Program Outcomes

PO-1: Disciplinary knowledge-Attain profound knowledge in Discipline with advanced concepts in science & technology to design the methodology suitable to the problem encountered and ability to apply the knowledge to solve real-life problems.

PO-2: Research Skills- Attain Research Skills to analyze problems, formulate a hypothesis, evaluate, and validate results with the help of advanced tools and technology, and draw a logical conclusion.

PO-3: Communication: Able to present scientific and technical information with clarity, conciseness, and correct manner in both oral and written presentation.

PO-3: Leadership Skills: Ability to demonstrate leadership and work collaboratively as a part of a team in multidisciplinary settings.

PO-4: Ethics: Attain the relevant knowledge and skills to identify unethical behavior and truthful actions in all aspects and demonstrate standard professional ethics in the discipline concerned.

PO-5: Lifelong Learning: Ability to seek new knowledge and skills and inculcate the habit of self-learning throughout life and adapting to contemporary demands of workplace.

PO-6: Lifelong Learning: Ability to seek new knowledge and skills and inculcate the habit of self-learning throughout life and adapting to contemporary demands of workplace.

Program Specific Outcomes

PSO1: Understanding the epistemological source of knowledge in Mathematical physics, Classical & Statistical Mechanics, Solid State Physics, Quantum Mechanics, Computer Programming, Nuclear and particle physics, Electrodynamics together with their applications in solving complex scientific problems in different related areas.

PSO2: Understandthe philosophy of fundamental and advanced level knowledge in the fields of material science, laser and photonics, Electronics, and Communication Electronics together with their applications in materials processing for advanced applications.

PSO3: Prepare the students to pursue research careers, careers in academics, in industries in physical science and develop knowledge to identify the problems and enable them for critical thinking.

PSO4: Students will understand communication, interpersonal skills, and listening skills and make the students aware of the professional ethics of the industry, and prepare them with basic soft skills essential for working in community and professional teams.

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109
Department Physics, School of Science

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme:	**M.Sc (Physics)**	**Semester :**	**I Sem**
Name of the Course:	**Mathematical Physics**	**Course Code:**	**MPH 1101**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

In Mathematical Physics, we offer to study combine theoretical physics with high-level math courses in differential equations, vector calculus, complex variable and applied mathematics. Students also get plenty of chances to apply that learning with hands-on labs in mechanics, electricity and magnetism, computer programming, optics, and more.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Get introduced to Vector space and Matrices and Eigen values and Eigen Vectors.
CO2	Learn about the meaning and application of Cauchy's theorem, Cauchy integral. formula, Laurent series, singularities, residue theorem.
CO3	Learn the fundamentals and applications of Fourier series, Fourier and Laplace. transforms, their inverse transforms etc.
CO4	Learn different ways of solving second order differential equations and familiarized with singular points.
CO5	Get introduced to Special functions like Legendre, Bessel, Hermite and Laguerre functions and their recurrence relations.

Syllabus:

Unit–ILinear Algebra:

Vector space and Matrices, Linear independence, Bases, dimensionality, Inner product, Linear transformation, matrices, Inverse, Orthogonal and Unitary matrices, Independent element of a matrix, Eigen values and eigen Vectors, Diagonalization, Complete orthonormal sets of functions.

Unit–II Complex Variables:

Cauchy- Riemann condition, analytic functions, Cauchy's theorem, Cauchy integral formula, Laurent series, singularities, residue theorem, contour integration, evaluation of definite integrals, problems.

Unit–III Differential equations:

First order differential equation, second order differential equation with constant coefficients, second order linear ODEs with variable coefficients, Solution by series expansion, non-homogeneous differential equations and solution by the method of Green's functions.

Unit–IV Special functions:

Legendre, Bessel, Hermite and Laguerre functions with their physical applications, generating functions, orthogonality conditions, recursion relations,

Unit–V Integral transforms: Fourier integral and transforms, inversion theorem, Fourier transform of derivatives, convolution theorem, Laplace Transform(LT), LT of Derivatives, Inverse LT, Fourier series; properties and applications, discrete Fourier transform.

REFERENCE BOOKS

1. Mathematical Methods for Physics, by G. Arfken.
2. Matrices and Tensors for Physicist, by A. W. Joshi.
3. Advanced Engineering Mathematics, by E. Kreyszig.
4. Special Functions, by E. B. Rainville.
5. Special Functions, by W.W. Bell.

Structures, unions, enum, Storage classes, dynamic memory allocation, file management using c programming.

CO-PO&PSO Correlation

Course Name: Mathematical Physics (MPH 1101)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	1	2	2	1	2	1	3	1	2	1
CO2:	2	1	1	1	2	1	2	2	2	1
CO3:	2	2	1	1	3	2	1	1	1	1

CO4:	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**
CO5:	**1**	**1**	**3**	**2**	**1**	**1**	**3**	**1**	**2**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme: **M.Sc (Physics)**

Semester : **I Sem**

Name of the Course: **Classical Mechanics**

Course Code: **MPH 1102**

Credits : **4**

No of Hours :

Max Marks: **100**

Course Description:

This first course in the physics curriculum introduces classical mechanics. Historically, a set of core concepts space, time, mass, force, momentum, torque, and angular momentum were introduced in classical mechanics in order to solve the most famous physics problem, the motion of the planets. The principles of mechanics successfully described many other phenomena encountered in the world. Conservation laws involving energy, momentum and angular momentum provided a second parallel approach to solving many of the same problems. In this course, we will investigate both approaches: Force and conservation laws. Our goal is to develop a conceptual understanding of the core concepts, a familiarity with the experimental verification of our theoretical laws, and an ability to apply the theoretical framework to describe and predict the motions of bodies.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn the Lagrangian and Hamiltonian approaches in classical mechanics.
CO2	Understand the classical background of Quantum mechanics and get familiarized with Poisson brackets and Hamilton -Jacobi equation.
CO3	Learn Kinematics and Dynamics of rigid body in detail and ideas regarding Euler's equations of motion.
CO4	Understand the theory of small oscillations in detail along with basis of Free vibrations
CO5	Get basic idea about a Two-body central force problem and its reduction to the equivalent one-body problem.

CO6	Learn Scattering in a central force field: Rutherford scattering.

Syllabus:

Unit-I Preliminaries, Newtonian mechanics of one and many particle systems, Conservation laws,Constraints& their classification, Principle of virtual work, Generalized coordinates, D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and dissipation function, Simple applications of the Lagrangian formulation, Hamilton's principle, Lagrange's equations from Hamilton's principle, Conservation theorems and Symmetry properties, Energy function and the conservation of energy.

Unit-II Hamiltonian formulation of mechanics, Legendre transformations and Hamilton's equations of motion, Cyclic coordinates and Conservation theorems, Hamilton's equations from Hamilton's principle, principle of least action, Simple applications of the Hamiltonian formulation.

Unit-III Canonical transformations with examples, harmonic oscillator, Poisson's brackets, Equations of motion and conservation theorems in the Poisson Bracket formulation. Hamilton-Jacobi (HJ) theory: HJ equation for Hamilton's principal function, Harmonic oscillator as an example of the HJ method, The HJ equation for Hamilton's characteristic function, The action angle variables

Unit–IV The Central force: Two-body central force problem and its reduction to the equivalent one-body problem, The equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, The differential equation of the orbit, Closure and stability of orbits, The Kepler problem, Scattering in a central force field: Rutherford scattering.

