M.Sc. PHYSICS (2017- 2018)

S. No	SEM	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks For Pass			Hours Week	Credits
					CIA	E.E	Total	CIA	E.E	Total		
1	I	Core	17P1PHC1	Classical Dynamics	25	75	100	10	30	50	6	5
2		Core	17P1PHC2	Mathematical Physics – I	25	75	100	10	30	50	6	4
3		Core	17P1PHC3	Statistical Mechanics	25	75	100	10	30	50	6	4
4		Core	17PIPHCP1	Major Practical – I	40	60	100	16	24	50	6	4
5		Major Elective	17P1PHEL1A 17P1PHEL1B	Nanophysics Laser and Fiber Optic Communication	25	75	100	10	30	50	6	4
6	II	Core	17P2PHC4	Electromagnetic Theory	25	75	100	10	30	50	5	5
7		Core	17P2PHC5	Mathematical Physics-II	25	75	100	10	30	50	5	4
8		Core	17P2PHC6	Electronics and Instrumentation	25	75	100	10	30	50	5	4
9		Core	17P2PHC7	Numerical Methods in Physics	25	75	100	10	30	50	5	4
10		Core	17P2PHCP2	Major Practical – II	40	60	100	16	24	50	6	4
11		Major Elective	17P2PHEL2A 17P2PHEL2B	Crystal growth & Thin Films Medical Physics	25	75	100	10	30	50	4	4
12	III	Core	17P3PHC8	Solid State Physics	25	75	100	10	30	50	5	4
13		Core	17P3PHC9	Quantum Mechanics	25	75	100	10	30	50	5	5
14		Core	17P3PHC10	Microcontroller- Programming and Applications	25	75	100	10	30	50	5	4
15		Core	17P3PHC11	Biomedical Instrumentation	25	75	100	10	30	50	4	4
16		Core	17P3PHCP3	Major Practical – III	40	60	100	16	24	50	6	4
17		EDC	17P3PHEDC	Extra Disciplinary Course	25	75	100	10	30	50	4	
			Communicative Skill and Personality development		-	-	-	-	-	-	1	-
18	IV	Core	17P4PHC12	Atomic and Molecular Spectroscopy	25	75	100	10	30	50	6	4
19		Core	17P4PHC13	Nuclear Physics	25	75	100	10	30	50	6	5
20		Core	17P4PHCP4	Major Practical – IV	40	60	100	16	24	50	6	4
21		Major Elective	17P4PHEL3A 17P4PHEL3B	Advanced Optics Radiation Physics	25	75	100	10	30	50	6	4
22		CN	17P4PHCN	Comprehension	-	100	100	-	50	50	5	2
23		PR	17P4PHPR	Project	40	60	100	16	24	50	-	4
			Communicative Skill and Personality Development		-	-	-	-	-		1	-
				Total			**2300**				**120**	**90**

M.Sc., PHYSICS (2017 – 2018)

Paper Code	Total No. Of Papers	Total Marks	Total Credits	Classification
Core	17	1700	72	✓
Elective	3	300	12	✓
E.D.C	1	100	---	✓
Project	1	100	4	x
Comprehension	1	100	2	✓
Soft skill using Language lab	--	--	---	X
Total	**23**	**2300**	**90**	

A.VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE (AUTONOMOUS),
POONDI, THANJAVUR DIST

Question Pattern for UG and PG Programmes for students to be admitted during 2017 – 2018 and afterwards

Total Marks: 75

QUESTION PATTERN

SECTION – A
(Question 1 to 10)

10 x 2 = 20 Marks

1. Short Answer Questions
2. Two Questions from each units (All are answerable)

SECTION – B
(Question 11 to 15)

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

SECTION – C
(Question 16 to 20)

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
I	**17P1PHC1**	**Classical Dynamics**	**6**	**5**

Objectives:

- To gain the knowledge about Lagrangian and Hamiltonian formulations.
- To introduce the concepts of rigid body dynamics and relativistic mechanics.
- To introduce the basic concepts of nonlinear dynamics.

Unit – I Lagrangian Formulation

Constraints – Generalised coordinates – Principle of Virtual work - D'Alembert's principle - Lagrange's equations of motion – conservative and non-conservative forces - Applications: one dimensional harmonic oscillator – Conservation theorems and symmetry properties – 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.

