensity of rotational lines, Effect of isotopic substitution, Microwave spectrum of polyatomic molecules, Microwave oven, The vibrating diatomic molecule as a simple harmonic and an harmonic oscillator, Diatomic vibrating rotator, The vibration-rotation spectrum of carbon monoxide, The interaction of rotation and vibrations, Outline of technique and instrumentation, Fourier transform spectroscopy.	**15**
UNIT IV	**Raman and Electronic Spectroscopy:** Quantum and classical theories of Raman Effect, Pure rotational Raman spectra for linear and polyatomic molecules, Vibrational Raman spectra, Structure determination from Raman and infra-red spectroscopy, Electronic structure of diatomic molecule, ,Electronic spectra of diatomic molecules, Born Oppenheimer approximation- The Franck Condon principle, Dissociation and pre-dissociation energy, The Fortrat diagram, Example of spectrum of molecular hydrogen.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1203.1**	Calculate the Zeeman effect and the Lande g-factor
CO2	**MPHY -1203.2**	Calculate the effects of an electric field on the energy levels of the hydrogen atom (the Stark effect).

CO3	**MPHY -1203.3**	Discuss the rotational spectra of molecules.
CO4	**MPHY -1203.4**	Understand how the new theory could explain the fine structure in the spectra of hydrogen and hydrogen-like ions, and how this theory can be extended to atoms which have a single electron in their outermost shell, i.e. the alkali metal atoms.
CO5	**MPHY -1203.5**	They should be able to apply the Simple Harmonic Oscillator to determine the vibrational spectrum of diatomic molecules.
CO6	**MPHY -1203.6**	Students learn about fine structure of Hydrogen atoms.
CO7	**MPHY -1203.7**	Students learn about rotational and vibrational energy levels of diatomic molecules and Raman spectroscopy.

Text and Reference Books

1. Introduction to Atomic Spectra, H.E. White, Mcgraw Nill Kogakusha Limited ,1934.
2. Fundamentals of molecular spectroscopy, C.B. Banwell-Mc Graw Hill Education, 2013
3. Elements of Spectroscopy, Gupta, Kumar, Sharma, Pragati Prakashan, Merrut, 2015

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: QUANTUM MECHANICS-II
SUBJECT CODE: MPHY-1204
SEMESTER: II
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: This course has focus on the need and development of variety of approximate methods in Quantum Mechanics (perturbation theory, variational method and WKB approach) and their illustration by way of application to selected atomic and molecular systems. Also, an introduction to the quantum theory of scattering is provided.

Sr. No.	Contents	Contact Hours
UNIT I	**Approximation Methods-I:** Time independent perturbation theory for non degenerate case, formulation up to second order, Time independent perturbation theory for degenerate energy level system, Perturbation of linear harmonic oscillator-(i) estimation of correction up to second order for perturbation term depending on x	15

	and x^2 (ii) first order correction to energy by x^3 and x^4 type terms, Ground state of Helium atom, First order Zeeman effect in hydrogen atom, First order stark effect in hydrogen	
UNIT II	**Approximation Methods-II:** Varitation method, Ground state energy of hydrogen and Helium atom by variational method, WKB approximation and its validity, Time dependent perturbation theory, Constant perturbation, Harmonic perturbation, Transition continuum, Fermi's golden rule, Adiabatic and sudden approximation, Semi-classical theory of interaction of atoms with radiation	**15**
UNIT III	**Scattering Theory:** Scattering cross section: differential and total scattering cross-sections, scattering amplitude, Expansion of plane wave in spherical harmonics, Scattering by spherically symmetric potentials, Partial wave analysis and phase shifts, Optical theorem, sign of phase shift and attractive or repulsive nature of the potential, Scattering by a rigid sphere and square well, Born approximation, Condition for validity of Born approximation, Born approximation for scattering by square well potential, Validity of Born approximation in square well potential	**15**
UNIT IV	**Relativistic Quantum Mechanics:** Klein Gordon equation, Klein Gordon equation in presence of electromagnetic field, Dirac relativistic equation for free electron and its solutions, negative energy states, probability and current densities, Properties of gamma matrices, Magnetic moments and spin orbit energy.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1204.1**	Calculate the ground state and excited state energies of various real life systems by using Principle, WKB method and perturbation methods.
CO2	**MPHY -1204.2**	Relativistic Quantum Mechanics using Dirac equation, Dirac matrices. The Klein Gordon equation etc
CO3	**MPHY -1204.3**	Know about scattering in two different frames and can easily calculate scattering amplitude and scattering cross section.
CO4	**MPHY -1204.4**	Write total energy and wave function as Slater determinant for system of identical fermions.

Reference Books:

1. Modern Quantum Mechanics by J. J. Sakurai, Pearson Education Pvt. Ltd., New Delhi, 2014
2. Quantum Mechanics by L I Schiff-Tata Mc Graw Hill Education, 2010
3. Quantum Mechanics by Powel and Craseman, Dover Publication 2015
4. Quantum Mechanics by Merzbacher, John Wiley & Sons Inc., 2004

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: STATISTICAL MECHANICS
SUBJECT CODE: MPHY-1205
SEMESTER: II
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The course on Statistical Physics has been framed to teach the students about techniques of Ensemble theory so that they can use these techniques to understand the macroscopic properties of the matter in bulk in terms of its microscopic constituents.

Sr. No.	Contents	Contact Hours
UNIT I	Introduction to Statistical Physics, Macrostate, Microstates, Specification of states of a system, Contact between statistics and thermodynamics, Postulate of equal a prior probability, Boltzmann's postulate of entropy, Classical ideal gas, Entropy of mixing and Gibb's paradox, The phase space of classical system, trajectories and density of states, Liouville's theorem and its consequences	**15**
UNIT II	Ensemble theory, Microcannonical ensemble with example, The canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations in the canonical ensemble. Equipartition theorem, Virial theorem, The grand canononical ensemble, the physical significance of the statistical quantities, Cluster expansion of classical gas, the virial equation of state.	**15**
UNIT III	Quatum states and phase space, the density matrix, statistics of various ensembles. Example of electrons in a magnetic field, a free particle in a box and a linear harmonic oscillator, Significance of Boltzamann formula in classical and quantum statistical mechanics	**15**
UNIT IV	An ideal gas in quantum mechanical microcanonical ensemble, Statistics of occupation numbers, concepts and thermo dynamical behavior of an ideal gas, Bose Einstein condensation, Discussion of a gas of photons and phonons, Thermo dynamical behavior of an ideal fermi gas, electron gas in metals, Pauli's paramagnetism, statistical equilibrium of white dwarf stars	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1205.1**	Define and discuss the concepts of microstate and macrostate of a model system , the concepts and roles of entropy and free energy from the view point of statistical mechanics

CO2	**MPHY -1205.2**	Apply the machinery of statistical mechanics to the calculation of macroscopic properties resulting from microscopic models of magnetic and crystalline systems
CO3	**MPHY -1205.3**	Define the Fermi-Dirac and Bose-Einstein distributions; state where they are applicable; understand how they differ and show when they reduce to the Boltzmann distribution
CO4	**MPHY -1205.4**	Apply the Fermi-Dirac distribution to the calculation of thermal properties of electrons in metals and the Bose-Einstein distribution to the calculation of properties of black body radiation

Reference Books:

1. Statistical Mechanics, R.K. Patharia, Pergamon Press, 1996
2. Introduction to Statistical Physics, Kerson Huang-CRC press, 2010
3. B. K Aggarwal, and M. Eisner, Statistical Mechanics, New Age International Publisher, 2005

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks*

COURSE TITLE: GENERAL PHYSICS LAB-II
SUBJECT CODE: MPHY-1206
SEMESTER: II
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Internal Assessment: 60
End Term Exam: 40
Duration of Exam; 3 Hrs

Objective: The aim of the course on Physics Laboratory is to train students in handling the basic tools of experimental physics, and their use in laboratory demonstration of important physical phenomenon and the underlying principles of physics

Note: Students will be required to perform at least 15 experiments from the given list of experiments.