Unit–V Rigid body dynamics, The Euler angles, Euler's theorem on the motion of a rigid body, Rate of change of a vector, The Coriolis force, Angular momentum and Kinetic energy of motion about a point, The Euler equations of motion of rigid bodies. Formulation of the problem of small oscillations, The eigen-value equation and the principal axis transformation, Frequencies of free vibration and normal coordinates, Free vibration of linear triatomic molecule.

REFERENCE BOOKS

1. Classical Mechanics, By N.C. Rana and P.S. Joag (Tata McGraw-Hill, 1991)

2. Classical Mechanics, by H.Goldstein (Addison Wesley, 1980)

3. Classical Mechanics, by H.Goldstein, C Poole & J Fafko (Pearson Education, Inc, 2002)

4. Mechanics, by A.Sommerfeld, (Academic press, 1952)

5. Introduction to Dynamics by Perceival and D.Richaeds(Cambridge University, press , 1982).

CO-PO&PSO Correlation

Course Name: Classical Mechanics (MPH 1102)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	1	1	1	1	2	1	1	3	1	2
CO2:	2	1	1	1	1	1	2	2	3	1
CO3:	1	1	1	1	2	2	1	1	1	2
CO4:	1	3	1	2	1	2	1	3	2	1
CO5:	2	1	1	1	1	2	1	1	2	2
CO6:	1	1	1	2	2	1	1	2	1	3

Note: 1: Low 2.: Moderate 3: High

Programme: **M.Sc (Physics)**
Name of the Course: **Statistical Mechanics**
Credits : **4**
Max Marks: **100**

Semester : **I Sem**
Course Code: **MPH 1103**
No of Hours :

Course Description:
To understand the properties of macroscopic systems using the knowledge of the properties of individual particles. The Statistical Basis of Thermodynamics: The macroscopic and microscopic states, contact between statistics and thermodynamics, classical ideal gas, Gibbs paradox and its solution. Ensemble Theory: Phase space and Liouville's Theorem, the micro-canonical ensemble theory and its application to ideal gas of monatomic particles, Partition function, Classical ideal gas in canonical ensemble theory, Energy fluctuations, Equipartition and virial theorems, A system of harmonic oscillators as canonical ensemble, Thermodynamics of magnetic systems and negative temperatures, The grand canonical ensemble and significance of statistical quantities. Classical ideal gas in grand canonical ensemble theory. Density and energy fluctuations. Ideal Bose Systems: Basic concepts and thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation, Discussion of gas of photons (the radiation fields) and phonons (The Debye field), Liquid helium and super

fluidity. Ideal Fermi Systems: Thermodynamic behavior of an ideal Fermi gas, Discussion of heat capacity of a free-electron gas at low temperatures, Pauli paramagnetism

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Get introduced to macroscopic and microscopic states, contact between statistics and thermodynamics.
CO2	Learn about Liouville`s theorem and its consequences.
CO3	Grasp the basis of ensemble approach in statistical mechanics to a range of situations.
CO4	Learn the fundamental differences between classical and quantum statistics and learn about quantum statistical distribution laws.
CO5	Understand examples of ideal Bose systems and Fermi systems.

Syllabus:

Unit-IFoundation of statistical mechanics:

macroscopic and microscopic states, contact between statistics and thermodynamics, physical significance of 'Ω(N, V, E), the classical gas, entropy of mixing and Gibb's paradox, phase space of classical system, Liouville`s theorem and its consequences, quantum states and phase space.

Unit-IIElements of ensemble theory:

A system in micro-canonical, canonical, and grand canonical ensembles, partition functions, physical significance of statistical quantities, example of classical system, energy and energy-density fluctuations and mutual correspondence of various ensembles.

Unit-IIIFormulation of quantum statistics:

Quantum mechanical ensemble theory, density matrix, statistics of various quantum mechanical ensembles, system composed of indistinguishable particles. Theory of simple gases –Ideal gas in various quantum mechanical ensemble, Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions, statistics of occupation number.

Unit-IVIdeal Bose and Fermi gases:

Thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation and, elementary excitations in liquid helium II, Thermodynamic behavior of an ideal Fermi gas, the electron gas, non relativistic and relativistic degenerate electron gas, theory of white dwarf stars.

Unit-VStatistical Mechanics of interacting systems:

The method of cluster expansion for a classical gas, Virial expansion of the equation of state. Theory of phase transition – general remark on the problem of condensation, Fluctuations: thermodynamic fluctuations, Spatial correlation in a fluid Brownian motion: Einstein Smoluchowski theory of Brownian motion.

REFERENCE BOOKS

1. R. K. Pathria, Statistical Mechanics (Pergamon Press).
2. L. D. Landau & E. M. Lifshitz, Statistical Mechanics (Butter worth and Heinemann Press).
3. FederickReif, Fundamental of statistical and thermal physics (McGraw-Hill publishers).
4. Kerson Huang, Statistical Mechanics (Wiley Eastern).

CO-PO&PSO Correlation

Course Name: Statistical Mechanics (MPH 1103)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	2	1	1	3	1	1	3	1	2	1
CO2:	1	1	1	1	2	2	1	1	1	2
CO3:	1	3	1	2	1	2	1	3	2	1
CO4:	2	1	1	1	1	2	1	1	2	2
CO5:	1	1	1	2	2	1	1	2	1	3

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**I Sem**
Name of the Course:	**Electronics**	**Course Code:**	**MPH 1104**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

Typically, an MSc Electronics course begins by providing the foundation concepts of core electronics and allied fields and then introduces the more advanced topics of analysis. The first part of syllabus will comprise of foundational topics and the second will be geared towards fostering independent research.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn basics of Op.-Amplifier and its Applications.
CO2	Learn Sequential Logic, Combinational Logic and different type of Flip-flops.
CO3	Learn interfacing with peripheral I/O devices.
CO4	Understand the Organization and internal architecture of the Intel 8085.
CO5	Learn assembly language programming and arithmetic.

Syllabus:

Unit-IOperational Amplifier:

Basic Op.Amp. Differential amplifier, the emitter coupled Difference Ampl, Transfer characteristics of a Diff. Ampl., an example of an IC Op.-Amp., off set error voltage and currents, measurement of Op.-Amp. Parameters, frequency response of Op-amp.Linear analog systems: Basic Op.-Amp. Applications, Analog integration and differentiation, Electronic analog computation, Non-linear analog systems: Comparators, Waveform generators.

Unit-IICombinational Logic:

Basic logic gates: OR, AND and NOT gates, NOR and NAND gates, Boolean algebra, DeMorgan’s theorems, exclusive OR gate, characteristics of logic families, saturated logic families: RTL, DCTL, nonsaturated logic families: TTL and ECL, Unipolar logic families.

Unit –IIISequential Logic, Flip-flops:

RS Flip-flop, level clocking, Edge triggered Flip Flops, D Flip flops. JK Flip-flops, J.K.master slave Flip-flops, Registers: buffer, shift and control shift registers, counters: ripple synchronous & ring counters, tri-state registers, Buffer: controlled buffer Register, Bus organized structure, Latch, multiplexer, Demultiplexer, decoder, ALU Memories: RAM, ROM, PROM, EPROM, A/D and D/A converters.