Unit –II Hamiltonian Formulation

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 – Canonical Transformations – Generating function - Poisson's and Lagrange's brackets – The Hamilton's Jacobi method.

Unit –III 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 of inertia tensor - Euler's equations of motion for rigid body – Theory of small oscillations – frequencies of free vibration and normal coordinates – vibrations of a linear tri-atomic molecule.

Unit –IV Relativistic Mechanics

The basic postulates of special theory of relativity – variation of mass with velocity – relativistic energy – mass-energy equivalence – Force in relativistic mechanics – The Lagrangian and Hamiltonian of a particle in relativistic mechanics - Minkowski space and Lorentz transformations – Four vectors – position, momentum and acceleration four vectors.

Unit –V Nonlinear Dynamics

Dynamical systems: Linear and nonlinear forces – mathematical implications of nonlinearity: Linear and nonlinear systems – linear super position principle – Definition of nonlinearity – Effect of nonlinearity – Free oscillations – damped oscillations – damped and forced oscillations – resonance and jump phenomena – linear Vs nonlinear oscillators - autonomous and non-autonomous systems – Equilibrium points – classification of equilibrium points – Logistic map – stability analysis – routes to chaos(in logistic map) - Definiton of chaos – Initial Conditions – solitary waves & solitons – KDV equation.

Books for Study

For unit I to IV:

1. Classical mechanics – Goldstein, Narosa Publications house, New Delhi.
2. Classical Mechanics - N. C. Rana and P. S. Joag, Tata McGraw Hill, New Delhi.
3. Classical Mechanics – J. C. Upadhyaya, Himalaya Publishing House.

For unit V

4. Nonlinear dynamics: Integrability, Chaos & Patterns - M. Lakshmanan and S. Rajasekar, Springer India,(II edition).

Books for Reference

1. T. L. Chow, classical Mechanics, John-Wiley, New York(1985)
2. R. Bhatia, classical Mechanics, Narosa publications House, New Delhi.

Course Outcome:

- To gain the knowledge about Lagrangian and Hamiltonian formulations.
- To introduce the concepts of rigid body dynamics and relativistic mechanics.
- To introduce the basic concepts of nonlinear dynamics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
I	**17P1PHC2**	**Mathematical Physics I**	**6**	**4**

Objectives:

- To introduce knowledge about vectors and tensors.
- To gain the idea about the differential equations and special functions.

Unit –I Vector Analysis

The Scalar and Vector fields – Gradient – Divergence – Curl and Laplacian in terms of orthogonal and curvilinear coordinates – Rectangular, cylindrical and spherical coordinates – Integration of vector – line integrals, surface integrals and volume integrals – Gauss divergence theorem - Stoke's theorem – Green's theorem.

Unit –II Tensor Analysis

Cartesian tensors – addition, subtraction and multiplication (inner and outer product) of tensors – rank – Kronecker delta symbol – Covariant, Contravariant and mixed tensors – Symmetric and antisymmetric tensors – Quotient Law – Contraction – Riemannian spaces – Christofell's three index symbols – Law of transformation for Christofell's symbols – Examples from Physics.

Unit –III Matrices

Solution of linear algebraic equation – Rank of a matrix – Characteristic equation of a matrix – inverse of matrix – Eigen values and eigenvectors – Trace of matrix – Clayey - Hamilton theorem – Reduction of a matrix to diagonal form (Diagonalization) – Hermitian and unitary matrices – Direct sum and product of matrices - Sylvester's theorem – Matrices in Physics: Derivations of spin matrix and Dirac matrices.

Unit –IV Ordinary differential equations

Some definitions – Common differential equations arising in Physics – Linear first order differential equations – Elementary methods – Linear second order differential equations with (i) constant and (ii) variable coefficients methods – Power series solution: Frobenius method – variation of parameters – Sturm-Liouville's differential equation.

Unit - V Partial differential equations

Linear Partial differential equations – separation of variables – Laplace, wave and heat equations in two and three dimensions – Helmholtz equation in Cartesian, spherical polar and cylindrical polar coordinates – choice of coordinate system and separability of a partial differential equation.

