DEPARTMENT OF PHYSICS

M.Sc. PHYSICS

Batch-(2024-26)

(Four Semesters /Full Time)

Curriculum Structure

TOTAL CREDITS: 96

Semester - I

S. No.	COURSE CODE	COURSE TITLE	No. of Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-111	Classical Mechanics	4	40	60	100
2.	MPH-112	Mathematical Physics	4	40	60	100
3.	MPH-113	Numerical Methods and Programming	4	40	60	100
4.	MPH-114	Electronics	4	40	60	100
5.	MPH-115	Quantum Mechanics-I	4	40	60	100
Practical						
1.	MPH-116	Physics Lab-I	4	60	40	100
		Total	24	260	340	600

SA: Sessional Assessment

UE: University Examination

Semester – II

S. No.	COURSE CODE	COURSE TITLE	Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-211	Electrodynamics	4	40	60	100
2.	MPH-212	Statistical Mechanics	4	40	60	100
3.	MPH-213	Atomic and Molecular Spectroscopy	4	40	60	100
4.	MPH-214	Quantum Mechanics-II	4	40	60	100
Choice based open elective course *Student are required to opt any one of the following courses (only few listed here)*						
1.	IT. 202	Soft skills in Information Technology	04	40	60	100
2.	Comp. 203	Computer Applications and Operations	04	40	60	100
3.	Bio. 204	Fundamentals of Biotechnology	04	40	60	100
4.	Bot. 205	Mysteries of Green Plants	04	40	60	100
5.	Bot. 206	Botany in Rural Development	04	40	60	100
6.	Zol. 207	Nutrition, Health and Hygiene	04	40	60	100
7.	Arab. 208	Fundamentals of Arabic Language	04	40	60	100
8.	Eng. 209	Applied English	04	40	60	100
9.	Edu. 210	Higher Education	04	40	60	100
10.	Eco. 211	Principles of Banking	04	40	60	100
11.	HT. 212	Basics of Tourism and Travel Agencies	04	40	60	100
12.	HT. 213	Tourism Resources of J and K	04	40	60	100
13.	Mgt. 214	Business communication and soft skills	04	40	60	100
14.	Edu. 215	Instructional Technology	04	40	60	100
		Practical				
1.	MPH-215	Physics Lab-II	04	60	40	100
		Total	24	260	340	600

Semester - III

S.No.	COURSE CODE	COURSE TITLE	Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-311	Condensed Matter Physics-I	4	40	60	100
2.	MPH-312	Nuclear Physics-I	4	40	60	100
	MPH-313	Advanced Electronics & Applications-I	4	40	60	100
3.	MPH-314	Condensed Matter Physics -I (Special)	4	40	60	100
4.	MPH-315	Nuclear Physics-I (Special)	4	40	60	100
5.	MPH-316	Advanced Electronics & Applications - I(Special)	4	40	60	100
Choice based Complementary Electives *(Students are required to choose any one of the following courses)*						
1.	MPH-331	Materials Science and Characterization	4	40	60	100
2.	MPH-332	Digital Signal Processing	4	40	60	100
3.	MPH-333	Radiation Physics	4	40	60	100
4.	MPH-334	Nanoscience and Technology	4	40	60	100
PRACTICAL						
1.	MPH- 316	Physics Lab-III	4	60	40	100
		Total	24	260	340	600

Note: ***The students are required to choose one special paper for specialization either in Nuclear or condensed Matter Physics or Advanced Electronics & Applications***

Semester - IV

S. No	COURSE CODE	COURSE TITLE	Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-411	Condensed Matter Physics-II	4	40	60	100
2.	MPH-412	Nuclear Physics-II	4	40	60	100
	MPH-413	Advanced Electronics & Applications-II	4	40	60	100
3.	MPH-414	Condensed Matter Physics-II(Special)	4	40	60	100
4.	MPH-415	Nuclear Physics-II (Special)	4	40	60	100
5.	MPH-416	Advanced Electronics & Applications-II (Special)	4	40	60	100
Choice based Complementary Electives *(The students are required to choose any one of the following courses)*						
1.	MPH-441	Atmospheric Physics	4	40	60	100
2.	MPH-442	Satellite Comm. and Remote sensing	4	40	60	100
6.	MPH-443	Astrophysics	4	40	60	100
Practical						
1	MPH-417	Project work	4	--	100	100
		Total	24	260	340	600

The students are required to choose one special paper for specialization either in Nuclear Physics-II or condensed Matter Physics-II or Advanced Electronics & Applications-II

Semester I

Course Title: CLASSICAL MECHANICS
Course Code: MPH-111
Credits: 4

Maximum Marks: 100
University Examination: 60
Internal Assessments: 40

OBJECTIVE

- To understand the basic concepts in Classical Mechanics.
- To have a comprehensive idea on the Hamiltonian & Langrangian formulation.

UNIT – I: Fundamental Principles and Lagrangian Formulations: Constraints – Generalised coordinates- Principle of Virtual work- D'Alembert's Principle -Lagrange's equations of motion – conservative and Non-conservative forces-Applications : L-C circuit – one dimensional harmonic oscillator. Central force and motion in a plane – Equation of motion under central force and first integrals-Differential equation for an orbit – Inverse square law of force- Kepler's laws of planetary motion and their deduction-Virial theorem.

12

UNIT-II: Hamiltonian Formulations: Hamiltonian function H-Physical significance-Hamilton's canonical equations of motion -Applications :simple pendulum – Motion of a particle in a central force field- charged particle in an electromagnetic field- Hamilton's Variational principle- proof-Derivation of Lagrange's equations-Principle of Least Action –its deduction, phase space and Liouville's Theorem. Hamilton's principle, Lagrange's equation from Hamilton's principle, Nielson form of Lagrange's equation

12

UNIT-III: Point Transformation and Generating Function

Canonical Transformations, Generating function, Poisson's and Lagrange's brackets, properties, relation between them, Exact differential method, The Hamilton – Jacobi equation, Kepler's problem -solution by Hamilton – Jacobi method, Action and angle variables, transition to quantum world.

12

UNIT-IV: Rigid Body Dynamics and Small Oscillations: Independent coordinates- Euler's angles – Components of Angular velocity in terms of Euler's angles –Angular momentum of a rigid body – Moments and products of inertia- Euler's equations of motion for a rigid body. Theory of small oscillations-frequencies of free vibration and normal coordinates-two coupled harmonic oscillators-vibrations of a linear triatomic molecule.

12

UNIT-V: Relativistics Mechanics : Relativistic energy – Mass- energy relation – Force in relativistic mechanics – The Lagrangian and Hamiltonian of a particle in relativistic mechanics, Minkowski space and Lorentz transformations, Differential form of the Lorentz transformation – Four vectors – position, momentum and acceleration four vector.

12

Note for Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Text Books

1. H. Goldstein, C. Poole and J. Safko, Classical Mechanics, 3nd edition, Addison & Wesley (2000).
2. W. Greiner, Classical Mechanics, Springer-Verlag (2003).
3. W. Greiner, Classical Mechanics – Point particles and Relativity, Springer (1989).

References

1. Goldstein. H, Classical Mechanics, Third edition, Narosa Publishing Home, New Delhi, 2002.
2. Upadhyaya. J. C., Classical Mechanics, Himalaya Publishing House, 2010.

3. Marion and Thorntron, Classical Dynamics of Particles and Systems, Fifth Edition, Holt Rinehart & Winston, 2012.
4. Panat P.V., Classical Mechanics, Narosa Publishing Home, New Delhi, 2008.
5. Rana. N.C and Joag P. S., Classical Mechanics,Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2004.

Outcome

- The basic concepts on Classical Mechanics.
- The need for introducing the **lagrangine mechanics**
- The theorems relating to the nonlinear bodies.
- The various aspects of dynamics and oscillations of bodies.
- Relativity and four vectors

Semester I

Course Title: MATHEMATICAL PHYSICS
Course Code: MPH-112
60
Credits: 4

Maximum Marks: 100
University Examination:

Sessional Assessment: 40

OBJECTIVE

- To understand the basic concepts in Mathematical Physics.
- To have an overall idea about the use of mathematical methods in physics.

UNIT-I: Matrices and Tensors: Matrices: types of matrices, determinant, trace of matrix, eigenvalues and eigenvectors, rank of a matrix, diagonalization of matrices, Tensors, Coordinate transformation, rank, Covariant and contravariant tensors, algebra of tensors, Levi-Civita symbol, Kronecker and alternative Tensor, Christoffel symbol, fundamental, mixed and associate tensors, symmetric and antisymmetric tensors.

12

Unit-II: First and Second Order Linear Differential Equations and Special Functions: Linear differential equations of second order, Legendre, Bessel, Hermite and Laguerre differential equations, series solutions, generating functions, Delta function, Legendre function recurrence relations orthogonal properties, associated Laguerre functions, associated Legendre functions.

12

Unit-III: Complex Variables: Complex numbers and functions, cartesian, polar forms, analytic functions, Cauchy-Riemann equations, conjugate functions, Cauchy's integral theorem, integral formula, Taylor and Laurent expansions, poles and singularities, residues, Cauchy's residue theorem and its applications for evaluation of integrals, residue integration.

12

Unit-IV: Fourier and Laplace Transforms: Fourier series and their applications, Taylor series, Laurent Expansion, Calculus of Residues and evaluation of Integral, Gamma and beta functions, Fourier transform and their properties, Laplace transform and properties, Green's function, one dimensional problem, general properties.

12

Unit-V: Group Theory: Definition of group, subgroup, cyclic group, isomorphism and homomorphism, representation theory of finite groups, reducible and irreducible representations, symmetry, orthogonality theorem, characters of representations, axial rotation groups- SO(2) and SO(3), special unitary group SU(1), SU(2).