Unit-IVMicroprocessors:

Building concept of microprocessors, developing inside of microprocessor , Instruction codes ,Instruction Register ,Introducing RESET Pin, Introducing on chip oscillator, Interfacing I/O devices, Introducing Interrupt lines :Stack, Push, Pop operation ,delay in servicing interrupts, multiply interrupts, location for interrupts .Introducing slow and fast data transfer, Status of microprocessor, interrupt pins, General purpose Register, flag Register, Increment/decrement register. Features of 8085 microprossor. Pin diagram of 8085, block diagram of 8085.

Unit–VInstructions set of 8085, types of instructions:

Data transfer group, Arithmetic logic, branch group, stack I/O machine control group, addressing mode of Intel 8085, examples of Assembly language programs of 8085, summing of two 8-bit numbers to result a 16-bit number, summing two 16-bit number, multiplying two 8-bit number to result a 16-bit product, block transfer of data from one memory block to other, BCD to hexadecimal data, finding the largest number in a series.

REFERENCE BOOKS

1. Integrated Electronics: J.MillmanR.C.C.Halkias.

2. Electronics devices and circuit theory, by Robert Boylested and Louis Nashdaky PHI,
New Delhi-110001, 1991.

3. Operational amplifier linear integrated circuits, by Romakanth A. Gayakwad PHI, second edition 1991.

4. Digital computer electronics- An introduction to microcomputers-A.P.Malvino.

5. Digital finances and applications, by A.P. Malvino and Donald P.Leach, Tata 9

McGraw Hill company, New Delhi 1993.

6. Microprocessor architecture, programming applications with 8085/8086 by Ramesh S.Gaonkar, Willey-Eastern limited 1987.

7. Introduction to microprocessors – A.P.Mathur (Tata McGraw).

CO-PO&PSO Correlation

Course Name: Electronics (MPH 1104)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	1	3	1	1	2	1	3	1	1	1
CO2:	2	2	1	1	1	2	1	1	3	2
CO3:	1	1	2	2	1	1	1	1	2	2
CO4:	1	2	1	2	1	3	1	2	1	2
CO5:	1	1	1	2	2	1	1	1	1	2

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**I Sem**
Name of the Course:	**Laboratory Practical Course-I**	**Course Code:**	**MPH 1105**
Credits :	**2**	**No of Hours :**	
Max Marks:	**100**		

Course Description:
The course deals with the practical knowledge of advance electronics course. It includes practical design and study of operational amplifiers, flip flops, half and full adders.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Knowledge of designing inverting amplifier.
CO2	Measurement of operational amplifier parameters.
CO3	Knowledge of designing non-inverting amplifier.
CO4	Gain practical knowledge of designing half and full adders.

Syllabus:

At least six experiments are to be performed by each student from the following list.

1- Measurement of op amp parameters.
2- To design an inverting amplifier. Using Op amp 741. And study its frequency response.
3- To design a non inverting amplifier using op amp. 741 and to study its frequency response.
4- To design a differentiator circuit using Op amp and draw input and output waveform.
5- To design an integrator circuit using Op amp and draw input and output waveform.
6- To study the characteristic and operations of inverters, or, and, Nor and NAND gate using TTL ICS.
7- To study and prove De Morgan's theorem.
8- To construct Half And full adder and subtractor circuits.
9- To construct. 421 multiplexer and demultiplexer circuit using logic gate.
10. To construct 3 is 28 decoder circuit.
11. To study Rs and JK flip flops.
12. To study B&T flip flops.
13. To perform the operation of BCD counter using 7490.

CO-PO&PSO Correlation

Course Name: Laboratory Practical Course-I (MPH 1105)										
	Program Outcomes						PSOs			
Course Outcomes	1	2	3	4	5	6	1	2	3	4
CO1:	2	2	2	2	2	1	3	2	1	2
CO2:	1	2	2	2	2	2	3	2	2	2
CO3:	2	1	2	1	1	2	2	2	1	2
CO4:	2	2	2	1	2	2	3	1	1	2

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**II Sem**
Name of the Course:	**Solid State Physics**	**Course Code:**	**MPH 1201**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

This course integrates theory of Solid State Physics with experimental demonstrations in the Research Physics Lab. The course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. This course includes theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors), based on the classical and quantum physics principles. Several advanced experiments of X-ray diffraction, Raman Scattering, Photoluminescence, etc., will be carrier out in the Research Physics Lab followed by their theoretical discussion.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Know what phonons are, and be able to perform estimates of their dispersive and thermal properties , be able to calculate thermal and electrical properties in the free-electron model.
CO2	Know Bloch's theorem and what energy bands are and know the fundamental principles of semiconductors.
CO3	Explain superconductivity using BCS theory.
CO4	Learn lattice vacancies, Schottkey and Frenkel point effects, colour centers, F and other centres.
CO5	Knowthe fundamentals and solution of Central equation, Kronig-Penny model in reciprocal space.

Syllabus:

Unit-I

Nearly free electron model, origin of energy gap and its magnitude, Bloch function, Kronig-Penny model, Wave equation of electron in periodic potential, restatement of Bloch theorem, crystal moment of an electron, solution of Central equation, Kronig-Penny model in reciprocal space, empty lattice Approximation, approximate solution near zone boundary, Number of orbitals in a band, metals and insulators.

Unit -II

Fermi surfaces and metals Effect of temperature on F-D distribution, free electron gas in three dimension. Different zone schemes, reduced and periodic zones, construction of Fermi surfaces, nearly free electrons, electron, hole, open orbits, Calculation of energy bands, Tight binding, Wigner-Seitz, cohesive energy, pseudo potential methods.

Experimental methods in Fermi surface studies, quantization of orbits in a magnetic field, de Haas van Alphen Effect, External orbits, Fermi surface of copper.

Unit- III

Crystal vibration and thermal properties Lattice dynamics in monoatomic and diatomic lattice: two atoms per primitive basis, optical and acoustic modes, quantization of elastic waves, phonon momentum, inelastic neutron scattering by phonons, Anharmonic crystal interactions-thermal expansion, thermal conductivity, thermal resistivity of phonon gas, umklapp processes, imperfections.

Unit –IV

Occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, heat capacity, energy gap, MW, and IR properties, isotope effect. Theoretical survey : thermodynamics of superconducting transition, London equation, Coherence length, Cooper pairing due to phonons, BCS theory of superconductivity, BCS ground state, flux quantization of superconducting ring, duration of persistent currents, Type II superconductors.

Unit – V

Optical Processes &Excitons and defects Optical reflectance, excitons, Frenkel and Mott-Wannierexcitons, Alkali Halides and Molecular crystals Defects: lattice vacancies, Schottkey and Frenkel point effects, colour centers, F and other centres, Line defect. Shear strength of single crystals, dislocationsedge and screw dislocations, Burger vectors, Stress fields of dislocations, low angle grain boundaries, dislocation densities, dislocation multiplication and slip, strength of alloys, dislocations and crystal growth, hardness of materials.

REFERENCE BOOKS

1. C. Kittel: Introduction to Solid State Physics (Wiley and Sons).
2. J. M. Ziman: Principles of theory of solids (Cambridge Univ. Press).
3. Azaroff: X-ray crystallography.
4. Weertman and Weertman : Elementary Dislocation Theory.
5. Verma and Srivastava: Crystallography for Solid State Physics.