Books for Study

1. Mathematical Physics – B. D. Gupta, Vikas publishing house pvt ltd.
2. Mathematical Physics – Sathya Prakash, Sultan Chand & Sons, New Delhi.
3. Matrices and Tensors in Physics – A.W. Joshi, Wiley Eastern publishers, New York, 1975.
4. Mathematics for Physicists- Susan M. Lea, Thomson Brooks/Cole, International Students Edition. (Only for Indian subcontinent only).

Books for Reference

1. Vector Analysis – Schaum's outline series.
2. Applied mathematics for engineers and physicists (TMH, Singapore,1967)
3. Mathematical physics – A. K. Ghattak, T. C. Goyal and S. J. Chua, Macmillan, New Delhi, 1995.

Course Outcome:

- To introduce knowledge about vectors and tensors.
- To gain the idea about the differential equations and special functions.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
I	**17P1PHC3**	**Statistical Mechanics**	**6**	**4**

Objectives:

- To introduce the knowledge about the statistical description of particles.
- To introduce the concepts of Quantum statistics and phase transitions.

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 – Gibbs – Helmholtz relations – thermodynamic equilibrium

Unit – II Statistical description of system of particles

Statistical formulation of a state system – calculation of pressure using time independent scenario - phase space – density distribution in phase space – Liouville's theorem – equation of motion and Liouville's theorem – ensembles – types and ensemble average – equal apriori probability – statistical equilibrium – isolated system – system in contact with heat reservoir – calculation of mean values in a canonical ensemble and connection with thermodynamics.

Unit-III Simple Applications

Concept of partition function – their properties - ideal monatomic Gas-calculation of thermo dynamic quantities – Gibb's paradox – equipartition theorem – proof – simple application – Harmonic oscillator – characteristics of crystalline solids – specific heat by Einstein model – Debye's modification.

Unit-IV Quantum statistics of Ideal gases

Identical particles – symmetry requirements – formulation of statistical problems – quantum distribution functions from partition function: Photon, Fermi-Dirac and Bose – Einstein statistics – chemical potential – Bose-Einstein condensation.

Unit-V Phase Transitions

General remarks on phase transitions – First and Second order – non ideal gas – calculation of partition function for low densities – equation of state and Virial coefficients- derivation of Vander Wall's equation – spin-spin interaction – one dimensional Ising model – Weiss molecular field approximation.

Books for Study

1. Fundamentals of statistical and thermal Physics - Frederick Reif, (McGraw–Hill, New York,1965).
2. Statistical mechanics –B. K. Agarwal and Meisner, New age international Publishers, 2003.

Books for Reference

1. Thermodynamics, kinetic theory and statistical thermodynamics - F.W. Sears and G.L.Salinger, Narosa publishing House.
2. Statistical Mechanics – Huang, Wiley India Publishers, 2nd Ed, 2005.
3. Elementary Statistical mechanics – S.L.Gupta and V. Kumar, Pragati Prakashan Publishers, Meerut.

Course Outcome:

- To introduce the knowledge about the statistical description of particles
- To introduce the concepts of Quantum statistics and phase transitions.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
I	**17P1PHCP1**	**Major Practical – I**	**6**	**4**

List of Experiments – Any 10 Experiments

1. Determination of q, n, σ by forming Elliptical fringes.
2. Determination of q, n, σ by forming hyperbolic fringes.
3. Determination of Stefan's constant.
4. Hartmann's formula – Wavelength calculation.
5. Determination of Dielectric constant using Lechere wire.
6. Determination of e/m by magnetron method.
7. Determination of Polarisibility of liquids using Spectrometer.
8. Determination of Charge of an electron by Spectrometer.
9. Identification of Prominent lines by Spectrum Photograph – Iron Arc Spectrum
10. Identification of Prominent lines by Spectrum Photograph – Copper arc Spectrum
11. Ultrasonic Diffraction – Velocity and Compressibility
12. Determination of Rydberg's Constant using Spectrometer.
13. Determination of e/m by Zeeman Effect.
14. Determination of Dielectric Constant using Wave meter.
15. Determination of Conductivity of thin film sample – four probe method.