12

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Text Books

1. G. B. Arfken and H.J. Weber, Mathematical Methods for Physicists, 5th edition, Academic Press (2001).

2. E. Kreyszig, Advanced Engineering Mathematics, 8 th edition, John Wiley & Sons Inc. (1999).

3. Mathematical Methods in the Physical Sciences, 3rd edition, Mary L. Boas, WileyIndia (2011).

4. Introduction of Mathematical Physics Charlie Harper (Prentice Hall of India.

References

1. Chattopadhyay. P.K, Mathematical Physics, 3rd Edition, New Academic Science, 2014.
2. Arfken. G and Weber.H. J Mathematical Methods for Physicists, 4th ed. Physicists Prism Books, Bangalore, 1995.
3. Joshi. A. W, Matrices and Tensors in Physics, 3rd edition, Wiley Eastern Ltd., New Delhi, 1995.
4. Gupta. B. D., Mathematical Physics, 4th edition, Vikas Publishing House Pvt Limited, 2007.

Outcome

- The basic concepts on Mathematical Sciences.
- Idea of complex variable and Cauchy formulla
- Fourier series and their applications to electronics signals
- Applications of group theory in physics .
- Types of groups and their association.

Course Title: NUMERICAL METHODS AND PROGRAMMING
Course Code: MPH-113
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the basic Numerical methods and programming.
- To have an idea to apply numerical methods into research areas.

UNIT-I: Errors and Measurements: Errors and their computations - General formula for errors - Errors of observation and measurement -Round of errors and Computer Arithmetic - Empirical formula - Graphical method - method of averages - Least square fitting - curve fitting - parabola, exponential. **12**

UNIT-II: Numerical Solution of Algebraic and Transcendental Equations: The iteration method - the bisection method - the method of false position - Newton - Raphson method. Simultaneous linear algebraic equations: Direct methods - Gauss elimination method - Gauss - Jordan method - Iterative method - Jacobi's method - Gauss Seidel iterative method. **12**

UNIT-III: Interpolation: Finite differences, finite difference operators - Interpolation - Gregory - Newton forward interpolation of Newton's formula - Backward differences - Newton's Backward interpolation formula - central differences - Gauss's forward and backward formula - Stirling's formula - Divided differences - Newton's divided difference formula - Lagrange's interpolation formula.

12

UNIT-IV: Numerical Differentiation and Integration: Introduction - Numerical differentiation - Errors in numerical differentiation - The cubic spline method - Maximum and Minimum values of a tabulated function - Numerical integration - Trapezoidal rule - simpson's rules, Talylor's series method, Euler. method and Runge-Kutta method.

12

UNIT-V: Basic Programming: Introduction to Python language and programming.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Textbooks

1. Samuel D. Conte and Carl de Boor, Elementary Numerical Analysis, 3rd edition, Tata McGraw-Hill (2010).
2. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International (1993).
3. Srimantha Pal, Numerical Methods, Oxford University Press (2009).

References

1. Sastry, S.S., Introduction of Numerical Analysis, Fifth Edition, Prentice Hall of India, New Delhi, 2012.
2. Gerald C.F., Wheatley P.O., Applied Numerical Analysis, Seventh Edition, Addison Wesley, Singapore, 2003.
3. Kandasamy, P., Thilakavthy, K and Gunavathy K., Numerical Methods, S.Chand and Co., New Delhi, 2006.
4. Grewal B.S., Grewal J.S., Numerical Methods in Engineering and Science, Khanna Publishers, New Delhi, 1999.
5. Balagurusamy, E, Programming in Ansi C, 4th Edition, Tata McGraw Hill, 2008.

Outcome

- The basic concepts of numerical methods and programming
- Errors and their computations.
- Interpolation Newton method of interpolation
- C programming-program Control
- standard input & output-structures

Course Title: ELECTRONICS
Course Code: MPH-114
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the fundamentals of working of semiconductor diodes
- To know the operations of special devices

UNIT-I: SEMICONDUCTOR DIODES: continuity equation - Application of the continuity equation for an abrupt PN junction under forward and reverse bias - Varactor Zener diode - Schottky diode - Tunnel diode - Gunn diode - Optoelectronic diodes - LASER diode, LED and photo diode

12

UNIT-II: SPECIAL SEMICONDUCTOR DEVICES: JFET- Structure and working - I -V Characteristics under different conditions - biasing circuits - CS amplifier design - ac analysis - MOSFET: Depletion and Enhancement type MOSFFT - UJT characteristics - relaxation oscillator - SCR characteristics .

12

UNIT-III: OPERATIONAL AMPLIFIER : Operational amplifier characteristics - inverting and non-inverting amplifier - instrumentation amplifier - voltage follower -integrating and differential circuits -log & antilog amplifiers - opamp as comparator - Voltage to current and current to voltage conversions-active filters:lowpass, high pass, band pass & band rejection filters-Solving simultaneous and differential equations

12

UNIT - IV: OP-AMP APPLICATIONS (OSCILLATORS & CONVERTORS): Wien Bridge, phase shift oscillators and twin-T oscillators - triangular, saw-tooth and square wave generators-Schmitt's trigger - sample and hold circuits - Voltage control oscillator - phase locked loops. Basic D to A conversion: weighted resistor DAC - Binary R-2R ladder DAC - Basic A to D conversion: counter type ADC - successive approximation converter - dual slope ADC

12

UNIT -V : IC FABRICATION AND IC TIMER: Basic monolithic ICs - fabrication of Ics (deposition, Photolithography, etching and doping), monolithic resistors, diodes, transistors, inductors and capacitors - circuit layout - contacts and inter connections - charge coupled device - applications of CCDs.555 timer.

12

Note for Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Text Books

1. J. Milman and C.C. Halkias, Electronic Devices and Circuits, McGraw-Hill (1981).
2. Albert Malvino, David J Bates, Electronics Principles, Tata McGraw-Hill (2007).
3. R.J. Higgins, Electronics with Digital and Analogue Integrated Circuits, Prentice Hall (1983).

References

1. Floyd L, Electronic Devices, Pearson Education, 8th edition, New York, 2009.
2. Milman.J and Halkias.C.C, Integrated Electronics, McGraw Hill, 1972
3. Roy Choudhary. D, Linear Integrated Circuits, 3rd edition, New Academic Science Ltd, 2010.
4. Mottershead, A., Electronic Devices and Circuits - An Introduction, Prentice Hall of India, 2003.

Outcome

- Fundamentals of working of semiconductor and special devices
- Practical application of diodes and their characteristics .
- Applications of electronic devices.
- IC chip and working
- applications of CCDs.555 time

Course Title: QUANTUM MECHANICS-I
Course Code: MPH-115
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To study the basic concepts of quantum mechanics.
- To understand the different equations & principles used in quantum mechanics.

UNIT-I: Basics of Quantum Mechanics; Brief discussion about failure of classical mechanics, wave packets (one and three dimensional), Motion of wave Packet (phase velocity and group velocity), wave packet in momentum space, uncertainty relations. wave function, physical Interpretation of wave function. Schrodinger time independent and dependent equations . probability current density, equation of continuity, Ehrenfest's theorem.

12

UNIT-II: Formulism; Operators, definition and properties, eigen value and eigen equation Linear operators, Hermitian operators, properties of hermition operator , Representation of operators as matrices, Unitary transformation and its significance. Parity operators, probability, varience ,standard deviation Orthogonality, normalization, expectation values of Eigen functions (problems related with these properties), Symmetric and anti-symmetric wavefunction, stationary States.

12

UNIT-III: Application of Schrodinger equation: solutions to a one and three dimensional box, linear harmonic oscillator, square well potential, spherically symmetric potential, **Schrodinger equation** in spherical polar coordinate, hydrogen atom: energy eigen values and complete wave function (Ψ_{100}).

12

UNIT-IV: Equation Of Motion And Angular Momentum: Bra and Ket notations, matrix representation of wave function and operators Schrödinger & Heisenberg picture of motion, Raising and lowering operator, Angular momentum operators, commutation relation of angular momentum operator with r & p, operators for orbital angular momentum L in spherical polar coordinates.

12

Unit -V: Advanced operations of Angular Momentum: Matrix representation commutation relation of J_2, J_z J_+, J_-, J_x, J_y for $J = 1/2$, 1. Clebsch Gordon Coefficients, Calculation of C.G. coefficients when (1) $J_1 = 1/2$, $J_2 = 1/2$, (2) $J_1 = 1/2$, $J_2 = 1$. Pauli;s spin matrices and their properties. Eigen values and Eigen functions of S^2 and S_z.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will

be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Text Books

1. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill (1976).
2. J.L. Powell and B. Crasemann, Quantum Mechanics, Narosa Publishing House (1993).
3. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley (1999).
4. Quantum Mechanics, Aruldhas, Prentice Hall of India (2006).
5. Introduction to quantum mechanics , David J Grifth

References

1. Mathews P.M. and Venkatesan K., A Textbook of Quantum Mechanics, Tata McGraw Hill, 1977.
2. Schiff I. Leonard, Quantum mechanics, Third Edition, McGraw-Hill Book Company, 1968.
3. Merzbacker E., Quantum Mechanics, Wiley Publishers , 4th Edition, 1991.
4. Satya Prakash, Quantum Mechanics, Sultan Chand Publishers, New Delhi, 2004.
5. John L. Powell and Bernd Crasemann, Quantum Mechanics, Narosa Publishing House, 1988.