CO-PO&PSO Correlation

Course Name: Solid State Physics (MPH 1201)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	**1**	**3**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**3**
CO2:	**2**	**1**	**2**	**1**	**3**	**1**	**1**	**2**	**2**	**1**
CO3:	**1**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**1**	**3**
CO4:	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**1**
CO5:	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**3**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**II Sem**
Name of the Course:	**Laboratory Practical Course-II**	**Course Code:**	**MPH 1205**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

Laboratory Practical Course-II involves practical knowledge of solid state physics. It includes how to practically measureresistivity and band gap of semiconductors and metals, corrosion rate of metal alloys, hardness and magnetic properties of materials, etc.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain hands-on experience of instruments to measure resistivity and band gap of metals and semiconductors.
CO2	Gain hands-on experience of instruments to measure magnetic properties of solid state materials.
CO3	Measurement of hardness of solid state materials.
CO4	Practical knowledge to measure corrosion rate of metals.

Syllabus:

At least six experiments are to be performed by each student from the following list.

1- Measurement of resistivity and bandgap of aluminium. By four probe method.
2- Determine. Corrosion rate of aluminium alloy in 3.5% inNaCl solution.
3- Measurement of resistivity and band gap of silicon by four probe method.
4- To determine the area of a loop of Universal BH curve tracer.
5- To determine the hardness of a material by. veaker hardness test.

CO-PO&PSO Correlation

Course Name: Laboratory Practical Course-II (MPH 1205)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	**2**	**3**	**1**	**2**	**1**	**2**	**2**	**2**	**2**	**2**
CO2:	**2**	**2**	**2**	**1**	**3**	**1**	**2**	**2**	**2**	**2**
CO3:	**2**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**3**
CO4:	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**II Sem**
Name of the Course:	**Quantum Mechanics-I**	**Course Code:**	**MPH1202**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

To impart knowledge of advanced quantum mechanics for solving relevant physical problems. Relativistic Quantum Mechanics: Klein-Gordon equation, Dirac equation and its plane wave solutions, solution of Klein Gordan equation for a particle with Coulomb potential, significance of negative energy solutions, spin angular momentum of the Dirac particle. The non-relativistic limit of Dirac equation, Dirac equation for a particle in a central field, fine structure of hydrogen atom, Lamb shift. Field Quantization: Classical field theory, Lagrangian and Hamiltonian formalism of a particle in an electromagnetic field, Second quantization, Concepts and illustrations with Schrödinger field. Relativistic Quantum Field Theory: Quantization of a real scalar field and its application to one meson exchange potential. Quantization of a complex scalar field, Dirac field and e.m. field, Commutation relations. Interaction: Yukawa interaction, Coupling of electron and electromagnetic field, Global and guage invariance Feynman diagrams, Feynman rules, Feynman graphs for Compton and e-e scattering, Path integration method: Wick's Theorem. Scattering matrix.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn Linear vector spaces, Hilbert space, concepts of basis and operators and bra and ket notation.
CO2	Understand both Schrodinger and Heisenberg formulations of time development and their applications.
CO3	Learn the theory of angular momentum and spin matrices, orbital angular momentum and ClebshGordan Coefficient.
CO4	Understand the Space-time symmetries and conservation laws, theory of identical particles.
CO5	Learn the theory of scattering and calculation of scattering cross section, optical theorem ,Born and Elkonal approximation, partial wave analysis etc.

Syllabus:

Unit-I Inadequacy of classical mechanics, Plank quantum hypothesis and radiation law, Photoelectric effect, de-broglie’s theory. Schrödinger equation, continuity equation, Ehrenfest theorem, admissible wave functions, stationary states, one-dimensional problems; walls and barriers, Schrödinger equation for harmonic oscillator and its solution, uncertainty relations, states with minimum uncertainty product.

Unit–II Superposition principle, general formalism of wave mechanics, representation of states and dynamical variables, commutation relationship, completeness and normalization of eigen functions, Dirac-delta function, Bra &Ket notation, matrix representation of an operator, harmonic oscillator and its solution by matrix method, Heisenberg equation of motion.

Unit-III Angular momentum in quantum mechanics, commutation relationships, eigen values, Spin angular momentum, Pauli`s matrices, addition of angular momentum, Clebsch-Gordon coefficients.

Unit–IV Central force problem, spherically symmetric potentials in three dimensions, separation of wave equation, parity, three-dimensional square-well potential and energy levels, the hydrogen atom; solution of the radial equation, energy levels and stationery state wave functions, discussion of bound states, degeneracy.

Unit–V Time- independent perturbation theory, non-degenerate case, first order and second perturbations with the example of an oscillator, degenerate cases, removal of degeneracy in second order, Zeeman effect without electron spin, first-order Stark effect in hydrogen, perturbed energy levels, correct eigen function, occurrence of permanent electric dipole moments.

REFERENCE BOOKS:

1. L.I. Schiff: quantum mechanics (McGraw-Hill).
2. S.Gasiorowicz, Quantum Physics (Wiley).
3. Landau and Lifshitz : Non-relativistic quantum mechanics.
4. B.Craseman and Z.D.Powell: quantum mechanics (Addison Wesley)
5. A.P. Messiah: Quantum Mechanics.

CO-PO&PSO Correlation

Course Name: Quantum Mechanics-I (MPH 1202)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	3	2	1	2	3	3	2	1	2	1
CO2:	2	1	1	1	2	2	1	1	1	1
CO3:	2	1	2	1	1	2	1	2	1	2
CO4:	3	2	1	2	3	3	2	1	2	1
CO5:	2	1	1	1	2	2	1	1	1	1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**II Sem**
Name of the Course:	**Computational Method and programming**	**Course Code:**	**MPH 1203**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

As the need to increase the understanding of real-world phenomena grows rapidly, computer-based simulations and modelling tools are increasingly being accepted as viable means to study such problems. In this course, students are introduced to some of the key computational techniques used in modelling and simulation of real-world phenomena. The course begins with coverage of fundamental concepts in computational methods including error analysis, matrices and linear systems, convergence, and stability. It proceeds to curve fitting, least squares, and iterative techniques for practical applications, including methods for solving ordinary differential equations and simple optimization problems. Employment of higher level programming based on C++ and visualization tools, such as MATLAB, reduces burdens on programming and introduces a powerful tool set commonly used by the industries and academia. A consistent theme throughout the course is the linkage between the techniques covered and their applications to real-world problems.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Get a wide knowledge of numerical methods in computational Physics that can be used to solve many problems which does not have an analytic solution.
CO2	Understand the Gauss Elimination, Gauss-Jordan Jacobi's and Gauss-Seidel method.
CO3	Learn Numerical Differentiation and Numerical Integration.
CO4	Find Numerical Solution of Ordinary Differential Equations.
CO5	Have a strong base in Basic Concepts of C++ Programming and Languages.

Syllabus:

Unit-I (Solution of algebraic and transcendental equations):

Roots of Algebraic and Transcendental Equations, Bisection, Regula- Falsi and Newton-Raphson Methods, System of linear algebraic equations, Consistency and Existence of Solutions, Direct Methods: Gauss Elimination and Gauss-Jordan Methods, Iterative Methods: Jacobi's, Gauss-Seidel method.