List of Experiments

1. Study of logic gates using discrete elements and universal gates

2.	Study of encoder, decoder circuit.
3.	Study of arithmetic logic unit (ALU) circuit.
4.	Study of shift registers.
5.	Study of half and full adder circuits.
6.	Study of A/D and D/A circuits.
7.	To study JK, MS and D-flip flops
8.	To study 4-bit counter (Synchronous and asynchronous)
9.	To study various aspects of frequency modulation & demodulation.
10.	Study of microprocessor 8085 for simple programming: addition, subtraction, multiplication and division.
11.	To find the wavelength of monochromatic light using Febry Perot interferometer.
12.	To find the wavelength of sodium light using Michelson interferometer.
13.	To calibrate the constant deviation spectrometer with white light and to find the wavelength of unknown monochromatic light.
14.	To study optical polarization by reflection and hence to find Brewster,s angle
15.	To measure numerical aperture, propagation losses and bending losses for optical fibres as function of bending angles and at various wavelengths.
16.	To find the grating element of the given grating using He-Ne laser light.
17.	To verify the existance of Bohr's energy levels with Frank-Hertz experiment.
18.	To determine the charge to mass ratio (e/m) of an electron with normal Zeeman Effect
19.	Study Hydrogen Spectra and hence to find Rydberg Constant
20.	To determine the velocity of ultrasonic waves in a liquid using ultrasonic interferometer

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-1206.1**	Analyze the physical principle involved in the various instruments; also relate the principle to new application.
CO2	**MPHY -1206.2**	Demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results

References:

1. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 2011, Kitab Mahal
2. B.Sc Practical Physics, C L Arora, S. Chand & Company, 2010

SYLLABUS

SEMESTER-III

COURSE TITLE: ELECTRODYNAMICS-II
SUBJECT CODE: MPHY-2301
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: This course Discuss electromagnetic eave propagation in waveguides, radiation, retarded potentials and relative formulation of electrodynamics.

Sr. No.	Contents	Contact Hours
UNIT I	**Wave Guides:** Field at the surface of and within a conductor, cylindrical cavities and wave- guides, Wave guides, modes in a rectangular wave guide, energy flow and attenuation in wave guides, resonant cavities, power loss in cavity and quality factor	15
UNIT II	**Relativistic Formulation of Electrodynamics:** Structure of space-time, four vectors and tensors, **Relativistic mechanics**: proper time and proper velocity, relativistic energy and momentum, **Relativistic electrodynamics**: Magnetism as a relativistic phenomena and field transformations, Covariance form of Maxwell equations, Electromagnetic Field Tensor, electrodynamics in tensor notation,	15
UNIT III	**Radiating Systems:** Retarded Potentials, Fields and radiation of localized oscillating sources, oscillating electric dipole fields and radiation, magnetic dipole and quadrupole fields, central fed antenna, Radiation reaction, The Abraham-Lorentz formula, the physical origin of radiation reaction	15
UNIT IV	**Fields of Moving Charges:** Lienard -Wiechert Potential and fields, the fields of a point charge in motion, Radiations from an accelerated charge at low velocities, Larmour's power formula and its relativistic generalization, Angular distribution of radiation emitted by an accelerated charged particle, radiation from extremely relativistic charged particle, Cherenkov radiations	15

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2301.1**	Use Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.

CO2	**MPHY -2301.2**	Describe the nature of electromagnetic wave and its propagation through different media and interfaces
CO3	**MPHY -2301.3**	Explain charged particle dynamics and radiation from localized time varying electromagnetic sources.
CO4	**MPHY -2301.4**	They have learnt about wave guides and transmission lines and propagation of waves through them.

Reference Books:

1. Classical Electrodynamics - J.D. Jackson-John Wiley & Sons Pvt. Ltd., New York, 2007
2. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd.,2015
3. Electrodynamics-Gupta, Kumar, Sharma-Pragati Prakashan, Merrut, 2015

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: CONDENSED MATTER PHYSICS-I
SUBJECT CODE: MPHY-2302
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The course on Condensed Matter Physics is meant to introduce students to crystal structure, basic concepts and principles underlying structure determination, defects & diffusion in solids, lattice vibrations and energy band theory

Sr. No.	Contents	Contact Hours
UNIT I	**Crystal structure**: Unit Cell, Bravais lattices and its classification, Miller Indices, X-Ray Diffraction according to von Laue, Bragg’s X-ray Diffraction, Atomic scattering factor, X-ray intensity and atomic configuration of unit cell, Experimental methods of X-ray Diffraction **Ordered Phase of matter**: Translational and orientational order, kinds of liquid crystalline order, Quasi Crystals	**15**
UNIT II	**Point defects**: Iimpurities, Schottky and Frenkel vacancies, Color centers, F-centers. **Line defects (dislocation):** Edge and Screw dislocation, Burger’s vector, Slip, Planar	**15**

	(stacking) faults, Grain boundaries **Diffusion**: Classification of diffusion process, Mechanism of atomic diffusion, Fick's law, Factor affecting diffusion and applications, Kirkendal law	
UNIT III	**Lattice Vibration and Thermal Properties:** Vibration of crystal with monatomic and diatomic basis, Dispersion relation, optical and acoustical branches, Quantization of elastic waves: Phonon, energy and momentum of phonons, inelastic scattering of photons by phonons, Molar Specific heat at constant pressure and volume Classical theory of Specific heat, breakdown of classical theory, Average energy of harmonic oscillator, Phonon Density of states, Einstein theory of specific heat, Debye model of specific heat, Debye T^3 law, Anharmonic crystal interactions, thermal expansion, thermal conductivity, thermal resistivity of phonon gas, Umklapp processes	**15**
UNIT IV	**Energy Bands:** Nearly free electron model, origin of energy gap, magnitude of gap, Bloch function, Kronig- Penny model, Wave equation of electron in periodic potential, Restatement of Bloch theorem, crystal momentum of an electron, solution of central equation, Kronig-Penny model in reciprocal space, empty lattice approximation, approximate solutions near a zone boundary, Classification of metal, insulator and semiconductors	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2302.1**	Have a basic knowledge of crystal systems and spatial symmetries , be able to account for how crystalline materials are studied using diffraction, including concepts like reciprocal Lattice and Brillouin zones.
CO2	**MPHY -2302.2**	Know what phonons are, and be able to perform estimates of their dispersive and thermalProperties, be able to calculate thermal and electrical properties in the free-electron model
CO3	**MPHY -2302.3**	Know Bloch's theorem and what energy bands are and know the fundamental principles of semiconductors

Recommended Books

1. C. Kittel, Introduction to Solid State Physics, John Willey (2008)
2. J. P Srivatava, Elements of Solid State Physics, Prentice-Hall of India Pvt. Ltd.(2006)
3. A. J Dekker, Solid State Physics, Prentice Hall 1957.