Outcome

- Basics of quantum mechanics.
- Transition from classical mechanic to quantum mechanics .
- Various physics concepts in the light of quantum mechanics.
- commutation relations of angular momentum.
    - Pauli;s spin matrices and their properties

Semester I

Course Title: PHYSICS LAB-I
Course Code: MPH-116
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

List Of Experiments

1. Determination of IV characteristics of different diodes.
2. Determination of input/out characteristics of NPN/PNP Transistors (different modes).
3. Determination of input/out characteristics of JFET/MOSFET.
4. Basic power electronics.
5. Design of Voltage series and shunt feedback amplifier and determination of Frequency response, Input and output impedance.
6. Design of current series and shunt feedback amplifier and determination of Frequency response, Input and output impedance.
7. Design of Hartley and Colpitts Oscillator.
8. Design of Class C single tuned amplifier.
9. Design of Schmitt trigger.
10. Digital to Analog converter using op amp.
11. Active 2^{nd} order Butterworth low pass, high pass and band pass filter.
12. PLL Characteristics and measurement of capture and locking range.
13. Instrumentation amplifier and measurement of CMRR

Note: **Experiments will be performed as per the availability of source in Department/University. Viva of experiments will be based on seminars.**

Semester - II

S. No.	COURSE CODE	COURSE TITLE	Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-211	Electrodynamics	4	40	60	100
2.	MPH-212	Statistical Mechanics	4	40	60	100
3.	MPH-213	Atomic and Molecular Spectroscopy	4	40	60	100
4.	MPH-214	Quantum Mechanics-II	4	40	60	100
Choice based open elective course *Student are required to opt any one of the following courses (only few listed here)*						
1.	IT. 202	Soft skills in Information Technology	04	40	60	100
2.	Comp. 203	Computer Applications and Operations	04	40	60	100
3.	Bio. 204	Fundamentals of Biotechnology	04	40	60	100
4.	Bot. 205	Mysteries of Green Plants	04	40	60	100
5.	Bot. 206	Botany in Rural Development	04	40	60	100
6.	Zol. 207	Nutrition, Health and Hygiene	04	40	60	100
7.	Arab. 208	Fundamentals of Arabic Language	04	40	60	100
8.	Eng. 209	Applied English	04	40	60	100
9.	Edu. 210	Higher Education	04	40	60	100
10.	Eco. 211	Principles of Banking	04	40	60	100
11.	HT. 212	Basics of Tourism and Travel Agencies	04	40	60	100
12.	HT. 213	Tourism Resources of J and K	04	40	60	100
13.	Mgt. 214	Business communication and soft skills	04	40	60	100
14.	Edu. 215	Instructional Technology	04	40	60	100
		Practical				
1.	MPH-215	Physics Lab-II	04	60	40	100
		Total	24	260	340	600

SA: Sessional Assessment
UE: University Examination

Semester II

Course Title: ELECTRODYNAMICS
Course Code: MPH-211
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the concepts electromagnetic potentials.
- To have an idea on the relativistic nature of electrodynamics.

Unit-I : Electromagnetic Theory: Physical representation of gradient, divergence and curl, gauss divergence theorem, stokes theorem, Dirac-Delta function, Helmholtz Theorem. Physical significance of Maxwell's equations and Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law.

12

Unit-II: Review of Electrodynamics: Review of four vectors and Lorentz transformation in four dimensional space, electromagnetic field tensor in four dimensions and Maxwell's equation, dual field tensor, wave equation for vector and scalar potentials.

12

Unit-III: Retarded potentials :Retarded potential and Lienard-Wiechert potential, electric and magnetic fields due to a uniformly moving charge and an accelerated charge, Linear and circular acceleration and angular distribution of power radiated Bremssahlung, synchrotron radiation and Cerenkov radiation, reaction force of radiation

12

Unit-IV: Motion of charged particles: Motion of charged particles in electromagnetic field: Uniform E and B fields, non- uniform magnetic fields, diffusion across magnetic field, time varying E and B fields, adiabatic invariants: first, second and third adiabatic invariants.

12

Unit-V: Plasma and Wave propagation: Plasma, Debye shielding, plasma parameters, magnetoplasma, plasma confinement, hydro dynamical description of plasma, fundamental equations, hydromagnetic waves, magnetosonic and Alfven waves. Electromagnetic wave phenomena in magnetoplasma: Polarization, phase velocity, group velocity, cutoffs, resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Textbooks

1. Ulaby, Fawwaz. T, *Fundamentals of Applied Electromagnetics* (5th ed.). Pearson Education, (2007).
2. Schwartz, Melvin, Principles of Electrodynamics. Dover, (1987).

References

1. Satya Prakash, Electromagnetic theory and Electrodynamics, Kedar Nath and co., Meerut, 1994.
2. David J.Griffith, Introduction to Electrodynamics, 4th Edition, Prentice-Hall of India, New Delhi, 2012.

3. Capri A.Z. and Panat P.V., Introduction to Electrodynamics, Narosa Publishing House, 2010.
4. Jackson J.D., Classical Electrodynamics, 3rd Edition John Wiley, 1998.
5. Gupta Kumar Singh, Eectrodynamics, Pragati Prakashan, Meerat, 2006.
6. Bittencourt: Plasma Physics
7. Chen: Plasma Physics

Outcome

At the end of the course, the students will be able to understand

- Electrostatics and its applications.
- Magnetostatic and application to varies field
- Maxwells equations and tensors form
- RelativisticsElectrodynamics and four vectors
- Knowledge about Plasma Dynamics

Semester II

Course Title: Statistical Mechanics
Course Code: MPH-212
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the concepts of thermodynamics
- To know the fundamentals of statistical physics

Unit-I: Review of Thermodynamics: Energy and first law of thermodynamics–entropy and second law of thermodynamics - Nernst heat theorem and third law of thermodynamics - consequences of Nernst heat theorem - heat capacity and specific heat - Maxwell's thermodynamic relations and potentials - Gibb's - Helmholtz relations- thermodynamic equilibria. **12**

Unit-II: Statistical Basis of Thermodynamics: Statistical basis, probability, principle of equal a priori probability, the macroscopic and the microscopic states, thermodynamic probability, phase space, trajectories and density of states, Liouville's theorem, statistical ensembles and types, the principle of maximum entropy, contact between statistical mechanics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox, equipartition theorem. **12**

Unit-III: Canonical and Grand-Canonical Ensembles: Classical canonical ensemble, concept of partition function- their properties- ideal monatomic gas- calculation of thermodynamic quantities, energy fluctuations, simple application- harmonic oscillator, characteristics of crystalline solids, Ising model, the grand canonical ensemble, particle number fluctuation, entropy in grand canonical ensemble, thermodynamic potentials.

12

Unit-IV: Quantum Statistics of Ideal Gases: Postulates of quantum statistical mechanics, density matrix, statistics of ensembles, statistics of indistinguishable particles, Maxwell-Boltzmann, Fermi-Dirac and Bose Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation, Lambda Transition.

12

Unit-V: Phase Transitions: General remarks on phase transitions- First and Second order - non ideal gas, 1D and 2D Ising Model, Heisenberg Hamiltonian, calculation of partition function for low densities, equation of state and Virial coefficients, derivation of Vander Wall's equation , spin - spin interaction, one dimensional model, Landau theory of phase transitions, brief idea of phase transitions in stars

12

Note For Paper Setter

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Textbooks:

1. M.W. Zeemansky and R.H. Dittman, Heat and Thermodynamics, 8th edition, Mc-Graw Hill (2011).
2. K. Haung, Statistical Mechanics, 2nd edition, Wiley India (2010).
3. F.W. Sears and G.L. Salinger, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, 3rd edition, Narosa Publishing House (1998).

References

1. Frederick Reif, Fundamentals of statistical and thermal physics, McGraw-Hill, 2008.
2. Agarwal B.K. and Eisner M, Statistical Mechanics, 2nd Edition, New Age International, New Delhi, 1998.
3. Sears F.W and Salinger G.L, Thermodynamics, kinetic theory and statistical thermodynamics, Narosa publishing House, 1998.
4. Huang. K, Statistical Mechanics, Wiley Eastern Ltd., 2nd Edition, New Delhi, 1987.
5. Bhattacharjee J.K, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi, 1996.

Outcome

- Fundamentals of thermodynamic systems.
- Various statistical laws governing the particles.
- Concept of partition function and its application.
- Quantum statistics and phase transition.
- Weiss molecular field approximation.

Semester II

Course Title: ATOMIC AND MOLECULAR SPECTROSCOPY
Course Code: MPH-213
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To have a knowledge on the applications of Spectroscopy
- To understand spectroscopy on the basis of quantum mechanics

UNIT-I **Atomic and molecular structure:** Spin–orbit interaction, Correction of Energy Terms. Alkali atoms - Doublet separation– intensities , Complex atoms , Vector Atomic Model, Coupling schemes , energy levels , Selection rules and intensities in dipole transition, Paschen –Back effect, Heitler - London theory , atomic and molecular hybrid orbitals.

12

UNIT-II **Raman spectroscopy:** Semi classical treatment of emission and absorption of radiation – emission and absorption coefficients – spontaneous and induced emission of radiation – polarisability – Rayleigh scattering – Raman effect – basic principles of Raman Scattering – vibrational and rotational Raman spectra – Experimental techniques of Raman Spectroscopy – molecular structure studies .

12

UNIT III **Infrared and microwave spectroscopy :**Characteristic features of pure rotation – vibration – rotation vibration – of a diatomic molecule (harmonic and as anharmonic oscillator) – theory – evaluation of molecular constants – IR spectra of polyatomic molecules – experimental techniques of IR – Dipole moment studies – molecular structure determination.

12

UNIT IV **NMR and ESR spectroscopy:** NMR spectroscopy Basic principles- classical and quantum mechanical techniques - Bloch equations- spin- spin and spin- lattice relaxation times- experimental technique, ESR spectroscopy- basic principles- ESR spectrometer (simple experimental set up for ESR), Nuclear interaction and hyperfine structure- Relaxation effects- 'g' factor, biological applications, Mossbauer spectroscopy: principle experimental arrangement, chemical shift, quadrupole splitting, applications

12

UNIT -V **X-ray spectroscopy:** Production of X-rays, reflection and refraction of X-rays, Continuous X-ray spectrum, Characteristic emission spectrum, Characteristic absorption spectrum, Comparison of Optical and X-ray spectra, Molseley's law and its applications, monochromatization of X-rays, explanation of emission and absorption spectra, fine structure of X-ray levels, the fluorescence yield and Auger effect, detection and determination of relative intensity of X-rays.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Text Books

1. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill, New York (2004).

2. G. Aruldhas, Molecular Structure and Spectroscopy, Prientice Hall of India, NewDelhi (2002).

References

1. Sune Svanberg, Atomic and Molecular spectroscopy, 3rd Edition, Springer Publishers, 2012
2. Jain V. K., Introduction to Atomic And Molecular Spectroscopy, Alpha Science Intl Publishers, 2007.
3. Colin N. Banwell and Elaine M. McCash, Fundamentals of Molecular spectroscopy, McGraw-Hill College, 1994.
4. Jeanne L. McHale , Molecular spectroscopy, Prentice Hall, 1994.

Outcome

- Basic ideas about the concepts of spectroscopy
- Comparisons between different spectroscopic studies.
- Raman Spectroscopy .
- Resonance and basic principles
  - London theory and its basics

Semester II

Course Title: QUANTUM MECHANICS-II
Course Code: MPH-214
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To study the basic perturbation theory in quantum mechanics.
- To understand the different approximation methods used in quantum mechanics.