Course Outcome:

Students acquire skills on carrying out general experiments in optics, solid state physics etc.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
I	**17P1PHEL1A**	**Major Elective – I Nanophysics**	**6**	**4**

Objective:

- To gain the knowledge about Nanotechnology.

Unit I Background and emergence of Nanotechnology

Atomic structure – Periodic table – Molecules and phases – Energy – Emergence of nanotechnology – Nanomaterials – types – characteristics – surface to volume ratio – its effect on properties of nanomaterials – Nanoparticles, wires, composites and nanoclusters – Applications of nanomaterials.

Unit II Preparation of nanomaterials

Nanomaterials – Preparation – Top-down method – Ball milling – Nanolithography – Photolithography – Electron beam lithography – Molecular beam epitaxy – Bottom-up technique – Molecular self assembly – Sol-gel synthesis.

Unit III Carbon nanotubes

Carbon age – new carbon forms – carbon clusters – discovery of C_{60} – Carbon fullerences – Bucky balls – Nanotubes – synthesis of single walled nanotubes – multiwalled nanotubes – thermal and mechanical properties – Applications of CNTs.

Unit IV Characterization Techniques

Structural characterization – Principle of X-ray powder diffraction – Determination of structural parameters – Optical studies – UV-Vis-NIR – Raman & IR spectral analysis – Surface morphological analysis– SEM – AFM – TEM.

Unit V Photonics & Nanoelectronics

Interaction of light and nanomaterials – Properties of light and nanophotonics – Nano manipulation – Imaging – Photonic crystals – New low cost energy efficient windows – Nanoelectronics – birth of electronics – Molecular diodes, transistors – quantum electronic devices.

Books for Study

1. Essentials of Nanotechnology, Preedep.
2. Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial college press, London.
3. NanoScience and nanotechnology K.P.Mathur, 1stEdition 2007, RajatPublications, NewDelhi

Books for Reference

1. M.Ratner.et al., Nanotechnology; A Gentle introduction, Prentice – Hall ISBN 0-13-101400-5, 2003.
2. Nanotechnology; Basic Science and Emergining Technologies, CRC Press
3. Charles P.Poole Jr and Frank J. Owens. "Introduction to Nanotechnology" Wiley, 2003.
4. A.S. Edelstein and R.C. Cornmarata, Nanomaterials; synthesis, Properties and Applications, 2 Ed, Iop (U.K), 1996.

Course Outcome:

- To gain the knowledge about Nanotechnology.

Semester	Subject Code	Title of the Paper	Hours of Teaching /week	No. of Credits
I	**17P1PHEL1B**	**Major Elective – I Laser and Fiber Optic Communication**	**6**	**4**

Objectives:

- To give general ideas on Lasers.
- To gain the knowledge about fiber optics.

Unit-I Principles of Laser

Basic principle of laser – Laser characteristics – coherence – temporal coherence principles of laser – absorption – spontaneous emission – stimulated emission – Einstein's theory of stimulated emission – population inversion – methods of achieving population inversion – Threshold condition – Pumping – pumping methods – Pumping schemes.

Unit – II Types of Lasers

Types of lasers – solid state lasers – Ruby lasers – construction and working - semiconductor laser – GaAs laser Gas lasers: He Ne laser – working principle – energy level diagram – argon ion laser – helium cadmium laser – molecular gas laser - Co2 laser – principle – construction and working – Continuous wave and pulsed lasers – Nd-YAG laser - Q switching – model locking – frequency doubling – Tunable laser – liquid lasers.

Unit – III Laser Applications

Laser materials – preparation and testing – Applications of lasers – interferometery – testing of optical system – lasers in communication – in computers – weapons – medical applications – industrial applications. Holography – Hologram – Recording and reconstruction of hologram – characteristics of hologram – classifications – Applications.

Unit – IV Optic Fibers

Fiber optic revolution – Characteristics of optical fiber – Acceptance agle – Numerical aperture – Propagation of light through optical fiber – Theory of mode formation – Classification of fibers – Step index and graded index fibers – single mode and multi mode fibers – Losses in fibers – Fabrication techniques of fibers.

Unit – V Fiber optic communication

Source and detectors for fiber optic communication - LASER and LED – Modulation methods – principle of optical detection – Pin and Photo detectors – Noise – Design of fiber optic communication system.