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks*

COURSE TITLE: NUCLEAR PHYSICS
SUBJECT CODE: MPHY-2303
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The course aims to provide the students with an understanding of basic radiation interaction and detection techniques for nuclear physics, radioactive decays, nuclear models and nuclear reactions. This syllabus describes the basic interaction mechanisms for charged particles and electromagnetic radiation relevant for radiation detectors and explain their importance for detecting various types of ionizing radiation at different energies, the working principles behind detectors and their characteristic properties with respect to energy resolution, efficiency etc.

Sr. No.	Contents	Contact Hours
UNIT I	**Nuclear Interactions:** Two nuclear system, deuteron problem, binding energy, nuclear potential well, pp and pn scattering experiments at low energy, Meson theory of nuclear force, e.g. Bartlett, Heisenberg, Majorana forces and potential, Exchange forces and tensor forces, Nucleon- nucleon scattering, Effective range theory, Spin dependence of nuclear forces, independence and charge symmetry of nuclear forces, Yukawa interaction.	**15**
UNIT II	**Nuclear Reactions:** Conservation laws, energetics of nuclear reaction, Direct and compound nuclear reaction mechanism, Cross section in terms of partial wave amplitude, Compound nucleus, scattering matrix, Reciprocity theorem, Breit Wigner one level formula, Resonance scattering.	**15**
UNIT III	**Nuclear Models:** Liquid Drop Model-Bohr-Wheelar theory of fission, Experimental evidence for shell effects, Shell Model, spin- Orbit coupling, Magic numbers, Angular momenta and parities of nuclear ground states, Qualitative discussion and estimates of transition rates, Magnetic moments and Schmidt lines, Collective model-nuclear vibration spectra and rotation spectra	**15**
UNIT IV	**Nuclear Decay:** Beta decay, Fermi theory of beta decay, Shape of beta spectrum, Total decay rate, Angular momentum and parity selection rules, Comparative half-lives, Allowed and forbidden transitions, Two component theory of neutrino decay, Detection and properties of neutrino, Gamma decay, Multiple transitions in nuclei, Angular momentum and parity selection rules, Internal conversion, Nuclear isomerism.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2303.1**	Learn about the knowledge of particles.
CO2	**MPHY -2303.2**	Know about the spin parity concept & magic no. Related to shell.

CO3	**MPHY -2303.3**	About the scattering process how it will occur.
CO4	**MPHY -2303.4**	Understand the basic properties of nuclei and the atomic nucleus.
CO5	**MPHY -2303.5**	Significance of various decays tells the students about the nuclear process.

Recommended Books:

1. R.R. Roy & B.P. Nigam, 'Nuclear Physics', New Age International Publisher, 2001
2. D.C. Tayal, 'Nuclear Physics', Himalaya Publication Home, 2007.
3. Kenneth S. Krane, 'Introductory Nuclear Physics, Wiley India Pvt. Ltd. 2008

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: COMPUTATIONAL METHODS IN PHYSICS
SUBJECT CODE: MPHY-2304
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. It highlights the use of computational methods to solve physical problems. The course will consist of lectures (both theory and practical) in the Lab

Sr.No	Contents	Contact Hours
UNIT I	**Errors in Numerical calculations:** Error and their analysis, General error formula, Errors in a series approximation. **Solution of Algebraic and Transcendental Equations:** Bisection Method, Secant Method, Newton Raphson Method, Matrices and Linear System of Equations, Solution of Linear Equations: Gauss Elimination Method, Gauss Seidel Iterative Method, Computation of Eigen values and Eigenvectors of Matrices by using Iterative Methods. **Finite Differences, Interpolation and Curve Fitting:** Forward and Backward Differences, Central differences, Differences of a polynomial, Newton' Forward and	**15**

	Backward Interpolation Formulas, Divided Differences, Newton's General Interpolation Formula, Curve Fitting, Polynomial least squares and cubic spline fitting	
UNIT II	**Numerical Differentiation and integration**: Numerical differentiation using forward difference formulae, backward difference formulae and central difference formulae Numerical integration: General Quadrature Formula, Trapezoidal Rule, Simpson's 1/3 and 3/8 Rules, Newton–Cote's formula	**10**
UNIT III	**Solution of Ordinary Differential Equations:** Euler's Method, Modified Eulers's Method, Runge Kutta Method of Second and fourth Order , Finite difference method, Finite difference equations for partial differential equations and their solution	**10**
UNIT IV	**Random Variables and Monte Carlo Methods:** Random numbers, Pseudo-random numbers, Monte Carlo integration: Moment of inertia, Monte Carlo Simulations: Buffen's needle experiment, Importance of sampling	**10**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2304.1**	Understand the theoretical and practical aspects of the use of numerical analysis.
CO2	**MPHY -2304.2**	Proficient in implementing numerical methods for a variety of multidisciplinary applications.
CO3	**MPHY -2304.3**	Establish the limitations, advantages, and disadvantages of numerical analysis.
CO4	**MPHY -2304.4**	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations

Reference books

1. Numerical Methods in Engineering & Science with programming in C & C++, B.S Grewal, Khanna Publishers, 2010
2. Numerical Methods–S.Balachandra Rao and C.K.Shantha- Stosius Inc/Advent Books Division-2000
3. Numerical Methods for Mathematics, Science and Engineering, J. H Mathews, Prentice Hall, (2000)

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: COMPUTATIONAL METHODS IN PHYSICS LAB
SUBJECT CODE: MPHY-2305
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60
End Term Exam: 40
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students about the concepts of computational physics practically and methods used to solve the concepts.

List of Experiments:

1. Determination of Roots of algebraic equations:
a) Bisection method b) Newton Raphson Method c) Secant Method
2. Roots of linear equations:
a) Gauss Elimination Method b) Gauss Seidal Iterative Method.
3. Eigen Value problem: Eigen value and Eigenvector of a Matrix by Iterative Method.
4. Integration:
a) Trapezoidal Rule b) Simpson 1/3 and Simpson 3/8 rules c) Gauss quadrature formula
5. Differential Equations:
a) Euler's method b) Modified Euler's method c) Range KuttaMethod (2nd order and 4th order)
6. Interpolation:
a) Newton's Forward interpolation, b) Newton's Backward interpolation c) Lagrange's interpolation
7. To determine Wien's constant using bisection method.
8. To solve Kepler's equation by Newton-Raphson method.
9. To solve van der Waals gas equation for volume of a real gas by the method of successive approximation.
10.To interpolate a real data set from an experiment using the Lagrange's method, and Newton's method of forward differences and cubic splines.
11. To fit the Einstein's photoelectric equation to a realistic data set and hence calculate Planck's constant.
12. To find the area of a unit circle by Monte Carlo integration.
13. To study the motion of an artificial satellite by solving Newton's equation for its orbit using Euler method.
14. To study the growth and decay of current in RL circuit containing (a) DC source and (b) AC using Runge Kutta method, and to draw graphs between current and time in each case