UNIT-I Perturbation theory: Equations in various orders of perturbation theory (time independent), the non- degenerate case, first and second order, Stark effect, Zeeman effect, Application to excited states: Helium atom, time dependent perturbation theory harmonic perturbation (transition probability and Fermi-Golden Rule).

12

UNIT-II Approximation Methods: Adiabatic approximation, sudden approximation, Variation technique, its applications. W.K.B approximation, WKB applications (bound state problem and tunneling, harmonic oscillator).

12

UNIT-III: **Scattering Theory-I:** Differential and total scattering cross-sections, scattering amplitude, relation between differential scattering cross/section and scattering amplitude, Partial wave analysis, expression for scattering amplitude and total scattering cross section in terms of Phase shifts, scattering by a perfectly rigid sphere and by square well potential, Deduction of optical theorem from scattering cross section.

12

UNIT-IV Scattering Theory-II: Green's function method for scattering, derivation of scattering amplitude and born approximation, validity of Born approximation, Application of Born approximation to square well, Yukawa and screen coulomb potential, symmetric and anti symmetric wave function

12

UNIT-V Relativistic Quantum Mechanics: K.G. equation , charge and current densities , Dirac's equation ,Dirac matrices- properties spinors, spin of Dirac's particle, Negative energy states- spin magnetic moment. Introduction to quantum field theory.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Text Books

1. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill (1976).
2. J.L. Powell and B. Crasemann, Quantum Mechanics, Narosa Publishing House (1993).
3. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley (1999).
4. Quantum Mechanics, Aruldhas, Prentice Hall of India (2006).

References

1. Mathews P.M. and Venkatesan K., A Textbook of Quantum Mechanics, Tata McGraw Hill, 1977.
2. Schiff I. Leonard, Quantum mechanics, Third Edition, McGraw-Hill Book Company, 1968.
3. Merzbacker E., Quantum Mechanics, Wiley Publishers , 4th Edition, 1991.
4. Satya Prakash, Quantum Mechanics, Sultan Chand Publishers, New Delhi, 2004.
5. John L. Powell and Bernd Crasemann, Quantum Mechanics, Narosa Publishing House, 1988.

Outcome

- Basics of quantum mechanics.
- Various physics concepts in the light of quantum mechanics.
- Scattering theory and its application
- Negative energy states and its existence .
    - Quantum field theory

Semester II

Course Title: PHYSICS LAB-II
Course Code: MPH-215
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

List Of Experiments

1. Determination of e/m by Thomson's Method.
2. Determination of Planks constant by photo-cell .
3. Determination of type of semiconductor by Four Probe method.
4. Determination of Hall Coefficient of Semiconductor.
5. Determination of Velocity and Comprehensibility of ultrasonic waves in liquid
6. Determination of Stefan's constant by pyrometer.
7. Determination of refractive index of a given liquid using Hollow prism method.
8. Determination of absorbance using spectrophotometer.
9. Determination of Characteristics of solar cell.
10. Determination of Curie Temperature of Magnetic Materials
11. Determination of susceptibility of a liquid using Guoy method.
12. Study of Transducers.
13. Determination of wavelength and thickness using Biprism
14. Fibre Optics Experiment
15. Michalson Moreley Experiment.
16. Determination of wavelength LASER.
17. Hysteresis loop of Ferromagnetic material.

Note: **Experiments will be performed as per the availability of source in Department/University. Viva of experiments will be based on seminars.**

Semester - III

S.No.	COURSE CODE	COURSE TITLE	Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-311	Condensed Matter Physics-I	4	40	60	100
2.	MPH-312	Nuclear Physics-I	4	40	60	100
	MPH-313	Advanced Electronics & Applications-I	4	40	60	100
3.	MPH-314	Condensed Matter Physics -I (Special)	4	40	60	100
4.	MPH-315	Nuclear Physics-I (Special)	4	40	60	100
5.	MPH-316	Advanced Electronics & Applications - I(Special)	4	40	60	100
Choice based Complementary Electives *(Students are required to choose any one of the following courses)*						
1.	MPH-331	Materials Science and Characterization	4	40	60	100
2.	MPH-332	Digital Signal Processing	4	40	60	100
3.	MPH-333	Radiation Physics	4	40	60	100
4.	MPH-334	Nanoscience and Technology	4	40	60	100
PRACTICAL						
1.	MPH- 317	Physics Lab-III	4	60	40	100
		Total	**24**	**260**	**340**	**600**

Note: *The students are required to choose one special paper for specialization either in Nuclear or condensed Matter Physics or Advanced Electronics & Applications*

Semester III

Course Title: Condensed Matter Physics –I
Course Code: MPH-311
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To study the basic concepts of Condensed Matter Physics.
- To understand the different properties of solids.

Unit-I: Basic Crystals Structures: Crystal solids, translation vectors, unit cell, primitive cell, basis, symmetry operations- point groups and space groups, Bravais lattices, Miller indices, Interplanar spacing, simple crystal structures, introduction about quasi crystals 12

Unit-II: X-ray Diffraction and Reciprocal lattice: Introduction about X-ray diffraction, Bragg's law, Laue's equation, X-ray diffraction methods- Laue's, Rotating and powder methods, Reciprocal lattice, reciprocal lattice to SC lattice, BCC lattice, FCC lattice and properties, Brag's law in reciprocal lattice, Brillouin zones, crystal atomic and geometrical scattering factor.

12

Unit-III: Lattice Dynamics and Thermal Properties of Solids: Lattice dynamics of atoms in crystals, vibrations of 1D monatomic chains, diatomic linear chains, dispersion relation, acoustic and optical phonon modes, concept of phonons, classical and quantum model for thermal properties of solids, Debye's quantum model, Anharmonic crystal interactions-thermal expansion, thermo power thermal conductivity.

12

Unit-IV: Free Electron Theory of Metals: Drude-Lorentz's classical theory, Sommerfeld's quantum theory (1D,2D and 3D), applications of free electrons gas model- electron specific heat, electrical conductivity and ohm's law, magneto-resistance, temperature dependent electrical conductivity of solids.

12

Unit-V: Band Theory and Semiconductors: Introduction, Bloch function, Bloch theorem, Kronig-Penny model, Velocity and effective mass of electron, Pure or extrinsic semiconductors, types of semiconductors, Drift velocity, mobility and conductivity, carrier concentrations, fermi level and law of mass action for intrinsic semiconductor, classical and quantum Hall effect.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Recommended Text/Reference Books :

1. Introduction to Solid State Physics- Charles Kittel
2. Elementary Solid State Physics- M.A.Omar
3. Applied solid state physics-Rajnikant
4. Quantum Theory of Solid State-Joseph Callaway
5. Introduction to Solid State Theory- Otfried Madelung
6. Solid State Physics- R.K.Singhal.

Outcome

- **Lattice dynamics in solids**
- overview of superconductivity
- Electron- phonon interaction
- Optical properties of metals and nonmetals
- Applications of Mossbauer effect

Semester III

Course Title: Nuclear Physics-I
Course Code: MPH-312
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To know the basic properties of Nucleus
- To understand the mechanisms stability and various models.

UNIT-I Basic properties of nucleus: Mass, Charge, and Constituents of the nucleus, Nuclear size and distribution of nucleons, Mass distribution in nucleus, semi empirical mass formula, binding energy curve, Angular momentum, Parity and symmetry, Magnetic dipole moment and electric quadrupole moment.

12

UNIT-II Bound states of nucleus: Exchange Force and Tensor Force, Bound State of two nucleons, Theory of Ground State of two nucleons. Nucleon- nucleon scatterings (n-p) at Low energies (<10MeV). Scattering Length. Effective range theory in n-p and p-p scattering, Spin dependence of nuclear forces. Scattering of Neutrons by ortho and para hydrogen molecule.

12

UNIT-III Radioactivity: Alpha particle emission, Geiger Nuttal law-,Gamow's theory of alpha decay, beta decay, Neutrino hypothesis, Fermi's theory of beta decay, Energies of beta spectrum, Fermi and G.T.Slection rules, Non- Conservation of parity in beta decay Gamma emission-selections rules- transition probability- internal conversion- nuclear isomerism.

12

UNIT-IV Nuclear models: systematic of stable nuclei, Nuclear fission, liquid drop model, Shell model - Experimental evidence for shell effects and magic numbers, Shell model – spin orbit coupling. Schmidts lines and prediction of angular momentum and parity of nuclear ground states. Collective model - rotational States and Vibrational levels.

12

UNIT-V Nuclear reactions: Energies of Nuclear reaction, level widths ,cross sections, compound nucleus resonance scattering, Breit- Wigner one level formula, optical model, direct reactions, Stripping and pick- up reactions, Fission and fusion reactions, elementary ideas of fission reaction, theory of fission- elementary ideas of fusion, controlled thermonuclear reactions, ideas of nuclear reactors,

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

TextBooks

1. W.R. Leo, Techniques for Nuclear and Particle Physics Experiments, Springer, 1987
2. E. Segre (ed.), Experimental Nuclear Physics, Vols. I, II, III. Wiley, 1953
3. W.E. Burcham, Elements of Nuclear Physics. Longman, 1979

References

1. Dayal D.C., Nuclear Physics, Himalaya Publishing House, 1997.
2. Khanna M.P., Introduction to Particle Physics, Prentice Hall of India, 2004.

3. Williams W. S. C., Nuclear and Particle Physics, Oxford University Press, 1991.
4. Brian Martin, Nuclear and Particle Physics: An Introduction, Wiley Publishers, 2011.

Outcome

- The basic properties of nuclear force
- Deuteron ,its ground state parity and angular momentum
- Radioactivity and its decay mode
- Shell model and calculation of magic numbers .
- Nuclear reactions and energy calculations

Semester-III

Course Title: Advanced Electronics & Applications-I
Course Code: MPH-313
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objectives:

- To provide theoretical knowledge in Op-Amps,
- basic digital systems, and 8085 Microprocessor.