Unit-II (Interpolation and Curve fitting):

Finite Differences and Interpolation, Interpolation with equally and unequally spaced points, Newton's Interpolation Formulae based of finite differences, Newton divided differences, Lagrange's Interpolation formula, Hermite and spline interpolation formula. Curve Fitting, Method of Least Squares and group averages, fitting a Straight Line, Parabolic Curve, Fitting the Nonlinear Curves, Regression and Correlation analysis.

Unit-III (Numerical Differentiation and Integration):

Numerical Differentiation, Derivatives using Forward, Backward and Central Difference Formulae, Numerical Integration, Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's rules, Boole's rule, Weddle's rule.

Unit-IV (Numerical Solution of Ordinary Differential Equations) :

Numerical Solution of Ordinary Differential Equations, Picard's Method, Taylor's Series Method, Euler's Method, Euler's Modified Method, Runge-Kutta Methods, Predictor-corrector Methods, Milne's Method, Adams-Bashforth Method, Shooting method.

Unit-V (Computer Programming):

Basic Concepts of C++ Programming Language: Constants and variables, arithmetic operators, integer mode and real mode operations, arithmetic expressions, assignment statements, logical operations, input/output statements, loop statements, break and continue statements, go to statement, nesting of loops, Functions and Arrays: Functions: Necessity of functions, defining functions, calling functions, passing values between functions. Function Overloading with various data types, Array initialization, inputting and outputting arrays, passing arrays to functions. Programming of matrix operations, programming of matrix inversion.

REFERENCE BOOKS:

1. Advanced Engineering. Mathematics by Erwin Kreyszig (8th edition) – John Wiley & Sons.
2. Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers.
3. Numerical Methods in Engineering and Science by Dr. B.S. Grewal, Khanna Publishers.
4. Numerical Methods for Scientific and Engineering Computation by M .K. Jain, S. R. K. Iyengar& R. K. Jain, Wiley Eastern Limited
5. Higher Engineering Mathematics by B. V. Rammana-Tata Mc Graw Hill.
6.

OPJU
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CO-PO&PSO Correlation

Course Name: Computational Methods and Programming (MPH										
	Program Outcomes						PSOs			
Course Outcomes	1	2	3	4	5	6	1	2	3	4
CO1:	1	1	1	2	2	1	3	3	2	1
CO2:	1	2	1	1	2	1	2	2	1	1
CO3:	2	1	2	3	3	2	3	3	2	1
CO4:	1	1	1	2	2	1	2	2	1	1
CO5:	1	1	1	2	2	1	3	3	2	1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**II Sem**
Name of the Course:	**Electrodynamics & Plasma Physics**	**Course Code:**	**MPH 1204**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

In the beginning few years of the last century, it was realized that the well profound Maxwell's equations, vector and scalar potentials and the wave equation, Gauge transformations, Lorenz gauge, Coulomb gauge, Green function for the wave equation, four-vectors. The theory is essential to study a variety of modern physics, Debye shielding phenomenon and criteria for plasma, motion of charged particles in electromagnetic field.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain a clear understanding of Maxwell's equations and electromagnetic boundary conditions.
CO2	Extend their understanding of special theory of relativity and grasped knowledge about radiation emitted by a charge in arbitrary extremely relativistic motion.
CO3	Know the spectrum of synchrotron radiation, spectral index for power law electron distribution.

CO4	Understand motion of charged particles in electromagnetic field.
CO5	Understand the rather complex physical phenomena observed in plasma.

Syllabus:

Unit-I Maxwell's equations, vector and scalar potentials and the wave equation, Gauge transformations, Lorenz gauge, Coulomb gauge, Green function for the wave equation, four-vectors, mathematical properties of the space-time in special relativity, matrix representation of Lorentz transformation, covariance of electrodynamics, transformation of electromagnetic fields.

Unit-II Radiation by moving charges, Lienard-Wiechert potential and fields for a point charge, total power radiated by an accelerated charge- Larmor's formula and its relativistic generalization, angular distribution of radiation emitted by an accelerated charge, radiation emitted by a charge in arbitrary extremely relativistic motion, distribution in frequency and angle of energy radiated by accelerated charge.

Unit -IIIBremsstralung: emission from single-speed electrons, thermal Bremsstralung emission and absorption, Synchrotron radiation: spectrum of synchrotron radiation, spectral index for power law electron distribution, transition from Cyclotron to Synchrotron emission, Cherenkov radiation

Unit-IVPlasma: definition, Debye shielding phenomenon and criteria for plasma, motion of charged particles in electromagnetic field; Uniform E & B fields, Electric field drift, Non-uniform magnetostatic field, Gradient B drift, Parallel acceleration and magnetic mirror effect, Curvature drift, adiabatic invariants.

Unit-V Elementary concepts of plasma kinetic theory, the Boltzmann equation, the basic plasma phenomena, plasma oscillations. Fundamental equations of magnetohydrodynamics (MHD), Hydrodynamics Waves; Magneto sonic and Alfven waves, Magnetic viscosity and magnetic pressure, plasma confinement schemes.

REFERENCE BOOK:

1. Jackson, classical electrodynamics.

2 Rybicki&Lightman: Radiative Processess in Astrophysics 2 Panofsky and Phillips:

Classical electricity and magnetism.

3 Bittencourt, Plasma physics.

4 Chen: Plasma physics.

CO-PO&PSO Correlation

Course Name: Electrodynamics & Plasma Physics (MPH 1204)										
	Program Outcomes						PSOs			
Course Outcomes	1	2	3	4	5	6	1	2	3	4
CO1:	1	1	1	2	2	1	3	3	2	1
CO2:	1	2	1	1	2	1	2	2	1	1
CO3:	2	1	2	3	3	2	3	3	2	1
CO4:	1	1	1	2	2	1	2	2	1	1
CO5:	1	1	1	2	2	1	3	3	2	1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**IIISem**
Name of the Course:	**Quantum Mechanics-II**	**Course Code:**	**MPH 2101**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

In the beginning few years of the last century, it was realized that the well profound classical mechanics fails to explain many experimental outcomes. To overcome such limitations and difficulties, an alternative theory of what we call Quantum Mechanics was proposed. This theory is essential to study a variety of modern physics subjects such as atomic, molecular, nuclear, particle physics. It has broad and rich applicability in condensed matter physics and also in chemistry.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand Variational method, W.K.B. approximation.
CO2	Learn theory and applications of scattering, the Born approximation, optical theorem.
CO3	Gain the knowledge of Time-dependent perturbation theory and its applications.
CO4	Learn Relativistic quantum mechanics, Klein-Gordon equation, Dirac

	equation.
CO5	Gain knowledge of spin of the Dirac particle, negative energy states, spin–orbit energy.

Syllabus:

Unit-I Variational method, expectation value of energy, application to excited states, ground state of He-atom, Zero point energy of one dimensional harmonic oscillator, Vander-waals interaction, the W.K.B. approximation, approximate solutions, asymptotic nature of the solution, solution near turning point, connection formulae, energy levels of a potential well and quantization rule.

Unit -II Theory of scattering: differential and total scattering cross section, wave mechanical picture of scattering & the scattering amplitude, Green's functions and formal expression for scattering amplitude, The Born approximation and its validity, Partial wave analysis, asymptomatic behavior of partial waves and phase shifts, optical theorem, scattering by a square well potential, scattering by a hard sphere, scattering by a Coulomb potential.