Books for Study

1. Laser theory and applications, K. Thyagarajan, Ajay Ghatak, Cambridge University, 1999.
2. An introduction to laser theory and applications, M. N. Avadhanulu, S. Chand and Co., New Delhi 2001.
3. Introduction to Fiber optics K. Thyagarajan, Ajay Ghatak, Cambridge University, 1999.

Books for Reference

1. Lasers and their applications- Besley- Taylor & Fancis. London
2. Lasers and their applications- J.Wilson, J.F.B.Hawkes - Prentice Hall- 1987.
3. Optical Fiber Communications, John. M. Senior, Cambridge University press, 1966.

Course Outcome:

- To give general ideas on Lasers.
- To gain the knowledge about fiber optics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHC4**	**Electromagnetic theory**	**5**	**5**

Objectives:

- To acquire the knowledge in Electrostatics and Magnetostatics.
- To introduce the knowledge about the electromagnetic waves and relativistic electrodynamics.

Unit – I Electrostatics

Gauss law – Application to cylindrical and spherical surfaces – Coulomb's Theorem – electric field – Divergence of E – Curl of E – scalar potential – Multipole expansion of electric field – The Dirac Delta function – Poisson's equation – Laplace's equation – Uniqueness theorem - Green's theorem – Formal solution of electrostatic field – Boundary value problems using Green's function – Method of electrical images – Electrostatic potential energy and energy density

Unit – II Magnetostatics

Biot-Savart's law – Application to straight conductor and solenoid – Differential equations of magnetostatics and Ampere's law – The magnetic vector potential – Magnetic scalar potential – The multipole expansion of the vector potential – Magnetic moment – Macroscopic magnetization – Susceptibility and Permeability.

Unit – III Time Varying Fields

Electromagnetic induction – Equation of continuity – Displacement current – Derivation of Maxwell's electromagnetic equations – Gauge transformation – Lorentz and Coulomb's Gauge transformations – Poynting's theorem.

Unit – IV Electromagnetic waves

Plane wave in a non – conducting medium – Boundary conditions – Reflection and transmission of e. m. wave at oblique incidence – Total internal reflection – Brewster's angle – Frequency dispersion – Characteristics of dielectrics and conductors – Retarded potentials – Lienard - Wiechart's potentials – Wave guides, Rectangular and circular mode of propagation.

Unit – V Relativistic Electrodynamics

Lorentz transformation for space and time in four vector form – invariance of D'Alembertian operator – invariance of Maxwell's field equations in terms of four vectors – electromagnetic field tensors – Maxwell's equations in co-variance four tensors form – Lorentz transformation of electromagnetic fields – in variance of electromagnetic field.

Books for Study

1. Introduction to Electrodynamics – David J. Griffiths, PHI learning, 2009.
2. Electromagnetic waves and radiating fields – Jordon and Balmain, Krieger publishing company, 2003.
3. Electrodynamics – Chopra and Agarwal, K. Nath & Co, Meerut.
4. Electromagnetic theory and Electrodynamics – Sathya prakash, Kedarnath Ramnath & Co, Meerut.

5. Electrodynamics – Gupta, Kumar and Singh, Pragati Prakashan Publishers, Meerut.

Books for Reference

1. Classical Electrodynamics – J. D. Jackson, Wiley Eastern publishing ltd.
2. Introduction to electromagnetic fields and waves – Corson and Lorraine, W. H. Freeman and company, New York.

Course Outcome:

- To acquire the knowledge in Electrostatics and Magnetostatics.
- To introduce the knowledge about the electromagnetic waves and relativistic electrodynamics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHC5**	**Mathematical Physics – II**	**5**	**4**

Objectives:

- To gain the knowledge in complex variables, matrices, vector spaces and Green's functions.
- To introduce the concepts of Fourier transform and group theory.

Unit - I Complex Variables

Functions of a complex variable – single and many valued functions – Analytic functions – Cauchy-Riemann equation – conjugate functions – complex line integrals – Cauchy's integral theorem – integral formula – Taylor and Laurent series expansion – poles, singularities and Residues – Cauchy's residue theorem and its applications in evaluating integrals.