Unit-I Number system and logic realization approaches: Binary, octal and Hexa decimal number and their inter-conversion, Addition and subtraction, Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR gates. Boolean algebra: Postulates and theorems, logic functions, minimization of Boolean functions using algebraic, D-Morgans laws and Karnaugh map methods, realization using logic gates. **12**

Unit-II:Combinational Circuits: Introduction to combinational circuits, realization of basic combinational functions like Half and full Adder, half and full Subtractors, Encoders, Decoders, Multiplexer, D-Multiplexer, and Comparators. **12**

Unit-III: Sequential Circuits: Flip-Flops and types of Flip-Flops: SR-Latch, SR, JK, T, D, Master/Slave FF, triggering of FF, analysis of clocked sequential circuits-their design, state minimization, state assignment, circuit implementation, registers: shift registers, inter-conversion of shift registers, Ripple counters

12

Unit-IV: Microprocessors-I: Evolution and introduction to microprocessors, internal architecture (ALU, Register Array, timing and Control Unit), Organization of microprocessor based system. Input/output devices, system bus, microprocessor languages (machine language, assembly language),and ASCII code.

12

Unit-V: Microprocessors-II: Simple microcomputer system and Microprocessor comparison, Recent trends in microprocessor technology, Introduction to 8085,8086 microprocessor and 8051 microcontroller. Memories (ROM, RAM & their types). **12**

Note For Paper Setter

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Course outcomes: Students will have achieved the ability to:

1. explain the working and design of various flip-flops,encoder/decoders, multiplexers, registers and counters.

2. describe the working and design of ROM, RAM, Memory storage cell and the various read and write operations.

3. explain the working and design of various A/D and D/A convertors.

4. explain various components and working of the 8085 microprocessor and their peripheral devices.

Recommended Books:

1. Mano M., Digital Logic and computer Design, PHI (2004).

2. Tocci R. J., Digital Systems-Principles and Applications, Prentice Hall of India, (2002).

3. Gaonkar R. S., Microprocessor Architecture, Programming and Applications, Prentice-Hall (2002).

Outcome

- The working of digital electronic devices.
- counters - up - down counters.
- The concepts of working model of microprocessors and microcontrollers
- flip - flops.
- 8085 microprocessor and its application.

Semester III

Course Title: Condensed Matter Physics-I(Special)
Course Code: MPH-314
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To study the basic concepts of crystallography.
- To understand the different techniques of determination of defects in crystal structure.

Unit I: Single Crystal Data Collection Techniques: An overview of X-ray diffractions, Principle, construction and working of rotating crystal X-ray diffraction methods (single/double oscillation, rotation), Measurement of identity period, basic principle and geometry of Weissenberg technique, visual estimation technique for intensity data collection, indexing of zero and higher Weissenberg photographs, determination of unit cell parameters and equi-inclination setting for obtaining higher layer Weissenberg photographs. **12**

Unit-II: Electron Microscopy: Construction and operation of Transmission electron microscope – Diffraction effects and image formation, specimen preparation techniques. Construction, modes of operation and application of Scanning electron microscope, EDX. Electron probe microanalysis, basics of scanning Tunneling Microscope (STM) and Atomic Force Microscope. **12**

Unit III: Interaction of Light With Biological Systems: Interaction of light with cells, tissues, non-linear optical processes with intense laser beams, photo-induced effects in biological systems. **12**

Unit-IV: Interacting Electrons in Solids: Review of free electron theory, nearly free electron approximation, tight-binding model, LCAO approximation, Wannier functions, Hartree-Fock approximation, Dielectric constant of metals and insulators.

12

Unit-V: Optical Properties: Electronic, inter-band and intra-band transitions, relation between optical properties and band structure, reflectance, diffraction, dispersion, photoluminescence, electroluminescence, optical constants, Kramers-kronig relations, polarons, excitons, plasmons. **12**

Note For Paper Setter

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Recommended Text/Reference Books :

7. Introduction to Solid State Physics- Charles Kittel
8. Elementary Solid State Physics- M.A.Omar
9. Applied solid state physics-Rajnikant
10. Quantum Theory of Solid State-Joseph Callaway
11. Introduction to Solid State Theory- Otfried Madelung
12. Solid State Physics- R.K.Singhal.

Outcome

- To study the basic concepts of crystallography.
- To understand the different techniques of determination of crystal structure.
- To determine the crystal parameters and directions.
- To understand the types of defects, grain boundaries and stacking faults.
- To understand the temperature dependence of magnetic properties of material

Semester III

Course Title: Nuclear Physics-I (Special)
Course Code: MPH-315
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To know the role of Group theory in Nuclear Physics
- To understand application of special groups in nuclear particle interaction.

UNIT-I: Review group theory: Review of basic concepts of finite group theory, permutation group, Caley's theorem, applications of Caley's theorem for determining group structures of finite groups of order 3,4,5 and 6, Lagrange theorem, its application for finding group structures of order, 4,5 and 6. Quotient group, self conjugate subgroups, Matrix representation, equivalent representation, unitary representation.

12

UNIT II: Group representation: Reducible and irreducible representation, characters of irreducible representations, Schur's Lemmas, Statement and proof of orthogonality theorem for irreducible representative of a group. Interpretation of orthogonality theorem. Orthogonality of characters and character tables. Continuous groups, Lie groups, General properties and examples of Lie groups.

12

UNIT III: Symmetry in Physics: Symmetry in physical laws, Noether's theorem, Symmetry and quantum Mechanics, Examples from quantum mechanics i.e., one dimensional system, Symmetry in quantum numbers. Matrix elements and selection rules. Concept of broken Symmetry. The axial rotation group SO (2). Generators of SO (2), 3-dimensional rotation group SO (3), its generators and irreduciblerepresentation. 12

UNIT IV: Groups of different order: O (4) and SO(4) Groups, SO (4)s as a direct product of two SO (3) groups. Special Unitary Group SU (2), its irreducible representations. Homomorphism of SU (2) on SO (3). Generators of U (n) and SU (n). Generators of SU (2), Physical applications of SU (2).

12

UNIT V: Special groups & applications: The special unitary group SU (3). Physical application of SU (3), Gelmann's representation of SU (3) and quarks. Detailed study of Lorentz group. Application of group theory of isotropic harmonic Oscillator and Hydrogen atom.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Text Books

4. W.R. Leo, Techniques for Nuclear and Particle Physics Experiments, Springer, 1987
5. E. Segre (ed.), Experimental Nuclear Physics, Vols. I, II, III. Wiley, 1953
6. W.E. Burcham, Elements of Nuclear Physics. Longman, 1979

References

5. Dayal D.C., Nuclear Physics, Himalaya Publishing House, 1997.
6. Khanna M.P., Introduction to Particle Physics, Prentice Hall of India, 2004.
7. Williams W. S. C., Nuclear and Particle Physics, Oxford University Press, 1991.
8. Brian Martin, Nuclear and Particle Physics: An Introduction, Wiley Publishers, 2011.

Outcome

- To study the basic concepts of Group Theory.
- To understand the Group theory & symmetry.
- To determine order & directions.
- Groups & particles.
- Special groups & applications

Semester-III

Course Title: Advanced Electronics & Applications-I (Special)
Course Code: MPH-316
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objectives:

- imparting in-depth knowledge of optical fiber communication
- Applications of fiber optics

Unit-I:Optical fibers and fabrication: Introduction, Light propagation through optical fiber, Fiber materials, Fiber fabrication, Mechanical properties of fibers, Attenuation, Signal distortion in optical waveguides, Pulse broadening in graded index waveguides, Mode coupling, Design optimization of single-mode fibers. Nonlinear effects , Solitons. 12

Unit-II: Power launching and coupling: Source-to-fiber launching, fiber-to-fiber joints, LED coupling to single-mode fibers, Fiber splicing, Optical fiber connectors 12

Unit-III: Photodetectors: The pin photodetector, Avalanche photodiodes, Photodetector noise, Detector response time, Structures for In GaAs APDs, Temperature effect on avalanche gain. 12

Unit-IV: Optical amplifiers and Optical receiver: Fundamental receiver operation, Pre-amplifier types, Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, System applications. 12

Unit-V: Measurements: Measurement standards, Test equipment, Attenuation measurements, OTDR field applications, Eye patterns, Optical spectrum analyzer applications. 12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Recommended Books

1. *Keiser, G., Optical Fiber Communications, McGraw-Hill International. (2000).*

2. *Seniors, J.M., Optical Fiber Communications – Principles and Practice, Prentice-Hall of India, (1996).*

3. *Cherin, A.H., An Introduction*

Course Outcomes

- describe basics of optical fiber, its fabrication and sources of attenuation the requisite inputs for optical fiber communication
- elaborate the methods of power launching and coupling and working of photodetectors.
- explain the mechanism and use of optical amplifiers and optical receiver.
- analyze optical networks and their performance.
- calculate attenuation and dispersion in optical fibers and identify fiber-fault location.

Semester III
SYLLABUS FOR ELECTIVE COURSES

Course Title: MATERIALS SCIENCE AND CHARACTERIZATION | Maximum Marks: 100
Course Code: MPH-331 | University Examination: 60
Credits: 4 | Sessional Assessment: 40

Objective

- To understand the applications Optical microscopy and metallographic applications.
- To understand the X-ray diffraction application of identification of crystal structures.

UNIT-I: Optical Microscopy: Optical microscope - Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast, Polarised light, Hot stage, Interference techniques), Stereomicroscopy, Photo-microscopy, Colour metallography, Specimen preparation, Applications 12

UNIT-II: X-Ray Diffraction Techniques: Crystallography basics, characteristic spectrum, Bragg's law, Diffraction methods–Laue, rotating crystal and powder methods. Intensity of diffracted beams –structure factor calculations and other factors. Cameras-Laue, Debye-Scherer cameras, Seeman-Bohlin focusing cameras. 12

UNIT-III: Application of X-Ray Diffraction: Diffract meter - general feature and optics, proportional, scintillating and Geiger counters. X-ray diffraction application in the determination of crystal structure, lattice parameter, phase diagram and residual stress - quantitative phase estimation, Elementary idea about neutron diffraction.

12

UNIT-IV Electron Microscopy: Construction and operation of Transmission electron microscope , specimen preparation techniques. Construction, modes of operation and application of Scanning electron microscope, EDX. scanning Tunneling Microscope (STM) and Atomic Force Microscopy.