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2305.1**	Use numerical methods for modeling physical systems

CO2	**MPHY -2305.2**	Demonstrate the ability to estimate the errors in the use of numerical methods
CO3	**MPHY -2305.3**	Write and develop simple programs in Matlab /C++
CO4	**MPHY -2305.4**	Describe the results of a simulation in a project report

Reference books

1. Numerical Methods in Engineering & Science with programming in C & C++, B.S Grewal, Khanna Publishers, 2010

2. Numerical Methods–S.Balachandra Rao and C.K.Shantha- Stosius Inc/Advent Books Division-2000

3. Numerical Methods for Mathematics, Science and Engineering, J. H Mathews, Prentice Hall, (2000)

COURSE TITLE: GENERAL PHYSICS LAB-III
SUBJECT CODE: MPHY-2306
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Internal Assessment: 60
End Term Exam: 40
Duration of Exam; 3 Hrs

Objective: The aim of the course on Physics Laboratory is to train students in handling the basic tools of experimental physics, and their use in laboratory demonstration of important physical phenomenon and the underlying principles of physics.

Note: Students will be required to perform at least 15 experiments from the below mentioned list of experiments

1. Determination of lattice constant and crystal structure of given powder sample using X-ray diffraction method.
2. To determine the lattice dynamics and dispersion relation for the monoatomic & diatomic lattices.
3. Investigation of Hall Voltage as a function of current and magnetic field and determination of Hall Coefficient and carrier concentration of the given sample of semiconductor.
4. To study Temperature dependence of Hall coefficient.
5. Determination of Band Gap of a given semiconductor material using PN Junction Diode.
6. To study magneto-resistance and its field dependence.
7. Investigation of B-H curve: (i) to determine the value of permeability and coercivity of ferrite sample. (ii) to distinguish between soft and hard ferrites.
8. To find the dielectric constant of benzene and dipole moment of acetone.
9. Investigation of ferroelectric behavior of $BaTiO_3$.

10. To study dielectric permittivity of different polymer/ composites as a function of frequency.
11. To study dielectric losses (Tan Delta) spectra of different polymer/ composites as a function of frequency.
12. To study the temperature dependence of dielectric losses (Tan Delta) of different polymer/ composites at different frequencies
13. To study the dielectric behavior of PZT ceramic by determining Curie temperature, dielectric strength & dielectric constant.
14. Dispersion of lattice vibrations using electrical analogue of real lattice.
15. Magnetic susceptibility of hydrated copper sulfate.
16. To determine transition temperature of ferrites
17. Thermo-luminescence studies.
18. Study of the characteristics of Klystron tube and to determine its electronic tuning range
19. To determine the frequency & wavelength in a rectangular waveguide working on TE_{10} mode.
20. Study of electron spin resonance (ESR) spectrum of a paramagnetic substance

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2306.1**	Analyze the physical principle involved in the various instruments; also relate the principle to new application.
CO2	**MPHY -2306.2**	Demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results

COURSE TITLE: RADIATION PHYSICS
SUBJECT CODE: MPHY-2311
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students in radiation physics and also tell the students about their effects and protection.

Sr. No.	Contents	Contact Hours
UNIT I	**Ionizing Radiations and Radiation Quantities:** Types and sources of ionizing radiation, fluence, energy fluence, kerma, exposure rate and its measurement –The free air chamber and air wall chamber, Absorbed dose and	15

	its measurement; Bragg Gray Principle, Radiation dose units- rem, rad, Gray and Sievert dose commitment, dose equivalent and quality factor	
UNIT II	**Dosimeters:** Pocket dosimeter, films, solid state dosimeters such as TLD, SSNTD, chemical detectors and neutron detectors, simple numerical problems on dose estimation	**10**
UNIT III	**Radiation Effects and Protection:** Biological effects of radiation at molecular level, acute and delayed effects, stochastic and non-stochastic effects, Relative Biological Effectiveness (RBE), linear energy transformation (LET), Dose response characteristics, Permissible dose to occupational and non-occupational workers, maximum permissible concentration in air and water, safe handling of radioactive materials, The ALARA, ALI and MIRD concepts, single target, multitarget and multihit theories, Rad waste and its disposal, simple numerical problems.	**15**
UNIT IV	**Radiation Shielding:** Thermal and biological shields, shielding requirement for medical, industrial and accelerator facilities, shielding materials, radiation attenuation calculations–The point kernal technique, radiation attenuation from a uniform plane source, The exponential point-Kernal, Radiation attenuation from a line and plane source, Practical applications and some simple numerical problems	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2311.1**	Measure of Radioactivity and Radiation Quantity.
CO2	**MPHY -2311.2**	Use the law of radioactive decay to describe alpha-decay, beta- decay, fission and fusion, predict decay reactions and calculate the energy release in nuclear decays
CO3	**MPHY -2311.3**	Explain the experimental evidence for Interaction of Radiation with matter and Radiation Protection
CO4	**MPHY -2311.4**	Explain Photoelectric effect, Compton Effect and Pair production

References Books:

1. Nuclear Reactor Engineering , S.Glasstone and A. Seasonke, Chapman & Hall Inc, 1994
2. Radiation Physics for medical physicist, Springer, 2016
3. Introduction to Radiological Physics and Radiation Dosimetry -F.H. Attix-Wiley VCH, 2004

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: FIBER OPTICS & LASER TECHNOLOGY
SUBJECT CODE: MPHY-2312
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to teach the students about various technologies of lasers and also the study of concepts of fiber optics.

Sr. No.	Contents	Contact Hours
UNIT I	**Optical fiber waveguides and sources:** Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays, evanescent field and Goos-Haechen shift, step index and graded index fibers, single and multi-mode fibers. Sources: LED, Lasers, mode locked Lasers, modulation capability, transient response, semiconductor losses: diode structure and threshold conditions, modulation, temperature effects source linearity and reliability, Photo detectors, PIN Photo detector, avalanche photodiode	**15**
UNIT II	**Transmission characteristics of optical fibers:** Attenuation, material absorption losses in silica fibers, linear and nonlinear scattering losses, fiber bend loss, mid-infrared and far-infrared transmission, intramodal and intermodal dispersion, overall fiber dispersion in multimode and single-mode fibers, modal birefringence	**15**
UNIT III	**Laser characteristics and Resonators:** Principles, Properties of laser radiation, Einstein Coefficients, Light amplification, Threshold condition for laser oscillations, Homogeneous and inhomogeneous broadening, Laser rate equations for 2,3 and 4 level, variation of laser power around threshold, optimum output coupling, Open planar resonator, Quality Factor ,ultimate line width of the laser, Transverse and Longitudinal mode selection	**15**
UNIT IV	**Laser Systems:** Solid State Laser, Gas lasers, liquid lasers, Eximer lasers, Semiconductor Laser, liquid –Dye and chemical lasers, high power laser systems and industrial applications	**10**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2312.1**	Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
CO2	**MPHY -2312.2**	Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.