Unit–III Time-dependent perturbation theory, first order perturbation, Harmonic perturbation, Fermi`s Golden rule, Ionization of a H-atom, absorption and induced emission, Selection rules. Identical particles, symmetric and anti symmetric wave functions

Unit–IV Relativistic quantum mechanics, formulation of relativistic quantum theory, the Klein-Gordon equation; plane wave solutions, charge and current densities, The Dirac equation for a free particle, matrices alpha and beta, Lorentz covariance of the Dirac equation, free particle solutions and the energy spectrum, charge and current densities.

Unit-V The spin of the Dirac particle, Dirac particle in electromagnetic fields and the significance of the negative energy state, Dirac equation for a central field : Spin angular momentum, approximate reduction, spin–orbit energy, separation of equation, the hydrogen atom, classification of energy levels and negative energy states.

REFERENCE BOOKS –

1. L.I. Schiff: Quantum Mechanics (McGraw-Hill).
2. S.Gasiorowicz: Quantum Physics (Wiley).
3. Landau and Lifshitz : Quantum Mechanics.
4. B.Craseman and Z.D.Powell : Quantum Mechanics (Addison Wesley)
5. A.P. Messiah: Quantum Mechanics.

CO-PO&PSO Correlation

Course Name: Quantum Mechanics-II (MPH 2101)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	2	1	1	1	2	2	1	2	1	1
CO2:	1	1	3	2	3	1	3	1	1	3
CO3:	1	3	1	2	2	1	1	1	3	1
CO4:	2	1	1	2	3	2	1	2	1	1
CO5:	3	1	1	1	2	2	1	3	1	1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**III Sem**
Name of the Course:	**Electronic & Photonic Devices**	**Course Code:**	**MPH 2102**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

This course has been designed keeping in mind the importance of ever increasing usage of electronic devices in our day-to-day life. The course will impart knowledge of the fundamental components and parts used in the electronic devices. This is an ability enhancement (AE) or skill development (SD) course to cater the need of skill India, a flagship program of the Government of India.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand special Bipolar devices:Thyristors-Diac&Triac, SCR, UJT.
CO2	Gain the knowledge of unipolar Devices : JFET, MESFET and MOSFET.
CO3	Understand microwave Devices: Tunnel diode, IMPATT diodes, Gunn diodes.
CO4	Understand the Photonic devices: solar cells, photodiodes, LEDs, and lasers.
CO5	Understand the Solar radiation and calculation of conversion efficiency

	of a solar cell.
CO6	Understand the electro-optic, Magneto-optic and Acoustic- optic effects, non-linear optics.
CO7	Display devices: photoluminescence, liquid crystal displays, numeric displays.

Syllabus:

Unit–I Special Bipolar devices: Thyristors- the four-layer diodes and their basic characteristics, Shockley diode, three terminal thyristor, Diac&Triac, SCR, UJT, Field controlled Thyristors.

Unit-II UnipotarDevices : JFET, MESFET and MOSFET, basic structure, working and device I-V characteristics, types of MOSFET.

Unit-III Special Microwave Devices: Tunnel diode and backward diode- basic device characteristics, IMPATT diodes and their static and dynamic characteristics, Gunn diodes.

Unit-IV Photonic Devices : LEDs, Visible and infrared SC lasers; Photo detectors; Photo conductor, & Photodiode, Solar cells, Solar radiation and ideal conversion efficiency, p-n junction solar cells.

Unit -V Optical Modulators and Display Devices :Modulation of light- Birefringence, Optical activity, Electro-optic, Magneto-optic and Acoustic- optic effects, Materials exhibiting these properties, Non-linear optics. Display devices: Luminescence, Photo-luminescence, Liquid crystal displays, Numeric displays.

REFERENCE BOOKS

1. Semiconductor Devices – Physics and Technology, by S M Sze ,Wiley (1985)
2. Introduction to semiconductor device, M.S. Tyasi, John Wiley and sons
3. Measurement, Instrumentation and experimental design in physics and engineering by
M.Sayer and A.Mansingh, Prentice Hall India 2000
4. Optical electronics by Ajay Ghatak and K.Thyagarajah, Cam.Univ. Press.
5. Opto electronics – An introduction: J.Wilson and JFB Hawkes (Eastern Economy Edition).

CO-PO&PSO Correlation

Course Name: Electronic & Photonic Devices (MPH 2102)										
	Program Outcomes						PSOs			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	1	1	2	2	1	1	1	2	2	1
CO2:	2	1	3	1	1	3	2	3	1	3
CO3:	2	1	2	1	3	1	2	2	1	1
CO4:	2	2	3	2	1	1	2	3	2	1
CO5:	1	2	2	3	1	1	1	2	2	1

Note: 1: Low 2.: Moderate 3: High

Programme: **M.Sc (Physics)**
Name of the Course: **Laboratory Practical Course-III**
Credits : **4**
Max Marks: **100**
Semester : **III Sem**
Course Code: **MPH 2103**
No of Hours :

Course Description:

Laboratory Practical Course-III involves practical knowledge of some importantelectronic devices, such asGunn diode, SCR, TRIAC, FET, MOSFET, solar panels, etc.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain practical knowledge to measure I-V characteristics of SCR.
CO2	Gain practical knowledge to measure I-V characteristics of TRIAC.
CO3	Practical study of characteristics of FET
CO4	Practical study of characteristics of MOSFET and Gunn diode.
CO5	Gain practical knowledge of solar panel.

Syllabus:

At least six experiments are to be performed by each student from the following list.

1- Draw and study of zener regulator.
2- To study and plot the FET. Characteristics.
3- To study and plot. MOSFET characteristics.
4- To study and plot the Characteristics of an SCR.
5- To study and plot. Characteristics of a TRIAC.
6- To study AM Modulator circuit.
7- To study. AM demodulator circuit.
8- To study digital time division multiplexing and demultiplexing.
9- To demonstrate. Hysteresis curve.
10- To study the frequency modulation.
11. To study. Frequency demodulation.
12-To study characteristics of gone diode.
13-To determine the frequency and wavelength of microwave. In a rectangular waveguide operated in TE mode.

CO-PO&PSO Correlation

Course Name: Laboratory Practical Course-III (MPH 2103)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO2:	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**1**	**2**
CO3:	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4:	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**1**
CO5:	**3**	**3**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**III Sem**
Name of the Course:	**Communication Electronics-I**	**Course Code:**	**MPH 2105**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

Electronics and communication systems deal with devices that use extremely small amounts of power such as micro-processors, fibre optics etc. The program provides students with the current, state-of-the-art electronics techniques used in all modern forms of electronic communications, including radio, television, telephones, cell phones, satellites, LAN systems, digital transmission, and microwave communications. The duration of the course is two years and it is very valuable and career orienting one nature.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn microwave devices: Klystron ,magnetron& traveling wave tubes.
CO2	Learn Microwave wave guides & components.
CO3	Learn Microwave cavites: rectangular, circular & semi–circular resonators, Q-factor.
CO4	Understand Microwave communications: System, advantages, and loss in free space.
CO5	Know the Transferred Electrons devices: principle of operation and modes of operations.
CO6	Understand Radar system: Radar block diagram & operation.
CO7	Aquire knowledge of satellite communication: Orbital and geostationary satellites.

Syllabus:

Unit I Microwave devices Klystron ,magnetron& traveling wave tubes ,velocity modulation ,basic principal of two cavity klystrons &relex klystrons ,principle of operation of magnetrons ,helix traveling wave tubes .

