OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

Master of Science in Physics

School of Science

Session- 2018-20

Approved scheme of teaching, examination and syllabus for Master of Science in Physics by the members of Board of Studies

Applicable from session 2018

The scheme of teaching, examination and syllabus are hereby approved by the following members of Board of Studies

V.C. Nominee (External Expert):

Dr R. S. Kher

Professor –Physics & Principal

Govt. Science College Ratanpur, Bilaspur

Dr Anil K Panigrahi

Professor –Physics

K.G. Science College Raigarh

Internal Experts:

Dr G. C. Mishra
Professor-Physics

Dr K. N. Singh
Asstt. Prof. (Sr.)-Physics

Dr P. S. Bokare
Dean, SOE

SCHEME OF TEACHING AND EXAMINATION

Semester- I

SN	Subject Code	Name of Subject	Periods per week			Scheme of Examination and Marks				Credits: L+ (T+P) 2
						PRE		ESE	Total Marks	
			L	T	P	Mid Sem	TA			
1	MPH 1101	Mathematical Physics	3	1	0	30	20	50	100	4
2	MPH 1102	Classical Mechanics	3	1	0	30	20	50	100	4
3	MPH 1103	Statistical Mechanics	3	1	0	30	20	50	100	4
4	MPH 1104	Electronics	3	1	0	30	20	50	100	4
5	MPH 1105	Laboratory Practical Course-I	0	0	4	0	25	25	50	2
6	MPH 1106	Communication Skills and Personality Development	2	0	0	0	25	25	50	2
Total			**14**	**4**	**4**	**120**	**130**	**250**	**500**	**20**

Semester- II

SN	Subject Code	Name of Subject	Periods per week			Scheme of Examination and Marks				Credits: L+ (T+P) 2
						PRE		ESE	Total Marks	
			L	T	P	Mid Sem	TA			
1	MPH 1201	Solid State Physics	3	1	0	30	20	50	100	4
2	MPH 1202	Quantum Mechanics-I	3	1	0	30	20	50	100	4
3	MPH 1203	Computational Methods and Programming	3	1	0	30	20	50	100	4
4	MPH 1204	Electrodynamics & Plasma Physics	3	1	0	30	20	50	100	4
5	MPH 1205	Laboratory Practical Course-II	0	0	8	0	50	50	100	4
Total			**12**	**4**	**8**	**120**	**130**	**250**	**500**	**20**

Semester- III

SN	Subject Code	Name of Subject	Periods per week			Scheme of Examination and Marks				Credits: L+ (T+P)/2
			L	T	P	PRE Mid Sem	PRE TA	ESE	Total Marks	
1	MPH 2101	Quantum Mechanics-II	3	1	0	30	20	50	100	4
2	MPH 2102	Electronic & Photonic Devices	4	1	0	30	20	50	100	5
3	MPH 21XX	Elective-I	4	1	0	30	20	50	100	5
4	MPH 2103	Laboratory Practical Course-III	0	0	8	0	50	50	100	4
5	MPH 2104	Seminar	0	0	0	0	25	25	50	2
Total			**11**	**3**	**8**	**90**	**135**	**225**	**450**	**20**

Note: Before going to winter vacation each student will choose a project for fourth semester under a faculty of the department. At the end of fourth semester, the student will submit a thesis/report of the project and will make presentation in the department for the evaluation of grade.

Semester- IV

SN	Subject Code	Name of Subject	Periods per week			Scheme of Examination and Marks				Credits: L+ (T+P)/2
			L	T	P	PRE Mid Sem	PRE TA	ESE	Total Marks	
1	MPH 2201	Nuclear and Particle Physics	3	0	0	30	20	50	100	3
2	MPH 22XX	Elective-II	3	0	0	30	20	50	100	3
3	MPH 22XX	Elective-II	3	0	0	30	20	50	100	3
4	MPH 2202	Laboratory Practical Course-IV	0	0	6	0	25	25	50	3
5	MPH 2203	Project / Dissertation / Thesis	0	0	8	0	100	100	200	8
Total			**9**	**0**	**14**	**90**	**185**	**275**	**550**	**20**

Elective – I

SN	Subject Code	Name of Subject
1	MPH 2105	Communication Electronics-I
2	MPH 2106	Nanoscience and Nanotechnology-I
3	MPH 2107	X-Ray I
4	MPH 2108	Nuclear Physics

Elective – II

SN	Subject Code	Name of Subject
1	MPH 2204	Communication Electronics-II
2	MPH 2205	Laser Physics and Applications
3	MPH 2206	Nanoscience and Nanotechnology-II
4	MPH 2207	X-Ray II
5	MPH 2208	Advanced Nuclear Physics

LEGENDS

L : Lecture
T : Tutorial
P : Practical
C : Credit
PRE : Progress Review Examination
ESE : End Semester Examination

SEMESTER-I

Course Code	Course Title	L+T+P	Credits
MPH 1101	Mathematical Physics	**3+1+0**	**4**

Unit–I Linear 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.

Course Code	Course Title	L+T+P	Credits
MPH 1102	Classical Mechanics	**3+1+0**	**4**

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).

Course Code	Course Title	L+T+P	Credits
MPH 1103	Statistical Mechanics	**3+1+0**	**4**

Unit-I Foundation 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-II Elements of ensemble theory:

A system in microcanonical, 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-III Formulation 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-IV Ideal 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-V Statistical 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. Federick Reif, Fundamental of statistical and thermal physics (McGraw-Hill publishers).
4. Kerson Huang, Statistical Mechanics (Wiley Eastern).

Course Code	Course Title	L+T+P	Credits
MPH 1104	Electronics	**3+1+0**	**4**

Unit-I Operational 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-II Combinational 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 -III Sequential 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-IV Microprocessors:

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–V Instructions 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.Millman R.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).