CO3	**MPHY -2312.3**	Design optical fiber communication links using appropriate optical fibers light sources, detectors.
CO4	**MPHY -2312.4**	Explore concept of designing and operating principles of modern optical systems and networks

Reference Books:

1. Introduction to fiber optics, Ajoy Ghatak and K. Thyagarajan, Cambridge University press, 2006.
2. Fiber-Optic communication systems, Govind P. Agrawal, John Wiley & Sons, 2010
3. Optical fiber communications, Gerd Keiser, Tata McGra-Hill Piblishing, 2008

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: ADVANCED QUANTUM MECHANICS
SUBJECT CODE: MPHY-2313
SEMESTER: III
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students about the new concepts of quantum mechanics and their various theories.

Sr. No.	Contents	Contact Hours
UNIT I	**Relativistic Quantum Mechanics:** Klein-Gordan (KG) equation: Plane wave solution, Probability and current densities, Energy levels in a Coulomb field (Hydrogen atom problem). Difficulties of KG equation, Dirac's relativistic equation: Dirac equation with electromagnetic potentials, Dirac equation for a central field, Existence of spin angular momentum, spin - orbit energy	**15**
UNIT II	**Field Quantization:** Introduction, Classical and Quantum field equations: Coordinates of the field, Time derivatives, Classical Lagrangian equation, Classical Hamiltonian equations; Quantum equation of the field, Field with more than one component, Complex field, Quantization of the non relativistic Schrödinger equation (Second quantization): Classical Lagrangian and Hamiltonian equations, Quantum field equations, The N representation, Creation, Destruction and Number operators for Bosons and Fermions, Connection with the many particles Schrödinger equation.	**15**

UNIT III	**Quantization of Relativistic Fields and Feynman Diagrams:** Natural system of units, Quantization of K-G field, Dirac field and Electromagnetic fields (in vacuum); Lagrangian equations, quantum equations, quantized field energy. Interacting fields and Feynman Diagrams: Introduction, Normal product, Dyson and Wick's chronological products, Contraction, Wick's theorem, Electromagnetic Coupling, The Scattering Matrix, Power series expansion of S-matrix	**15**
UNIT IV	**Quantum theory of Classical radiation field**: Transversality condition, Fourier decomposition and radiation oscillators, Quantization of radiation oscillators, Creation, Annihilation and Number operators, Photon states, Photon as a quantum mechanical excitations of the radiation field, Fluctuations and the uncertainty relation, Validity of the classical description, Matrix element for emission and absorption, Spontaneous emission in the dipole approximation, Rayleigh scattering, Thomson scattering and Raman effect, Radiation damping and Resonance fluorescence.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2313.1**	Describe the basic Hilbert space structures describing all quantum field theories.
CO2	**MPHY -2313.2**	Obtain independent scientific knowledge from literature, and communicate it effectively to peers
CO3	**MPHY -2313.3**	Critically analyze current candidates for a fully defined quantum theory.
CO4	**MPHY -2313.4**	Discuss the difficulties with the theory of quantum measurement and local realism.
CO5	**MPHY -2313.5**	Model physical systems using common approximation techniques for making dynamical calculations.

Reference Books:

1. Quantum Mechanics by L I Schiff-Tata Mc Graw Hill Education, 2010
2. Quantum Mechanics by V. K. Thankappan, New age international publishers, 2012
3. Advanced Quantum Mechanics by B. S. Rajput, Pragati Prakashan, 2012

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

SYLLABUS

SEMESTER-IV

COURSE TITLE: PARTICLE PHYSICS
SUBJECT CODE: MPHY-2401
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The course aims to provide the students with understanding elementary particle physics. It also describes the basic features involved in alpha and beta decays, nuclear forces and various kinds of nuclear reactions besides the fundamentals of elementary particle physics.

Sr. No.	Contents	Contact Hours
UNIT I	**Elementary Particles and Their Properties:** Historical survey of elementary particles, Classification of elementary particles and their properties (mass, life time, production, decay mode, spin and parity etc.), Experimental evidence for two types of neutrinos, production and detection of some important resonances and antiparticles	10
UNIT II	**Symmetries and Conservation Laws:** Conserved quantities and symmetries, the electric charge, baryon number, leptons and muon number, particles and antiparticles, hypercharge (strangeness), the nucleon isospin, isospin invariance, isospin of particles, parity operation, charge conjugation operation, time reversal invariance, Elementary ideas of CP and CPT invariance, unitary symmetry SU(2), SU (3) and the quark model.	15
UNIT III	**Week Interaction:** Classification of weak interactions, Fermi theory of beta decay, matrix element, classical experimental tests of Fermi theory, Parity non conservation in beta decay, Weak decays of strange-particles and Cabibbo's theory	15
UNIT IV	**Gauge theory and GUT:** Gauge symmetry, field equations for scalar (spin 0), spinor (spin ½), vector (spin-1) and fields, global gauge invariance, local gauge invariance, Feynmann rules, introduction of neutral currents. Spontaneously broken symmetries in the field theory, standard model	15

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MPHY-2401.1	Recognize and name the six flavors of lepton and the six flavors of quark.
CO2	MPHY -2401.2	Understand that all leptons and quarks have corresponding antiparticles
CO3	MPHY -2401.3	Appreciate that quarks and anti quarks combine to form baryons, anti baryons and mesons.

CO4	**MPHY -2401.4**	Write balanced strong interactions, understanding the role of gluons

Recommended Books:

1. D. Griffiths, 'Introduction to Elementary Particles', Wiley-VCH, 2008.
2. D.H. Perkins, 'Introduction to High Energy Physics', Cambridge University Press, 2001
3. M.P. Khanna, 'Introduction to Particle Physics', Prentice Hall of India, New Delhi, 2004.

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: CONDENSED MATTER PHYSICS-II
SUBJECT CODE: MPHY-2402
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The course on Condensed Matter Physics is meant to introduce students to magnetic, dielectric and ferroelectric properties of materials and salient features of superconductivity. The course also focuses on the free electron theory of metals. This course will also provide a sound foundation for specialization in Condensed Matter Physics

Sr. No.	Contents	Contact Hours
UNIT I	**Magnetism:** Types of magnetism, the origin of permanent magnetic dipoles, **Diamagnetism**: Langevin diamagnetic equation, Quantum theory of Diamagnetism, **Paramagnetism**: Classical and Quantum Theory, Crystal field Splitting, quenching of orbital angular momentum. Paramagnetism of conduction electrons, **Ferromagnetic order**: Weiss molecular theory, Ferromagnetic Domain, Curie point and exchange integral, temperature dependence of saturation magnetization, **Magnons**: Quantisation of spin wave, thermal excitation of Magnon and Bloch $T^{3/2}$ law, **Ferrimagnetic Order:** Curie Temperature and susceptibility of ferrimagnet, **Antiferromagnetic ordering**: Susceptibility below Neel temperature, Antiferromagnetic magnon	**15**
UNIT II	**Superconductivity:** Superconductivity, Superconductors as ideal diamagnetic	**15**

	materials, Signatures of Superconducting state, Meissner Effect, Type I & II superconductors, London Equations, London penetration depth, Isotope effect, BCS Theory of superconductivity, Josephson Effect (DC & AC), SQUIDS and its Applications. Applications of superconductors, High Temperature superconductors	
UNIT III	**Dielectric Properties and Ferro Electrics:** Macroscopic electric field, local electric field at an atom, Lorentz field, Claussius-Mossotti relations, Different contribution to polarization: dipolar, electronic and ionic polarizabilities, Response and Relaxation Phenomenon, General properties of ferroelectric materials, dipole theory of ferroelectricity, Thermodynamics of ferroelectric transitions, Ferroelectric Domains	**15**
UNIT IV	**Free Electrons Theory of Metal:** Difficulties of the classical theory, the free electron model, The Fermi-Dirac distribution, The electronic specific heat, Paramagnetism of free electrons, Thermionic emission from metals, energy distribution of the emitted electrons, Field-enhanced electron emission from metals, Changes of work function due to adsorbed atoms, contact potential between two metals, photoelectric effect of metals	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2402.1**	Know the fundamentals of dielectric and ferroelectric properties of materials
CO2	**MPHY -2402.2**	Know basic models of Dia, Para and Ferro magnetism
CO3	**MPHY -2402.3**	Explain superconductivity using BCS theory
CO4	**MPHY -2402.4**	Have a knowledge of magnons