12

UNIT-V: Advanced Chemical and Thermal Analysis: Differential thermal analysis DTA, Differential scanning calorimetry DSC and thermogravimetric analysis TGA. UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

TextBook

1. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2nd Edition, Wiley Publishers, 2013
2. **References**
3. Cullity B. D., Elements of X-ray diffraction, Addison-Wesley Company Inc., New York, 3rd Edition, 2001.
4. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley Publishers, 2008.
5. Cherepin and Malik, Experimental Techniques in Physical Metallurgy, Asia Publishing Co., Bombay, 1968.
6. Brandon D. G., Modern Techniques in Metallography, Von Nostrand Inc. NJ, USA, 1986.
7. Wachtman, Characterization of Materials, Butterworth-Heinemann Publishers, 1992.

Outcome

- Various methods involved in material characterization
- quantitative metallographic techniques
- Importance of use of different instruments for material study.
- X-ray photoelectron spectrometry
- Chemical and thermal analysis of material cheraterasations

Semester III

Course Title: DIGITAL SIGNAL PROCESSING
Course Code: MPH-332
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objectives

- To use signal processing to contribute towards the development of innovative algorithms, performance analysis.
- To understand the theory and applications of digital signal processing and modern communications technology.

UNIT-I: Signals: Signals, classification of signals, basic operation on signals, elementary signals, systems, properties of systems, linear time invariant systems and their properties. **12**

UNIT-II: Fourier Representation: Fourier representation for four classes of signals, discrete - time periodic signals, discrete time Fourier series, continuous time periodic signals and the Fourier series, discrete time no periodic signals, and the discrete time Fourier transform, continuous time no periodic signals and the Fourier transform.

12

UNIT-III: Properties Of Fourier Representation: Linearity and symmetry property, convolution property, differentiation and integration, time and frequency shift property, Parseval relationship, Time Bandwidth product, Duality. 12

UNIT-IV: Sampling: Sampling continuous time signals, sampling a sinusoid, aliasing, sub sampling, sampling theorem, ideal reconstruction and practical reconstruction: zero order hold.

12

UNIT-V: Communication: Types of modulation, full amplitude modulation, generation, frequency domain representation of amplitude modulation, spectral overlap and demodulation.

12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

References

1. Haykin S. and Van Veen B., Signals and Systems, II edition, Wiley Student Edition, 2002.
2. Lathi B.P., Signal processing and linear systems, Oxford University Press Inc., USA, 2003.
3. Paolo Prandoni and Martin Vetterli, Signal Processing for Communications, CRC Press, 2008.
4. Denbigh P.N., System analysis and signal processing, Addison Wesley, 1998.

Outcome

- The basic idea of elementary signal , and classification of signals.
- Fourier transformation for different types of signals.
- Properties of fourier transformations,differentiation and integration.
- Sampling continuous time signals
- Types of modulation, spectral overlap and demodulation

Semester III

Course Title: RADIATION PHYSICS
Course Code: MPH-333
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the theory of electromagnetic radiation,natural and artificial radioactivity
- To study the interaction of radiation with matter and its effects.

UNIT-I : Electromagnetic Radiation : Wave model – Quantum Model– visible light and fluorescence particulate radiation – inverse square law. **12**

UNIT-II :Natural And Artificial Radioactivity : Radioactivity – General properties of alpha, beta and gamma rays – Laws Of radioactive disintegration – Radioactive decay constant – Half-life period – average life – Isotopes, Isobars, Isomers – Isotones and Isodiapheres – Natural radioactive series – Radioactive equilibrium –Radioactive decay - α particle decay – β particle decay – Theory of beta decay – Gamma emission – Electron capture – Internal conversion – Nuclear isomerism – Artificial radioactivity - Nuclear reactions –α, p reaction - α, n reaction- Proton bombardment – deuteron bombardment- neutron bombardment – photo disintegration – Activation of nuclides - Elementary ideas of fission, fusion and nuclear reactors. **12**

UNIT-III: Radiation Quantities: Quantities to describe a radiation beam- particle flux and fluence- Photon flux and fluence- cross section- linear and mass absorption coefficient-stopping power and LET Activity – Curie – Becquerel. Exposure and its measurements – Roentgen, Radiation absorbed Dose- Gray - kerma- kerma rate constantElectronic equilibrium - relationship between kerma, exposure and absorbed dose–Relative biological effectiveness (RBE)- radiation weighting factors. **12**

UNIT-IV: Interaction Of Radiation With Matter: Interaction of electromagnetic radiation with matter: Ionization – Photon beam exponential attenuation – Rayleigh scattering – Photoelectric effect – Compton effect - energy absorption – Pair production – Attenuation, energy transfer and mass energy absorption coefficients – Relative importance of various types of interactions. **12**

UNIT-V: Interaction Of Charged Particles With Matter : Classical theory of inelastic collisions with atomic electrons – Energy loss per ion pair by primary and secondary ionization – Dependence of collision energy losses on the physical and chemical state of the absorber – Cerenkov radiation – Electron absorption process – scattering excitation and ionization – Radiative collision – Bremmstrahlung – Range energy relation – Continuous slowing down approximation (CSDA) – straight ahead approximation and detour factors – transmission and depth dependence methods for determination of particle penetration - empirical relations between range and energy - Back scattering. **12**

Note For Paper Setter

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References

1. Segre E., Experimental Nuclear Physics, Vol 3, John Wiley, 1959.
2. Theraja B.L., Modern Physics, S.Chand Company, 1995.
3. Faiz M Khan , The Physics of Radiation Therapy, Lippincott Williams & Wilkins Publishers, 2010.
4. Oliver R., Radiation Physics in Radiology, Blackwell Scientific Publication, 1974.
5. Frank Herbert Attix, Introduction to Radiological Physics and Radiation Dosimetry, Wiley-VCH Publishers, 1991.

Outcome

- Concepts of electromagnetic radiation
- Theory of artificial and natural radioactivity
- Interaction of radiation with matter.
- Radiative collision and back scattering.
- Classical theory of radiation .

Semester III

Course Title: NANOSCIENCE AND TECHNOLOGY
Course Code: MPH-334
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To get in-depth knowledge of at least one specialisation area within the field of nanoscience and nanotechnology
- To gain Sufficient scientific background to undertake research

UNIT-I: Nanomaterials And Structures: Nanomaterials and types: nanowires, nanotubes, fullerenes, quantum dots, nanocomposites - properties - Methods of preparation: top-down, bottom-up. **12**

UNIT-II: Characterization Tools: Electron Microscopy Techniques - SEM, TEM, X ray methods - optical methods Fluorescence Microscopy - Atomic Force Microscopy, STM and SPM. 12

UNIT-III: Nanomagnetism: Mesoscopic magnetism - Magnetic measurements: miniature Hall detectors, integrated DC SQUID Microsusceptometry - magnetic recording technology, biological magnets 12

UNIT -IV: Nanoelectronics And Integrated Systems : Basics of nanoelectronics - Single Electron Transistor - quantum computation - tools of micro-nanofabrication - nanolithography - quantum electronic devices - MEMS and NEMS - dynamics of NEMS - limits of integrated electronics.

12

UNIT -V:Biomedical Applications Of Nanotechnology: Biological structures and functions - drug delivery systems - organic-inorganic nanohybrids - inorganic carriers - nanofluidics.

Note For Paper Setter

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References

1. Jan Korvink and Andreas Greiner, Semiconductors for Micro and Nanotechnology - an Introduction for Engineers, Weinheim Cambridge: Wiley-VCH, 2001.
2. Murty B.S., Shankar P. & et al., Textbook of Nanoscience and Nanotechnology, Universities Press (India) Private Ltd., 2012.
3. Richard Booker and Earl Boysen, Nanotechlongy, Wiley Publishing, 2005.
4. Timp G (ed), Nanotechnology, AIP press, Springer, 1999.
5. Wilson M., Kannangara K., Smith G., Simmons M. and Raguse B., Nanotechnology: Basic Sciences and Energy Technologies, Overseas Press, 2005.

Outcome

- The basic concepts about the Nano materials
- The importance of use of nano materials in design and synthesis of novel materials.
- Uses of nanoscience in different branches
- Nanoelectronics and integrated systems .
- **Biomedical application of nanoscience .**

Semester III

Course Title: Physics Lab-III
Course Code: MPH-317
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

List of Experiments

Note: The experiments will be performed as per the availability of source at Department/ University. Each Practical will be followed by seminar

Semester - IV

S. No	COURSE CODE	COURSE TITLE	Credits	Distribution of Marks		
				SA	UE	Total
Theory						
1.	MPH-411	Condensed Matter Physics-II	4	40	60	100
2.	MPH-412	Nuclear Physics-II	4	40	60	100
	MPH-413	Advanced Electronics & Applications-II	4	40	60	100
3.	MPH-414	Condensed Matter Physics-II(Special)	4	40	60	100
4.	MPH-415	Nuclear Physics-II (Special)	4	40	60	100
5.	MPH-416	Advanced Electronics & Applications-II (Special)	4	40	60	100
Choice based Complementary Electives *(The students are required to choose any one of the following courses)*						
1.	MPH-441	Atmospheric Physics	4	40	60	100
2.	MPH-442	Satellite Comm. and Remote sensing	4	40	60	100
6.	MPH-443	Astrophysics	4	40	60	100
Practical						
1	MPH-417	Project work	4	--	100	100
Total			**24**	**260**	**340**	**600**

The students are required to choose one special paper for specialization either in Nuclear Physics-II or condensed Matter Physics-II or Advanced Electronics & Applications-II

Semester IV

Course Title: Condensed Matter Physics-II
Course Code: MPH-411
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the basic of crystal growth.
- To have an idea to defects in solids.