Course Code	Course Title	L+T+P	Credits
MPH 1105	Laboratory Practical Course-I	**0+0+4**	**2**

At least ten experiments are to be performed by each student from Electronics course.

Course Code	Course Title	L+T+P	Credits
MPH 1106	Communication Skills and Personality Development	**2+0+0**	**2**

Unit-I COMMUNICATION AND INTERPERSONAL SKILLS:

Communication, the importance of open and clear communication and how to practice the same; Public speaking and communication gaps; Listening Skills, active listening skills and how to give and receive healthy feedback; Collaborative communication; Effect of body language, tone and words.

Unit-II INTRODUCTION TO PERSONALITY DEVELOPMENT:

The concept of personality - Dimensions of personality, The concept of success and failure: What is success? Hurdles in achieving success - Overcoming hurdles, Factors responsible for success – What is failure - Causes of failure, SWOT analysis.

Unit-III ATTITUDE & MOTIVATION ATTITUDE:

Concept, Significance and Factors affecting attitudes, Positive attitude – Advantages, Negative attitude- Disadvantages, Ways to develop positive attitude, and Differences between personalities having positive and negative attitude. Concept of motivation – Significance, Internal and external motives, Importance of self- motivation, Factors leading to de-motivation.

Unit-IV OTHER ASPECTS OF PERSONALITY DEVELOPMENT:

Body language, Goal Setting, Conflict and Stress Management, Decision-making skills, Leadership and qualities of a successful leader, Team-work, Time management, Good manners and etiquette.

Unit -V EMPLOYABILITY QUOTIENT RESUME BUILDING:

Resume Writing, the art of participating in Group Discussion, Facing the Personal Interview, Frequently Asked Questions.

REFERENCE BOOKS

1. Raman, Meenakhshi, and Prakash Singh, Business Communication. O U P, New Delhi, 2008.
2. Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
3. Stephen P. Robbins and Timothy A. Judge (2014), Organizational Behavior 16th Edition: Prentice Hall.
4. Communication in a Global Market Place.3rd ed. John Wiley India, New Delhi, 2007.
5. Guffey, Mary Ellen., Business Communication: Process and Product. 3rd ed. Thomson and South-western, 2004.

SEMESTER-II

Course Code	Course Title	L+T+P	Credits
MPH 1201	Solid State Physics	**3+1+0**	**4**

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-Wannier excitons, 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.

Course Code	Course Title	L+T+P	Credits
MPH 1202	Quantum Mechanics-I	**3+1+0**	**4**

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.

Course Code	Course Title	L+T+P	Credits
MPH 1203	Computational Methods and Programming	**3+1+0**	**4**

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.

Course Code	Course Title	L+T+P	Credits
MPH 1204	Electrodynamics & Plasma Physics	**3+1+0**	**4**

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 -III Bremsstralung: 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-IV Plasma: 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.

Course Code	Course Title	L+T+P	Credits
MPH 1205	Laboratory Practical Course-II	**0+0+8**	**4**

At least fifteen experiments are to be performed by each student from solid state physics and computation methods and programming course.

SEMESTER-III

Course Code	Course Title	L+T+P	Credits
MPH 2101	Quantum Mechanics-II	**3+1+0**	**4**

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.

Course Code	Course Title	L+T+P	Credits
MPH 2102	Electronic & Photonic Devices	**4+1+0**	**5**

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 Unipotar Devices : 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).

Elective-I

Course Code	Course Title	L+T+P	Credits
MPH 2105	Communication Electronics-I	**4+1+0**	**5**

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 Siman Haykin, 3rd ed. John wiley & sons inc.1994.
5) Microwave devices & circuits by : Samuel, Y. Liau.

Course Code	Course Title	L+T+P	Credits
MPH 2103	Laboratory Practical Course-III	**0+0+8**	**4**

At least fifteen experiments are to be performed by each student from Electronic & Photonic Devices and Communication Electronics-I course.

Course Code	Course Title	L+T+P	Credits
MPH 2104	Seminar	**0+0+0**	**2**

SEMESTER-IV

Course Code	Course Title	L+T+P	Credits
MPH 2201	Nuclear and Particle Physics	**3+0+0**	**3**

Unit-I Nuclear 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-II Nuclear Reactions :

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

Unit-III Nuclear 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 –IV Nuclear Models :

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

Unit –V Elementary 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. Shriokov Yudin, Nuclear Physics vol.1 & 2, Mir Publishers, Moscow, 1982.
6. R.R.Roy and B.P.Nigam, Nuclear Physics, Wiley-Easterm Ltd. 1983.

Elective – II

Course Code	Course Title	L+T+P	Credits
MPH 2204	Communication Electronics-II	**3+0+0**	**3**

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 siman Haykin, third edition John wiley & sons inc.1994.

5) Microwave devices & ckts by: Samuel, Y. Liau.

Course Code	Course Title	L+T+P	Credits
MPH 2205	Laser Physics and Applications	**3+0+0**	**3**

Unit- I Laser 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 – II Laser 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 – IV Laser spectroscopy :

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

Unit – V Laser 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.and Thyagarajan, K : Optical electronics (Cambridge Univ. Press 1999).

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

Course Code	Course Title	L+T+P	Credits
MPH 2202	Laboratory Practical Course-IV	**0+0+6**	**3**

At least ten experiments are to be performed by each student from Nuclear physics,Laser physics and Communication Electronics-II course.

Course Code	Course Title	L+T+P	Credits
MPH 2203	Project / Dissertation / Thesis	**0+0+8**	**8**

Project work will be primarily based on research oriented topics. On completion of the Project work, student will submit project report in the form of dissertation which will be examined by external/internal examiner. The examination of Project work shall consist of Presentation and comprehensive viva-voce.