Recommended Books

1. C. Kittel, Introduction to Solid State Physics, John Willey (2008)
2. J. P Srivatava, Elements of Solid State Physics, Prentice-Hall of India Pvt. Ltd.(2006)
3. A. J Dekker, Solid State Physics, Prentice Hall ,1957.

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks*

COURSE TITLE: GENERAL PHYSICS LAB-IV
SUBJECT CODE: MPHY-2403
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Internal Assessment: 60
End Term Exam: 40
Duration of Exam; 3 Hrs

Objective: The aim of the course on Physics Laboratory is to train students in handling the basic tools of experimental physics, and their use in laboratory demonstration of important physical phenomenon and the underlying principles of physics.

Note: Students will be required to perform at least 15 experiments from the given list of experiments

List of Experiments:

1. Analysis of pulse height of gamma ray spectra.
2. To study absorption of beta rays in Al and deduce end-point energy of a beta emitter.
3. To study the dead time and other characteristics of G.M. counter.
4. To study Poisson & Gaussian distribution using G.M. counter.
5. Recording and calibrating a gamma ray spectrum by scintillation counter.
6. Detecting gamma radiation with a scintillation counter.
7. Identifying and determining the activity of weakly radioactive samples.
8. To calibrate the given gamma-ray spectrometer and determine its energy resolution.
9. Energy resolution and calibration of a gamma-ray spectrometer using multi-channel analyzer.
10. Time resolution and calibration of a coincidence set-up using a multi- channel analyzer.
11. Formation and Counting of alpha particle tracks on Solid State Nuclear Track
12. To study the alpha spectrum fro natural source Th and U
13. To determine range of alpha particles in air at different pressure and energy loss in thin foils
14. Detectors using Optical Microscope/ spark counter.
15. Determination of Ionization Potential of Mercury
16. To determine the operating voltage of a PMT and to find the photopeak efficiency of a NaI (Tl) crystal of given dimension for ϒ rays of different energies.
17. To study the Compton scattering using ϒ rays of suitable energy.
18. To determine ϒ ray attenuation coefficient for different metals.
19. To study the relationship between thickness of absorber and backscattering using GM counter.
20. To determine the half-life of a radioactive sample.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2403.1**	Analyze the physical principle involved in the various instruments; also relate the principle to new application.
CO2	**MPHY -2403.2**	Demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results

COURSE TITLE: PHYSICS OF NANO STRUCTURED MATERIALS
SUBJECT CODE: MPHY-2411
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students about the concepts of nanophysics and also clear the concepts about various techniques used in the formation of nanomaterials.

Sr. No.	Contents	Contact Hours
UNIT I	**Introduction to the Nanoscience:** Nano scale, Surface to volume ratio, Electron confinement in infinitely deep square well, Confinement in one and two-dimensional wells, Idea of quantum well, quantum wire and quantum dots, Comparison of Density states for 0D, 1D and 2D confined nanostructured materials with the bulk.	**15**
UNIT II	**Synthesis of Nanostructures:** Top down and Bottom up approach for synthesis of nanoparticles, growth of nuclei, Growth controlled by diffusion and surface process in Zero Dimensional nanostructures, Synthesis of One-Dimensional Nanostructures: Template-Based Synthesis, Electrochemical deposition, Electrophoretic deposition, Electrospinning and Lithography. Synthesis of two-Dimensional Nanostructures: Fundamentals of Film Growth, Physical Vapor Deposition, Molecular beam epitaxy, Sputtering, Chemical Vapor Deposition, Atomic Layer Deposition, Self-Assembly, Sol-Gel Films, Langmuir-Blodgett Films.	**15**
UNIT III	**General Characterization Techniques:** Determination of particle size, Structural Characterization: X-ray diffraction, Small angle Xray scattering, Morphological Characterization: Scanning electron microscopy, Transmission electron microscopy, Atomic Force Microscopy, Scanning probe microscopy. Optical Characterization: photo luminescence (PL), Raman and FTIR spectroscopy of nanomaterials.	**15**
UNIT IV	**Special Nanomaterials and its Applications:** Structure of Fullerene, Methods of synthesis of Carbon Nanotubes, Properties of CNT; Electrical, Optical, Mechanical, Vibrational properties etc., Applications: Molecular Electronics and Nanoelectronics,	**15**

	Carbon Nanotube Emitters, Solar cells, Fuel Cells, Display devices.	

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2411.1**	Explain the Nano science and technology in light of quantum confinement.
CO2	**MPHY -2411.2**	Understand various phenomenon's like quantum dot, quantum wire in light of Schrödinger equation.
CO3	**MPHY -2411.3**	Synthesis various nonmaterial with various techniques with proper understanding.
CO4	**MPHY -2411.4**	They can analysis the Nano crystal with Structural and opto electrical properties.
CO5	**MPHY -2411.5**	The understanding of the subject leads the students in their research work

Recommended Books:

1. Nano Structured Materials, Carl C. Koch, William Andrew, 2007
2. K.P. Jain, 'Physics of Semiconductor Nanostructures', Narosa Publishing House, 1997.
3. G. Cao, 'Nanostructures and Nanomaterials: Synthesis, Properties and Applications', Emperial College Press, 2004.

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks*

COURSE TITLE: PLASMA PHYSICS
SUBJECT CODE: MPHY-2412
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Objective: The purpose of the course is to clear the explanation of the topics of physics related to plasma .

Sr. No.	Contents	Contact Hours
UNIT I	**Basics of Plasmas:** Occurrence of plasma in nature, definition of plasma, concept of temperature, Debye shielding and plasma parameter, Single particle motions in uniform E and B, nonuniform magnetic field, grad B and curvature	15

	drifts, invariance of magnetic moment and magnetic mirror. Simple applications of plasmas	
UNIT II	**Plasma Waves:** Plasma oscillations, electron plasma waves, ion waves, electrostatic electron and ion oscillations perpendicular to magnetic field, upper hybrid waves, lower hybrid waves, ion cyclotron waves, Light waves in plasma	**15**
UNIT III	**Boltzmann and Vlasov equations:** The Fokker Planck equation, integral expression for collision term, zeroth and first order moments, the single equation relaxation model for collision term, Applications of kinetic theory to electron plasma waves, the physics of Landau damping	**15**
UNIT IV	**Non-linear Plasma Theories:** Non-linear effects, Ponderomotive force, KdV Equations, Nonlinear Schrodinger Equation, Solitons, Shocks, Non-linear Landau Damping, Sagdeev method.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2412.1**	Define plasma state, give examples of different kinds of plasma and explain the parameters characterizing them
CO2	**MPHY -2412.2**	Analyze the motion of charged particles in electric and magnetic field.
CO3	**MPHY -2412.3**	Explain the concept of quasi neutrality and describe plasma interaction with surfaces
CO4	**MPHY -2412.4**	Discuss plasma resistivity and diffusion in plasma based on the charged particle motion
CO5	**MPHY -2412.5**	Explain the properties of the most important wave modes in plasma: dispersion relation, polarization and motion of the charged particles.