Unit-I: Defects in Crystals: Point defect, Impurities, Vacancies, Frenkel defects, Schottky defects, Intrinsic vacancies, Concentration of Schottky defects, Concentration of Frenkel defects, extrinsic vacancies, Diffusion, Colour centres, F-Centre, V-Centre, dislocation, Line defects, edge dislocation, screw dislocation, Burger vector. **12**

Unit-II: Magnetic Properties of Solids: Magnetic terminology, types of magnetism, Langevin's classical, quantum theory of diamagnetism and paramagnetism, Weiss theory of ferromagnetism, Heisenberg model and molecular field theory. Spin waves and Magnons, Bloch $T^{3/2}$ law, formation of domains, Bloch-wall energy, Antiferromagnetism-Neel's theory, two sublattice model and ferrites. **12**

Unit-III: Dielectric and Ferroelectric Properties: Dielectric constant and susceptibility, induced polarization, Clausius-Mossotti relation, source of polarizability, ferroelectricity, classification of ferroelectric crystals, Landau theory of the ferroelectric phase transition, piezoelectricity, applications. **12**

Unit-IV: Superconductivity: Overview of superconductivity, Basic properties of superconductivity, Meissner effect, London equations, Type I and type-II superconductors, BCS theory of superconductivity, Phenomenological models, Elementary idea of high temperature superconductivity. **12**

Unit-V: Introduction to Nanomaterials: Introduction to nanotechnology, historical development, nanomaterials and applications, new forms of carbon- fullerenes, nanowires and nanotubes, types of nanotubes, applications of nanowires and nanotubes, Basic idea about thin film (2D materials) techniques. **12**

Note For Paper Setter

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Text and Reference Books

1. Applied solid state physics-Rajnikant
2. Crystallography Applied to Solid State Physics by Verma and Srivastava
3. Quantum Theory of Solids- Charles Kittel
4. Art and science of growing crystals-J.J.Gilman
5. Crystal growth- Brian R Pamplin

Outcome

- To understand the different techniques of determination of crystal structure.
- Diffusion under non steady different condition
- To understand the types of defects, grain boundaries and stacking faults.
- To understand the Dilectric and Ferrroelectric Properties of material.
- General properties of metals

Semester IV

Course Title: Nuclear Physics-II
Course Code: MPH-412
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the basic detectors & accelerators.
- To gain the knowledge on elementary particles.

Unit -I: Detectors: General characteristics of detectors: Sensitivity, energy resolution and fano factor, detector efficiency and dead time. Gas filled, liquid filled, and Solid State detector (Proportional counter Geiger-Muller counter, scintillation counter, emulsion, semicounductor detectors). 12

Unit-II :**Accelerators:** Particle Accelerators Need for accelerator of charged particles, Classication of types of accelerators, Proton Synchrotron, Betatron; Alternating gradient accelerator, Colliding beam accelerator. 12

Unit-III : **Elementary particles:** Various types of interactions gravitational, electromagnetic, weak and strong interactions and their mediating quanta, Classification and properties of elementary particles, Leptons, Baryons, mesons particles and antiparticles excited states and resonances. Conservation rules in fundamental interactions. Charge symmetry and charge independence, Parity and charge conjugation, Conservation of parity and its violation in different types of interactions. Strange particles, associated production, strangeness and decay modes of charged Kaons, Isospin and its conservation. Quark and Gell Mann Nishijima's formula. 12

Unit -IV : Quark and Hadrons: The Baryon Moments Decuplet, Quark spin and color, Baryon Octect, Quark-Antiquark combinations :- The pseudoscalar mesons, the vector mesons, leptonic decay of vector mesons, Baryon Magnetic moments, Heavy-meson spectroscopy and the quark model. J/U and upsilon states; Quark confinement and search for free quarks. 12

Unit -V: **Elementary Particles:** CPT invariance in different interactions, parity non conservation, k-meson, complex and time reversal invariance, elementary ideas of gauge theory of strong and weak interactions. Standard Model (elementary idea), Feynman diagrams (basics). 12

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TextBooks

7. W.R. Leo, Techniques for Nuclear and Particle Physics Experiments, Springer, 1987
8. E. Segre (ed.), Experimental Nuclear Physics, Vols. I, II, III. Wiley, 1953
9. W.E. Burcham, Elements of Nuclear Physics. Longman, 1979

References

9. Dayal D.C., Nuclear Physics, Himalaya Publishing House, 1997.
10. Khanna M.P., Introduction to Particle Physics, Prentice Hall of India, 2004.
11. Williams W. S. C., Nuclear and Particle Physics, Oxford University Press, 1991.
12. Brian Martin, Nuclear and Particle Physics: An Introduction, Wiley Publishers, 2011.

Outcome

- The basic concepts nucleus and its properties
- To gain the knowledge on elementary particles.
- Quarks model and .Quark and GellMann Nishijima's formula.
- Quark and Hadrons , classification of elementary particles
- Standard models and Feynman diagram

Semester IV

Course Title: Advanced Electronics & applications-II
Course Code: MPH-413
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objectives: To understand, analyze and implement the fundamental experimentation.

Unit-I: Data Interpretation and analysis: Precision and accuracy, Errors in measurements: Statistical and systematic, Error analysis, Propagation of errors. Frequency distributions, Probability distributions: mean and variance, Probability densities: Normal distribution, Log Normal distributions. Curve Fitting: least square method, Linear and non linear, Chi-square test. 12

Unit-II: Transducers: Transducers Classification: Capacitive and Inductive transducers; variable differential transformers, Strain Gauge; Resistance thermometer; Thermocouple; Photoelectric and Piezoelectric transducers; Magnetic Transducers ; Photosensitive devices ; Photoconductive and Photovoltaic cells 12

Unit-III: Bridges: Maxwell bridge, Kelvin bridge, ,Wein bridge, Anderson bridges, De Schotley bridge, and diode bridges, LCR meters and Mulitmeters uses. 12

Unit-IV: Oscilloscopes: Block Diagram; CR tube; Electrostatic Deflection; CRT Screen ;CRT circuits; Vertical deflection system; Horizontal deflection system; Delay line; Oscilloscope prober; Oscilloscope techniques; Measurement of frequency, Phase angel and Time delays, Applications. 12

Unit -V: Signal Conditioning: Signal Conditioning, Analog signal conditioning: Operational amplifiers, Instrumentation amplifiers, precision absolute value circuits, True RMS to DC converters. Phase sensitive detection: Lock in amplifier, Box-car integrator, Spectrum analyzer. 12

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Recommended Books

1. Sayer, M., Mansingh, A., Measurement, Instrumentation and Experiment Design in Physics and Engineering, Prentice Hall of India (2000).
2. Northrop, Robert, B., Introduction to Instrumentation and Measurements, CRC, Taylor & Frances (2005).
3. Murthy, D.V.S., Transducers and instrumentation, Prentice Hall of India (2008).
4. Johnson, Richard A., Miller and Freund's Probability and Statistics for Engineers, Dorling Kingsley (2005)
5. Horowitz P. and Hill, W., The Art of Electronics, Cambridge University Press (2006)
6. Helfrick, A.D., Cooper, W.D., Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India (2007).

Course outcome

- to analyze and fit the experimental data. Different kind of errors coming in data will also be analyzed.
- explain principle, theory and application of various sensors and transducers.
- explain the basic principle and importance of the different AC and DC measurement techniques.
- explain the concepts of signal conditioning and noise analysis.

Semester IV

Course Title: Condensed Matter Physics-II (special)
Course Code: MPH-414
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the uses of X-ray technology in solids
- To have an idea of different dimensions of crystal formations.

Unit-I: Crystal Growth Techniques: Theoretical concept of crystal growth (supercooling and nucleation), Homogeneous and Heterogeneous Nucleation, Crystal Growth Techniques- Solution growth: Water solution, Gel, Flux method, Hydrothermal growth; Melt technique: Czochralski pulling, Bridgeman Stockbarger, Concept of Zone melting. **12**

Unit-II: Surface and Thin Film Physics: Preparation of thin films by chemical vapour, rf sputtering, Pulsed Laser, spin coating, molecular beam expitaxy methods, effects of various treatments (temperature, background), Boltzmann transport equation for thin film. **12**

Unit-III: Density Functional Theory: Extension of Central Field Approximation, Hohenberg-Kohn Theorems, statement and proof, Kohn Sham orbitals, pseudo potentials, the self-consistent field method for the calculation of ground state energies in DFT. **12**

Unit-IV: Experimental Methods of Observing Dislocations: X-ray photographic technique, basic principle, Berg Barrett technique, Lang Technique, X-ray diffraction topography camera, double crystal diffractometry, Etching Methods of etching, An overview of Scanning Electron Microscope and Transmission Electron Microscope for materials characterization. **12**

Unit-V: Electron-Phonon Interaction: Introduction, Hartree-Fock Approximation, Correlation energy, Plasmons, Plasma optics, Transverse optical modes in Plasma, Longitudinal Plasma oscillations, Polaritons, Long wavelength optical phonon in isotropic crystal (Lyddans, Sachs and Teller relation), Electron- phonon interaction in polar solids- polarons, electron- phonon interaction in metals. **12**

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Text and Reference Books

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3. Quantum Theory of Solids- Charles Kittel
4. Art and science of growing crystals-J.J.Gilman
5. Crystal growth- Brian R Pamplin

Outcome

At the end of the course, the students will be able to understand

- An overview of Microscopy
- Elementary concept of surface crystallography
- Introduction to nanotechnology
- Class Seminars related with subject

Semester IV

Course Title: Nuclear Physics-II (Special)
Course Code: MPH-415
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To understand the different interactions in nuclear physics.
- To have an idea of quarks and QCD.

UNIT-I : Weak Interactions-I Classification of Weak Interactions, Nuclear ß-decay-Fermi theory, inverse ß-decay, Parity nonconservation in Neutrino, Helicity of the Neutriono, Helicity States, Diarc theory to ß-decay, The V-A interaction, parity violation in decay, Pion and Muon decay

12

UNIT-II : Weak Interactions-II Weak Decays of strange particles _ Cabibbo Theory, weak neutral currents, Absence of S=1, neutral currents. The GIM model and charm. Weak mixing angles with six quarks. Observations of W+ and Z^0 Bosons. Lepton families, Neutrino masses and neutrino Oscillations.