Unit - II Vector Spaces and Green's Functions

Vector Spaces: Definition – linear dependence and linear independence of vectors – Basis – change of basis – inner product space – Schmidt's orthogonalisation procedure – Schwarz's inequality – Hilbert space.

Green's Functions: Definition, construction and uses – symmetry properties – Expression for Green's function in terms of Eigen values – Green's functions for simple and second order operators.

Unit - III Fourier and Laplace transforms

Fourier transform – finite and infinite – sine and cosine transform – complex transform – Faltung's theorem – Properties of fourier transform – Application in wave equations – Laplace transform – Properties – Inverse laplace transforms – Convolution theorem – Evaluation of inverse Laplace transforms – Equation using laplace transforms – Applications.

Unit - IV Special functions

Gamma and Beta functions – Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equation and their solutions - Generating functions - Rodrigue formula -Important recurrence relations - Orthogonality relations.

Unit – V Group Theory

Basic definition – multiplication table – sub groups, cossets and classes – direct product groups – point groups and space groups – representation theory – isomorphism and homomorphism – reducible and irreducible representations – Schurz's lemma – The great orthogonality theorem – character table for C3V point groups – rotation groups – SU(2), SU(3) and O(3) groups.

Books for Study

1. Mathematical physics – B. D. Gupta, Vikas publishing house pvt ltd.
2. Mathematical physics – Sathya prakash, Sultan Chand & Sons, New Delhi.

3. Matrices and tensors in physics – A.W. Joshi, Wiley Eastern publishers, New York, 1975.

Books for Reference

1. Advanced Engineering Mathematics, E. Kreyzig (Wiley Eastern publishers, New York, (1999).
2. Integral Transforms, J. K. Goyal, K. P. Gupta, Pragati Prakashan Publishers, 2002.
3. Applied mathematics for engineers and physicists (TMH, Singapore, 1967)

Course Outcome:

- To gain the knowledge in complex variables, matrices, vector spaces and Green's functions.
- To introduce the concepts of Fourier transform and group theory.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHC6**	**Electronics and Instrumentation**	**5**	**4**

Objective:

- To gain the knowledge in Electronics and Instrumentation.

Unit - I Analog Electronics

Precision and accuracy–Introduction: Op-amp– op-amp based circuits: Integrator-Differentiator– Summing– Differential–Logarithmic amplifier – comparators and controls–Analog simulation–Wein Bridge oscillators using op-amp– Instrumentation Amplifier–Solid state switching circuits – 555 Timer– Discrete and integrated voltage regulators.

Unit – II Digital Electronics

Logic gates-Combinational logic circuits-Flip Flop: SR-JK-M/S-D-T Flip Flop- Register: Left shift and right shift register – Counter: Modulus of a counter – MOD X counter (Feedback only)–4 bit asynchronous Ripple counter– Ring counter - A/D Convertor: Simultaneous conversion – Dual slope method – D/A convertor: Variable resistor network–R2Rmethod–Computer and Microprocessor: Introduction– Architectures - Sample & Hold Circuits.

Unit – III Optoelectronics

Semiconductor lasers – optical fiber and characteristics – modes of propagation – losses in fibers – fiber optic communication, optoelectronic modulation and switching devices – Photo detectors – Optocoupler and isolators – Optical data storage techniques.

Unit – IV Instrumentation - I

Static characteristics–Error in measurement– Errors: Gross error – Systematic error–Random error– Dynamic characteristics – Statistical analysis – Permanent magnetic moving coil –Taut band instrument – Electrodynamometer – moving iron type instrument –LCD – Dot matrix display – Liquid vapour display.

Unit – V Instrumentation – II

Qualities of measurements–digital instruments: Digital multimeter – transducers, strain gauge, LVDT, Load cell, piezo electric transducers, temperature transducers, flow meters - recorders and transducers – signal conditioning – data acquisition, conversion and transmission– digital signal processing.

Books for Study:-

1. B.G. Stretman and S. Banerjee, 'Solid state electronic devices', (5th Edition), Pearson Education Inc., New Delhi, (2000).
2. A.P. Malvino, 'Electronic principles', (6th Edition), Tata McGraw Hill Publ. Co.Ltd., New Delhi (1999).
3. Robert T. Paynter, "Introductory electronic devices and circuits", Pearson Education Inc., New Delhi, (2009).
4. T.L.Floyd, Electronic Devices (6th Edition), Pearson Education Inc., New Delhi, (2003).