Reference Books:

1. Introduction to Plasma Physics and Controlled Fusion: F F Chen, Springer, 2016
2. Plasma Physics: An Introductory, Richard Dendy, Cambridge University Press, 1996
3. Fundamental of Plasma Physics: S R Seshadri, American Elsevier Pub. Co. 1973

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: OPTOELECTRONICS
SUBJECT CODE: MPHY-2413
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students in optoelectronic devices and their applications.

Sr. No.	Contents	Contact Hours
UNIT I	**Optoelectronic Devices:** Photoconductivity, Light dependent resistor, photodiode, phototransistor, solar cell, metal semiconductor detector, charged coupled devices, advanced semiconductor laser structures, temperature dependence of laser output. PIN photodiode, Avalanche photodiode, Heterojunction photodiode, Organic light emitting diodes (OLED), Organic thin films transistors (OTFT), OTFT based display technology; Organic laser-Lasing process, optically pumped lasing structures	15
UNIT II	**Optoelectronic modulators:** Polarization of Light, Elliptical polarization, Optics of anisotropic media: The index ellipsoid, Birefringence, Optical activity, Electro-optic effect, Materials exhibiting electro-optic effect, Electro-optic modulator, Kerr modulators, Kerr effect, Magneto-optic modulator, Faraday effect; Acousto-optic effect, Raman-Nath Acousto-optic modulator,	15
UNIT III	**Display Devices:** Introduction, Luminescence – Photoluminescence, Cathodoluminescence, Electroluminescence; Injection luminescence and light emitting diode – Radiative recombination processes: Interband transitions, Impurity center recombination, Exciton recombination; LED materials, LED construction, Plasma displays, Liquid crystal displays, Numeric displays.	15
UNIT IV	**Photodetectors:** Introduction, Thermal detectors – Thermoelectric detectors, Bolometer, Pneumatic devices, Pyroelectric detectors; Photon devices – Photoemissive devices, photodiodes, Photomultipliers, Photon cutting techniques, Image intensifiers, Photoconductive detectors, Junction arrays, Detector performance parameters.	15

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2413.1**	Explain fundamental physical and technical base of Optoelectronic systems,

CO2	**MPHY -2413.2**	Describe development and application of optoelectronic systems
CO3	**MPHY -2413.3**	Interpret the acquired data and measured results,
CO4	**MPHY -2413.4**	Conduct experiments and measurements in laboratory and on real components, devices and equipment of optoelectronic systems,
CO5	**MPHY -2413.5**	Use optical fibre equipment, and data transfer using optical fiber.
CO6	**MPHY -2413.6**	Analyze various premises, approaches procedures and results related to optoelectronic systems,
CO7	**MPHY -2413.7**	Describe basic laws and phenomena that define behavior of optoelectronic systems,

Recommended Books:

1) Optoelectronics: An Introduction - J. Wilson & J. F. B. Hawkes, Prentice Hall Europe, 1998

2) Optical Electronics - Ajoy Ghatak & K.Thyagarajan, Cambridge University Press, 1999

3) Optical Properties of Solid, Frederick Wooten, Academic Press Inc,2010..

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: ADVANCED ELECTRONICS
SUBJECT CODE: MPHY-2414
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective: The purpose of the course is to train the students about the advances in electronic devices and also their circuit diagrams.

Sr. No.	Contents	Contact Hours
UNIT I	**Microcontrollers:** Introduction to Microcontrollers, Embedded versus External Memory Devices, 8–bit and 16–bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontroller Devices. MCS–51 Architecture, Registers in MCS, 8051 Pin Description, Connections, I/O Ports and Memory Organization. Addressing	15

	Modes, Instructions and Simple programming's, Stack Pointer, Assembly Language Programming, Introduction to Atmel 89C51 & 89C2051 Microcontrollers, Applications of Microcontrollers.	
UNIT II	**Microsensors:** General principles-types of sensors; optical sensors, thermal sensors, pressure sensors, magnetic field measurements, Measurement and control: Signal conditioning and recovery. Impedance matching, Op-amp based, instrumentation amp, Positive and negative feedback, filtering and noise reduction, shielding and grounding. Lock-in detector-principle – example of PSD, box-car integratorprinciple–block diagram.	**15**
UNIT III	**Data Transmission Systems I:** Analog and Digital Transmissions, Sinusoidal AM, modulation index-frequency spectrum-average power-effective voltage and current, Non-sinusoidal modulation-modulation index Generation of AM waves-BJT collector modulator-modulator using FETs.	**15**
UNIT IV	**Data Transmission Systems II:** Block diagram of AM Transmitter, Pulse Amplitude Modulation, Pulse Width Modulation, Time Division Multiplexing, Pulse Modulation, Digital Modulation, Pulse Code Format, Modems	**10**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2414.1**	Draw and describe architecture of 8051 and ARM7 microcontroller. Interface various peripheral devices to the microcontrollers.
CO2	**MPHY -2414.2**	Understand about various types of signals and systems, classify them, analyze them, and perform various operations on them,
CO3	**MPHY -2414.3**	Understand different blocks in communication system and how noise affects communication using different parameters.
CO4	**MPHY -2414.4**	Distinguish between different amplitude modulation schemes with their advantages, disadvantages and applications

References

1. The 8051 Microcontroller and Embedded Systems, Rajiv Kapadia, Jaico Publishing House, 2004
2. Op-Amps and Linear Integrated Circuits - R. A. Gayakwad , Prentice Hall India, 2000
3. Electronic Communication Systems, Kennedy and Davis, Tata-McGraw Hill, 2004

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: PHYSICS OF MATERIALS
SUBJECT CODE: MPHY-2415
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Course objective: This part of the syllabus basically deals with the study of the extended version of Condensed matter physics as we have studied in our previous semester. These applications also help us to understand various phenomenons in Nanotechnology .the study of Symmetry elements and concept groups and their physical contributions in various properties like, Physical, Optical, and Magnetic etc