Unit II Microwave wave guides & components (Wave modes) rectangular wave guides: solution of wave equation in rectangular coordinates, TE modes in rectangular wave guides ,TM modes in rectangular wave guides ,excitations of modes in rectangular wave guides . Circular wave guides :solutions of wave equation in Cylindrical coordinates, TE modes in Circular wave guides ,TM modes in Circular wave guides , TEM modes in Circular wave guides, excitations of modes in Circular wave guides .

Unit-III Microwave cavites: rectangular cavity resonator, circular –cavity resonator &semi –circular –cavity resonators Q- factor of a cavity resonator. Transferred Electrons devices (TEDs) Gunn effect diodes, principle of operation, modes of operations, read diodes, IMPATT diodes, TRAPATT diodes. Microwave communications: advantages of microwave transmission, loss in free space, propagation of microwave, components of antennas used in MW communication system.

Unit-IV Radar system: Radar block diagram &operation ,radar frequencies ,pulse consideration, radar range equation ,derivation of radar range equation ,minimum detectable single receiver noise ,signal to noise ratio ,integration of radar pulses ,radar cross sections ,pulse reflections frequency ,antenna ,parameters ,systems losses & propagation losses ,radars transmitters receivers .

Unit V Satellite communication Orbital Satellite, geostationary satellite ,orbital patterns ,look angles ,orbital spacing , satellite system ,link modules

REFERENCE BOOKS:

1) "Microwaves" by K.L. Gupta Wiley Estern Ltd. Delhi.
2) Advanced Electronic communication system by Wayne Tomsi Physics education.
3) Principle of communication of system-by Toub& Schilling: 2nd ed. TMH 1994
4) Communication system: by SimanHaykin, 3rd ed. John wiley& sons inc.1994.
5) Microwave devices & circuits by : Samuel, Y. Liau.

CO-PO&PSO Correlation

Course Name: Communication Electronics-I (MPH 2105)										
	Program Outcomes						PSOs			
Course Outcomes	1	2	3	4	5	6	1	2	3	4
CO1:	2	1	1	1	2	2	1	1	2	2
CO2:	1	1	2	1	3	1	1	1	2	1
CO3:	2	1	2	1	2	1	3	2	2	1
CO4:	1	2	2	2	3	2	1	2	2	1
CO5:	2	1	1	2	2	3	1	2	1	1
CO6:	1	1	1	2	1	1	3	1	1	1
CO7:	1	3	2	2	1	1	1	1	3	2

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**IV Sem**
Name of the Course:	**Nuclear and Particle Physics**	**Course Code:**	**MPH 2201**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

The nuclear and particle physics course is the fundamental course of physics. In the quest of knowing about the fundamental building blocks of the matter, scientists have gone through a sequence from atoms to nuclei, from nuclei to hadrons and from hadrons to quarks. The course, designed here for the M.Sc. Physics students incorporate several properties of the nucleus and their detailed deliberations.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand basics of nuclear physics, nuclear force, properties of nuclear force.
CO2	Gain knowledge of nuclear reactions, Q-equation and threshold energies.
CO3	Understand Beta decay, Femi's theory of beta decay, Gamma decay, selection rules.
CO4	Understand liquid drop model, Bohr-Wheeler theory of fission, shell model.
CO5	Gain knowledge of fundamental interactions, elementary particles, quark model.

Syllabus:

Unit-INuclear Interactions :

Nucleon-nucleon interaction, Two-nucleon system, The ground state of the deuteron, Tensor forces, Nucleon-nucleon scattering at low energy, Scattering length, Effective range theory, Spin dependence of nuclear forces, Charge independence and charge symmetry of nuclear forces, Iso-spin formalism, Exchange forces, Meson theory of nuclear forces and the Yukawa interaction.

Unit-IINuclear Reactions :

Reaction energetics: Q-equation and threshold energies, Reactions cross sections, Resonance: Breit-Wigner single-level formula, Direct and compound nuclear reactions.

Unit-IIINuclear Decay :

Beta decay, Femi's theory of beta decay, Shape of the beta spectrum, Total decay rate, Angular momentum and parity selection rules, Comparative half-lives, Allowed and forbidden transitions, Selection rules, Parity violation, Two component theory of neutrino decay, Detection and properties of neutrino Gamma decay.

Unit –IVNuclear Models :

Liquid drop model, Bohr-Wheeler theory of fission, Shell Model, Experimental evidence for shell effects.

Unit –VElementary particle Physics:

The fundamental interactions, Classification of elementary particles, Leptons and Hadrons, Symmetries, groups and conservation laws, SU(2) and SU(3) multiplets and their properties, Quark model, Properties of Quarks, the standard model.

REFERENCE BOOKS:

1. A.Bohr and B.R.Mottelson, Nuclear structure, vol. 1 (1969) and vol.2, Benjamin, Reading,
A, 1975.

2. Kenneth S.Kiane, Introductory Nuclear Physics, Wiley, New York, 1988.

3. Ghoshal, Atomic and Nuclear Physics vol.2.

4. P.H.Perking, Introduction to high energy physics, Addison-Wesley, London, 1982.

5. ShriokovYudin, Nuclear Physics vol.1 & 2, Mir Publishers, Moscow, 1982.

6. R.R.Roy and B.P.Nigam, Nuclear Physics, Wiley-Easterm Ltd. 1983.

CO-PO&PSO Correlation

Course Name: Nuclear and Particle Physics (MPH 2201)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**

CO1:	**1**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**1**	**1**
CO2:	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**1**	**1**
CO3:	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**2**
CO4:	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**1**
CO5:	**1**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**2**

Note: 1: Low 2.: Moderate 3: High

Programme: **M.Sc (Physics)**
Semester : **III Sem**
Name of the Course: **Laboratory Practical Course-IV**
Course Code: **MPH 2202**
Credits : **3**
No of Hours :
Max Marks: **100**

Course Description:

This course comprises practical realization of microwave devices and systems. It involves the study the characteristics of the Reflex Klystron tube, calibrate phase shifter, energize a reflex oscillator and Gunn diode, characteristics and behavior of an Attenuator and a magic Tee, and measure of microwave frequency using frequency meter.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain knowledge of Reflex Klystron tube.
CO2	Calibrate phase shifter.
CO3	Understand characteristics and behavior of an Attenuator and a magic Tee.
CO4	Measure of microwave frequency using frequency meter.
CO5	Energize a reflex oscillator and Gunn diode.

Syllabus:

At least six experiments are to be performed by each student from the following list.