12

UNIT-III : Quark & Models Quark Parton Model Evidence for Partons, deep inelastic electron-nucleon scattering, scale invariance and Partons (Bjosrken scaling), Neutrino nucleon inelastic scattering, lepton-quark scattering, Patron spin, Parton charges, antiquark contents of the nucleon, gluon constituents Electron-Positron ahhinilation to hadrons, Lepton pair production in hadron collisions – The Drell-Yan process

12

UNIT-IV : Quantum Chromodynamics: Quantum Chromodynamics and Quark-Quark interactions, QCD potential at short distances, QCD potential at large distances (String model) Multijet events in e+e annihilation, effects of quark interactions in Deep-Inelastic lepton-nucleon scattering, Running coupling constant : Quantitative predictions of QCD, q2 evolution of structure functions, Comparison of Quark and Gluon distribution

12

UNIT-V: Unification of Interactions: Renormalization in Quantum Electrodynamics, divergence in weak interactions, introduction of Neutral currents, Gauge invariance in QED, generalized Gauge Invariance. The Weinberg Salam SU(2) x U(1) Model, Yang-Mils fields and SU(2) symmetry, spontaneous symmetry breaking. Neutral current coupling of Fermions. Higgs mechanism. The standard model. Grand unification : Proton decay, the cosmic baryon asymmetry.

12

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Text and reference Books:

1. Introduction to High Energy Physics by Donanld H.Perkins.
2. Nuclear & Paticle Physics by E. Burcham
3. Elementary Particles by I.S. Hughes
4. Quarks, Leptons and Gauge fields by Kerson Huang
5. Introduction to Particle Physics by M.P. Khanna
6. Particle Physics by B. R. Masrtin and G. Shah
7. The big and small by G. Venkataraman
8. Elementary Particles and their interactions, concepts and phenomena by Quang HoKim, Pham Xuan Yam
9. Introduction to Elementary Particle Physics by David Griffith

Outcome

- Weak interactions
- Quarks
- High energy particle physics
- Grand Unifications

Course Title: Advanced Electronics & applications-II (Special)
Course Code: MPH-416
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objectives:

- basics of microwave communications
- modern applications

Unit-I: Microwave Transmission. Basics, Concept of Mode: TEM, TE and TM Modes and their characteristic, Losses and concept and microwave impedance. **12**

Unit-II: Microwave Transmission Lines. Coaxial Line, Rectangular Waveguide, Circular waveguide, Stripline and Microstrip Line. **12**

Unit-III: Microwave Network Analysis and Measurements: Equivalent Voltages and currents for non-TEM lines, Network parameters and Scattering Parameters for microwave Circuits. Power, Frequency and impedance measurement, Network Analyser and measurement of scattering parameters. **12**

Unit-IV: Microwave Devices. Active component: Diodes, transistors, oscillators and mixers. Passive component: Directional coupler, Power divider, Magic tree, attenuator and resonator. Low power microwave devices: Gun diodes. High power microwave devices: Travelling wave tubes (TWT), Magnetron and klystron. **12**

Unit-V: Microwave Systems and applications: Radar, Cellular Phone., Satellite Communication, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC) as modern application. **12**

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Recommended Books:

1. *David, M. Pozar, Microwave Engineering, Wiley India, (2012).*

2. *Ramo, S., Whinnery, J.R., and Duzer, T.V., Fields and Waves in Communication Electronics, Wiley India.*

3. *Collin, R.E., Foundations for Microwave Engineering, IEEE Press.*

Course outcome:

- describe microwave transmission modes and transmission lines.
- analyze microwave networksand measure their measurements parameters.
- explain the working of various microwave devices
- Identify the modern day applications of microwaves.

Semester IV

Course Title: Atmospheric Physics
Course Code: MPH-441
Credits: 4

Maximum Marks: 100
University Examination: 60
Internal Assessments: 40

OBJECTIVE

- To introduce students to the basic concepts and principles of atmospheric physics.
- To understand the thermodynamics of dry and moist air, radiative transfer in the atmosphere, saturated and unsaturated accent, thermodynamic diagrams, turbulent fluxes.

Unit-I: Structure of the atmosphere and its composition, Thermodynamics of dry thermals, Thermodynamic of moist air, thermodynamic properties of water; Clausius- Clapeyron (C-C) equation, moist processes in the atmosphere, adiabatic. 12

Unit-II: Radiative transfer in the atmosphere, shortwave and longwave radiation computation, radiative heating in the atmosphere, saturated and unsaturated accent. 12

Unit-III: Thermodynamic diagrams, Moist convection, Aerodynamic formulae for surface turbulent fluxes, vertical turbulent diffusion, Cloud physics; Nucleation and Growth of Cloud Droplets; Warm Rain Formation, Collision-coalescence. 12

Unit-IV: Atmospheric Electricity; Principles of atmospheric electricity, Charge generation and separation mechanisms, Cloud electrification mechanism. 12

Unit-V: Synoptic weather forecasting charts, Weather observations, and transmission, Prediction of Weather elements, hazardous weather elements. 12

Note for Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks

Textbooks:

1. Holton JR: An Introduction to Dynamical Meteorology, Academic Press
2. Howell JR, Siegel R, Menguc M. Pinar: Thermal Radiation Heat Transfer, CRC Press
3. Lynne D. Talley: Descriptive Physical Oceanography: An Introduction, Academic Press
4. Apel J R: Principles of Ocean Physics. Academic Press.
5. Introduction to Theoretical Meteorology by Seymour L. Hess

References:

1. Lecture Notes on Physical Meteorology For Integrated Meteorological Training Course

Outcome

- Understand the atmospheric thermal structure,
- Atmosphere and its composition
- Compare dry and moist atmospheric processes
- Demonstrate knowledge of the physical processes in the atmosphere.
- Apply the knowledge of thermodynamic diagrams, calculate thermodynamic parameters.
- Discuss the mechanism of Atmospheric electrical processes.

Semester IV

Course Title: SATELLITE COMMUNICATION AND REMOTE SENSING
Course Code: MPH-442
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To Study satellite orbits and launching.
- To Study the principles of remote sensing and the data acquisition and analysis of satellite data.

UNIT-I:Satellite Orbits :Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits - Look Angle Determination- Limits of visibility -eclipse-Sub satellite point -Sun transit outage-Launching Procedures - launch vehicles and propulsion 12

UNIT-II:Space Segment And Satellite Link Design :Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget,E/N calculation- performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime 12

UNIT-III: Satellite Applications: INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)-Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, Specialized services - E -mail, Video conferencing, Internet 12

UNIT-IV: Physics Of Remote Sensing: Introduction of Remote Sensing - Electro Magnetic Spectrum, Physics of Remote Sensing- Effects of Atmosphere- Scattering - Different types - Absorption-Atmospheric window- Energy interaction with surface features - Spectral reflectance of vegetation, soil ,and water -atmospheric influence on spectral response patterns- multi concept in Remote sensing. 12

UNIT-V: Thermal And Hyper Spectral Remote Sensing :Sensors characteristics - principle of spectroscopy - imaging spectroscopy - field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing - thermal sensors, principles, thermal data processing, applications. 12

Note For Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

References

1. Dennis Roddy, Satellite Communication, McGraw Hill International, 4th Edition, 2006.
2. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.
3. N.Agarwal, Design of Geosynchronous Space Craft, Prentice Hall, 1986
4. Paul Curran P.J., Principles of Remote Sensing, ELBS, 1995.
5. Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.

Outcome

- The working model satellite technology
- Satellite communication of different country
- The physics of remote sensing.
- :Sensors characteristics- thermal sensors, principles
- Satellite application and history of our satellite communication system

Semester IV

Course Title: Astrophysics
Course Code: MPH-443
Credits: 4

Maximum Marks: 100
University Examination: 60
Sessional Assessment: 40

Objective

- To study the basic concepts of Galaxies & stars.
- To understand the different approximation methods used in Astrophysics

UNIT-I: The early Universe.: Big bang theory , varies evidences of big bang theory , Cosmic Microwave background radiation an eco of big bang . CMB discovery , Evolution of the early universe , big bang nucleosynthesis . Thermal history of early universe , recombination , reionization , physical interaction in the early universe .

12

UNIT-II: Galaxies: Formation of galaxies, The Milky way Galaxy, size and shape, distribution of mass Rotation curves of the Galaxy, Implication of dark matter, Radio-observation and spiral structure, star counts, interstellar extinction, Implications of Dark matter,

12

UNIT-III Classification of galaxies and observational tools ; Hubble's classification of galaxies External galaxies: Methods of extra galactic distance, determination spectra and red-shift, radio galaxies quasars. Systems of coordinates in astronomy, Stellar parallaxes, Stellar magnitudes, stellar classification, H-R diagram, Saha-Boltzman equation, colour temperature, temperatures of stars; Observational tools: Optical Telescope, Photoelectric Photometry.

12

UNIT-IV: Thermodynamics of stars: Equation of stellar structure, equation of conservation of mass, hydrostatic equilibrium, thermal equilibrium and energy transport, polytropic model, Lane-emden's equation, central temperature, pressure and application to Sun, Application of virial theorem to isothermal spheres, Jean's criteria for stability

12

UNIT-V:Evolution & death of stars: Evolution of stars, interstellar dust and gas, formation of stars, Evolution of stars on the basis of HR-diagram, Binary stars, masses of binary stars, Fate of massive stars, Supernovae, White dwarfs, Chandershker limit, neutron stars, Pulsars, black holes

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Note for Paper Setter

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will be contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

Reference books:

1. Astronomy by R. H. Baker

2. Structure of Universe by J. V. Narlikar

3. Cosmology by J. V. Narliker

4. Modern Astrophysics by B. W. Carroll and D. A. Ostlie Addison-Weslet Publishing

5. Introductory Astronomy & Astrophysics by M. Zelik & S. A. Gregory, 4th Edition Saunders College Publishing

6. Theoretical astrophysics, Vol. II: Stars and Stellar Systems, T. Padmanabhan, Cambridge University Press.

Text books:

1. Structure Formation in the Universe by T. Padmanabhan, vambridge University

2. Stellar Dynamics by S. Chandersakher

3. Stellar Evolution by Kippenhahn

4. Quassars and Active Galactic Nuclei by A. K. Kembehavia & G. V. Narliker, Cambridge University Press

Outcome

- Origin of universe and its evoluation .
- Characteristics of the stars and galaxies
- galaxies and hubble expansions
- Various types of stellar dynamics .
- Contributions of Indian physicists in astronomy .