Sr. No.		Contact Hours
UNIT I	**Polymer Materials:** Polymer Structure: Molecular Weight, Shape, Structure and Configuration; Thermoplastic and Thermosetting, Mechanical Behavior of Polymers-stress strain behavior, Macroscopic and Viscoelastic deformation, Fracture of polymers, Mechanical charachteristics-Fatigue, Tear Strength and Hardness, Mechanisms of Deformation and strengthening of polymers. Crystallization, Melting and Glass Transition Phenomena in Polymers	**15**
UNIT II	**Composite Materials:** Introduction, Particle-Reinforced Composites-Large, Fiber-Reinforced Composites: Influence of Fiber Length, Influence of Fiber Orientation and Concentration, The Fiber Phase, The Matrix Phase, Polymer-Matrix Composites, Metal-Matrix Composites, Ceramic-Matrix Composites.	**15**
UNIT III	**Nano-Materials:** Emergence of Nanotechnology, Micro to Nanoscale materials, Characteristics of Nanomaterials- Band gap, surface to volume ratio, Electron confinement for zero, one and two dimensional nanostructures, synthesis of nanomaterials with top down and bottom up approach, Methods of Synthesis- ball milling, sol-gel, Electro-spinning and Lithography techniques, Carbon nanotubes (synthesis and properties), applications of nanomaterials.	**15**
UNIT IV	**Electrical, Magnetic and Thermal Properties of Materials:** Electrical properties of materials: Conduction in ionic materials, Dielectric behavior, Field vectors and polarization types, Frequency dependent dielectric constant, Other Electrical characteristics of materials and its applications: Ferroelectricity, Piezoelectricity. Magnetic Properties of Materials: Magnetic materials and its classifications, Domain and Magnetic Hysteresis, Magnetic storage, Magnetic Anisotropy, Soft and Hard magnetic materials. Thermal properties of materials: Heat capacity, Thermal expansion, Thermal conductivity and Thermal stresses.	**15**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MPHY-2415.1**	Be the leader of Nanotechnology in the future. Then they can precede their further study in the field of Nanotechnology with proper understanding which may lead to some new scientific contributions.
CO2	**MPHY -2415.2**	The electric and magnetic fields in matter and ferroelectric materials.

Recommended Books:

1. Material Science & Engineering, PHI Learning Pvt. Ltd., 2015
2. Elements of Material science & Engineering, Pearson Education, 2008
3. G. Cao, 'Nanostructures and Nanomaterials:, Synthesis, Properties and Applications', Emperial College Press, 2004.

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: MATLAB
SUBJECT CODE: MLAB-2401
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
2	0	2	3

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

COURSE OBJECTIVE: The objective of this course is to teach the basics of MATLAB. For the purpose of learning programming skill Numerical problems with quantum mechanics are included.

Sr. No.	Contents	Contact Hours
UNIT I	**Basic Operations of Matlab:** The Desktop Layout, Syntax, and Operations, Variable names, Operator and delimiter symbolic, Multiple operations, Displaying content of multi-element variables, Importing and Exporting Information, Command Line Import, Import Functions, M-file Scripts, Export Functions	10
UNIT II	**Computing and Programming:** Computational Procedures: Special Built-in Constants and Functions, Computing with matrices and vectors, Simultaneous linear equations, Eigenvectors and Eigenvalues Programming: Using the Editor, Types and Structures of M-files, Passing variables by name and value, Function evaluation and function handles, Flow control: if, else, and elseif, for, while, switch and case, break, return, nested loops, Sorting and Searching	15
UNIT III	**Graphics and Data Analysis:** Graphics and Data Visualization, Two dimensional plotting, Sub plotting Patching and Filling, Three dimensional plotting, The Handle Graphics system, saving and exporting graphics, Sub plotting Patching and Filling, Three dimensional plotting, Saving and exporting graphics	10
UNIT IV	**Working with the various practical examples of Quantum Mechanics:** a. Writing differential operators as matrix b. Eigen functions and energy eigen values of free particle c. Eigen functions and eigen energies of one -dimensional Schrödinger equation for arbitrary potentials d. Probability density for particle in double well potential e. Time dependent Schrödinger equation in one dimension: Reflection at a potential cliff f. Time dependent Schrödinger equation in two-dimensions: Reflection at a potential barrier	10

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MLAB-2401.1**	To use Matlab for interactive computations.

CO2	**MLAB-2401.2**	To use basic flow controls (if-else, for, while).
CO3	**MLAB-2401.3**	To program scripts and functions using the Matlab development environment..
CO4	**MLAB-2401.4**	To generate plots and export this for use in reports and presentations.

Reference Books:

1. Duffy, D.G., Advanced engineering mathematics with MATLAB, Boca Raton, FL: CRC Press, 2003.
2. Register, A.H., A guide to MATALB object-oriented programming, Boca Raton, FL: CRC Press, 2007.
3. Kalechman, M., Practical MATALB applications for engineers, Boca Raton, FL: CRC Press, 2009.

Instructions to Question Paper Setter*: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*

COURSE TITLE: RESEARCH METHODOLOGY
SUBJECT CODE: MSRM-2401
SEMESTER: IV
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Course Objective: The course is designed to enable students to understand & apply concepts of research methodology on real research problems

Sr. No.	Contents	Contact Hours
UNIT I	Research Methods-Introduction : Introduction to Research-Basic and applied Research Methods, Road Map to Learn Business Research Methods, Business research methods: A Decision Making Tool, Use of Software in Data Preparation and Analysis, Introduction and Business Research Process Design	**5**
UNIT II	Introduction and Scales of Measurement, Four Levels of Data Measurement, The Criteria for Good Measurement, Factors in selecting an appropriate Measurement Scale, Questionnaire: Introduction and Design Process. Introduction to Sampling-Importance and Sampling Design Process, Random Sampling Methods and Non-Random Sampling, Central Limit Theorem and Sampling distribution. Classification of Secondary Data Sources, Road Map to Use Secondary Data, Survey and Observation: Classification of Survey Methods, Observation Techniques and Classification of Observation Methods, Experimental Research Designs	**15**
UNIT III	Field-work and Data Preparation, Hypothesis Testing for Single Population: Introduction, Hypothesis Testing Procedure, Two-Tailed Test of Hypothesis and One - Tailed Test of Hypothesis, Type-I and Type-II Error, Hypothesis Testing for a Single Population Mean Using the Z and T statistic, Hypothesis Testing for a Population Proportion, Hypothesis Testing for Two Populations, Hypothesis Testing for the Difference Between Two Population Means Using the z and t-Statistic, Statistical Inference About the Difference between the means of Two Related Population, One way ANOVA and Experimental Research Designs	**15**
UNIT IV	Hypothesis testing for Categorical data (Chi-square test), Non-parametric statistics , Correlation Karl Pearson and Spearman's Rank Correlation, Introduction of Simple Linear Regression and Determining the Equation of a Regression Line, Presentation of Result: Report Writing, Organization of Written Report, Tabular and Graphical Representation of Data, Oral Presentation	**10**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MSRM-2401.1**	Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
CO2	**MSRM-2401.2**	Have basic knowledge on qualitative research techniques

CO3	**MSRM-2401.3**	Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis
CO4	**MSRM-2401.4**	Have basic awareness of data analysis-and hypothesis testing procedure.

Reference Books:

1.Business Research Methods by Naval Bajpai, Pearson, 1st Edition, (2011)
2.Research Methodology: Methods and Techniques by C R Kothari, New Age International (2004)
3.Marketing Research: Text and Cases by Nargundkar, R., Tata McGraw Hill, 3rd Edition, (2010)

***Instructions to Question Paper Setter**: The question paper consist of three sections A, B & C. Section-A is compulsory consisting of short answer type questions (1 or 2 marks) from the whole syllabus. It should be of 12 Marks. Section-B consists of 8 questions and students will attempt any six questions. Each question carries 4 Marks. Section-C consists of 4 questions and Students will attempt any three questions. Each question carries 8 Marks.*