1. To study the characteristics of reflex klystron
2. To study frequency, guide wavelength & free space wavelength by using klystron microwave setup
3. To measure the SWR & reflex co-efficient by using klystron microwave setup
4. To measure impedance of load by using klystron microwave setup
5. To study the Gunn Oscillator
6. To study frequency, guide wavelength & free space wavelength by using the Gunn Oscillator
7. To measure the SWR & reflex co-efficient by using the Gunn Oscillator
8. To measure impedance of load by using the Gunn Oscillator

CO-PO&PSO Correlation

Course Name: Laboratory Practical Course-IV (MPH 2202)										
	Program Outcomes						**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**3**	**1**
CO2:	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**
CO3:	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CO4:	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**2**
CO5:	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**IVSem**
Name of the Course:	**Project / Dissertation / Thesis**	**Course Code:**	**MPH 2203**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

During the two years consisting of four semesters, the students are taught basic and advanced quantum mechanics, analog and digital electronics, classical mechanics, condensed matter physics, mathematical Physics, statistical mechanics, Nuclear Physics, Atomic and Molecular Physics etc. Besides, the students can opt for the elective courses in Materials Sciences, Fiber Optics and Lasers etc. They can also take elective courses form other departments as a part of choice based credit system. In the final semester, the students are required to do a major project in Physics which prepares them for higher studies.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain basic idea of research work.
CO2	Identify problems, skill of critical thinking and innovative ideas.
CO3	Familiarize with plagiarism.
CO4	Learn how to write dissertation/project report with references.
CO5	Prepare power point presentation.
CO6	Gain presentation skills of project/research work in English.
CO7	Familiarize with research paper and conference presentation.

CO-PO&PSO Correlation

Course Name: Project / Dissertation / Thesis (MPH 2203)

	Program Outcomes						PSOs			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	3	1	1	2	2	1	1	1	1	1
CO2:	1	1	1	1	2	1	2	2	2	1
CO3:	1	2	2	2	3	3	1	1	1	2
CO4:	3	1	1	1	2	2	3	1	1	2
CO5:	2	3	1	1	2	1	1	3	2	3
CO6:	1	1	3	2	2	1	1	1	1	1
CO7:	3	1	1	2	2	1	2	2	2	1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**III Sem**
Name of the Course:	**Communication Electronics-II**	**Course Code:**	**MPH 2204**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:
This course has been designed keeping in mind the importance of ever increasing usage of electronic devices in our day-to-day life. The course will impart knowledge of the fundamental components and parts used in the electronic devices. This is an ability enhancement (AE) or skill development (SD) course to cater the need of skill India, a flagship program of the Government of India.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand digital communications, pulse modulation systems, Quantization of signals
CO2	Learn different digital modulation techniques.
CO3	Learn Mathematical representation of noise, sources of noise, Noise bandwidth.
CO4	Understand data transmission, base band signal receiver, probability of error.
CO5	Gain knowledge of Noise in pulse code & delta modulation system, Calculation of quantization noise.

Syllabus:

Unit-I Digital communications Pulse modulation systems, Sampling Theorem, Low pass &Band pass signal, PAM- Channel BE for PAM signal, Natural Sampling, Plat-top sampling, Signal through holding, Quantization of signals, quantization error.

Unit-II Digital modulation techniques PCM, Differential PCM, Delta modulation, Adaptive, delta modulation (CVSD). BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK,MSK

Unit-III Mathematical representation of noise Sources of noise, Frequency domain representation of noise , Effect of filtering on the probability density of Gaussian noise, Spectral component of noise, Effect of a filter on the power spectral density of noise, Superposition of noise, Mixing involving noise, bilinear filtering, Noise bandwidth, Quadrature component of noise, Power spectral density of nc (t) ns (t) & their time derivatives.

Unit-IV Data Transmission I Base band signal receiver, Probability of error optimum filter, White noise: Matched filter & probability of error, Coherent reception correlation, PSK, FSK, Non-Coherence detection on FSK, Differential PSK, QASK, Calculation of error probability for BPSK,BSFK,QPSK.

Unit-V Data Transmission II Noise in pulse code & delta modulation system, PCM transmission, Calculation of quantization noise output signal power, Effect of thermal noise, output signal to noise ratio in PCM, DM, Quantization noise in DM, output signal power, DM output signal to quantization noise ratio, effect of thermal noise in delta modulation, output signal to noise ratio in DM

REFERENCE BOOKS:

1) "Microwaves" by K.L. Gupta Wiley Eastern Ltd. Delhi.
2) Advanced Electronic communication system by Wayne Tomsi Physics education.
3) Principle of communication of system-by Toub& Schilling: second edition TMH 1994 33
4) Communication system: by simanHaykin, third edition John wiley& sons inc.1994.
5) Microwave devices &ckts by: Samuel, Y. Liau.

CO-PO&PSO Correlation

Course Name: Communication Electronics-II (MPH 2204)

	Program Outcomes						PSOs			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	1	2	1	3	2	1	2	2	2	1
CO2:	1	2	3	1	1	2	1	1	1	2
CO3:	2	2	1	1	1	1	1	2	1	3
2CO4:	1	2	1	2	2	2	1	2	1	2
22CO5:	1	3	3	1	1	1	2	2	2	3
CO6:	1	2	2	3	1	1	2	1	2	2
CO7:	2	2	1	1	3	2	3	2	2	1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Sc (Physics)**	**Semester :**	**IVSem**
Name of the Course:	**Laser Physics and Applications**	**Course Code:**	**MPH 2205**
Credits :	**4**	**No of Hours :**	
Max Marks:	**100**		

Course Description:

This course is designed keeping in mind the important application of light in communication. It is believed that the course will infuse the basic knowledge of optical fiber and also develop the understanding of practical applications.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn basic principle of lasers, population inversion, laser pumping.
CO2	Understand two & three level laser systems, resonator.
CO3	Understand the ruby laser, semiconductor lasers, Gas laser, He-Ne laser.
CO4	Understand Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect.
CO5	Familiarize with various laser applications.

Syllabus:

Unit- ILaser Characteristics:

Spontaneous and stimulated emission, Einstein's quantum theory of radiation, theory of some optical processes, coherence and monochromacity, kinetics of optical absorption, line broadening mechanism, Basic principle of lasers, population inversion, laser pumping, two & three level laser systems, resonator.

Unit – IILaser Systems Solid state lasers:

The ruby laser, semiconductor lasers – features of semiconductor lasers, Gas laser - He-Ne laser.

Unit-III Advances in laser Physics Production of giant pulse -Q-switching, giant pulse dynamics, laser amplifiers, mode locking and pulling, Non-linear optics.

Unit – IVLaser spectroscopy :

Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect, Coherent anti-stokes Raman Scattering, Photo-acoustic Raman spectroscopy.

Unit – VLaser Applications:

Ether drift and absolute rotation of the Earth, isotope separation, plasma, thermonuclear fusion, laser applications in chemistry, biology, astronomy, engineering and medicine. Communication by lasers: ranging, fiber Optics Communication, Optical fiber, numerical aperture, propagation of light in a medium with variable index, pulse dispersion.

REFERENCE BOOKS:

1. Laud, B.B.: Lasers and nonlinear optics, (New Age Int.Pub.1996).

2. Thyagarajan, K and Ghatak, A.K.: Lasers theory and applications (Plenum press, 1981).

3. Ghatak, A.K.andThyagarajan, K : Optical electronics (Cambridge Univ. Press 1999).

4. Seigman, A.E.: Lasers (Oxford Univ. Press 1986)

CO-PO&PSO Correlation

Course Name: Laser Physics and Applications (MPH 2205)

	Program Outcomes						PSOs			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1:	1	1	1	2	1	1	1	2	3	1
CO2:	2	2	1	1	1	3	2	1	2	2
CO3:	1	2		1	2	1	1	1	2	3
CO4:	2	1	1	1	1	1	1	2	1	1
CO5:	1	2	1	1	2	2	1	1	1	3
CO6:	3	1	2	2	1	2		1	2	1
CO7:	1	2	2	1	2	1		1	1	1

Note: 1: Low 2.: Moderate 3: High