Books for Reference:-

1. P. Bhattacharya, Semiconductor Optoelectronic Devices, 2nd Edition, Pearson Education Inc., New Delhi, (2002).
2. H. S. Kalsi, Electronic Instrumentation, 2nd Edition, Tata McGraw Hill Publishing Co., New Delhi, (2004).
3. William David Cooper, Electronic Instrumentation and Measurement techniques – Prentice Hall of India Pvt. Ltd., (1991).
4. A. K. Sawhney, Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons, New Delhi, (1990).

Course Outcome:

To gain the knowledge in Electronics and Instrumentation.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHC7**	**Numerical Methods in Physics**	**5**	**4**

Objective:

- To gain the knowledge in Numerical methods in physics.

Unit – I Errors and Curve fitting

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 – Algorithms and convergence.

Unit – II Numerical solution of Algebraic and Transcendental equations

The iteration method – the bisection method – The method of false position – Newton – Raphson method - C++ program for finding roots using Newton – Raphson method - Simultaneous Linear algebraic equations: Direct methods – Gauss elimination method – Gauss – Jordan method – Iterative method – Jacobi's method – Gauss Seidel iterative method – C++ Program for solution of linear equations.

Unit – III Interpolation

Finite differences – 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 - C ++programming for Lagrange's interpolation.

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 rule – Extended Simpson's rule – Use of cubic splines – Romberg integration – C++ Program to evaluate integrals using Simpson's and trapezoidal rules – Gaussian integration.

Unit – V Numerical solutions of ordinary differential equations

Solution by Taylor's series – Picard's method of successive approximation – Euler's method – Modified Euler's method – Runge Kutta method – second and fourth order – Predictor – Corrector method – Milne's method – C++ program for solving ordinary differential equations using RK method.

Books for Study

1. Unit I-IV – Numerical methods in Science and Engineering - G. Venkatraman, National Publishing Co., Chennai, 2001.
2. Unit V - Numerical methods - E. Balagurusamy, McGraw Hill Publishing Company.
3. Introductory methods of Numerical Analysis – S.S. Sastry, IV Ed, PHI learning pvt ltd, 2006.
4. Numerical methods – Maccormic, Prentice hall.

Books for Reference

1. Numerical Methods for Scientific and Engineering Computation – M. K. Jain, S. R. K. Iyengar, R. K. Jain, New age international, New Delhi, 1983.
2. Numerical Methods – P. Kandasamy, K. Thilagavathi and Gunavathy S. Chand & Co, New Delhi, 2010.

Course Outcome:

To gain the knowledge in Numerical methods in physics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHCP2**	**Major Practical - II**	**6**	**4**

List of Experiments – Any 10 Experiments

1. Construction of power supply – Bridge rectifier
2. Feed-back Amplifier
3. Monostable Multivibrator – Transistors
4. Phase – shift oscillator
5. Characteristics of JFET
6. Characteristics of UJT
7. Common source FET Amplifier
8. Relaxation oscillator – UJT
9. Operational Amplifier – Parameters (Input impedance, output impedance, off-set voltage)
10. Operational Amplifier- applications (inverting, Non inverting, unit gain and closed loop gain)
11. Operational Amplifier – Summing and Difference amplifiers
12. Operational Amplifier – Differentiating and integrating circuits
13. Dual Power Supply- construction
14. Half Adder, Hall- Subtractor, Full Adder and Full- Subtractor
15. 4-bit Parallel Binary Adder.

Course Outcome:

Students acquire skills in doing experiments in analog and digital electronics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHEL2A**	**Major Elective – II Crystal Growth & Thin Films**	**4**	**4**

Objectives:

- To introduce the knowledge of crystal growth
- To know the basic ideas of thin films

Unit – I Nucleation and Growth

Nucleation – Different kinds of nucleation - Concept of formation of critical nucleus – Classical theory of nucleation - Spherical and cylindrical nucleus – Growth Kinetics of Thin Films - Thin Film Structure – Crystal System and Symmetry.

Unit – II Growth Techniques

Solution Growth Technique: Low temperature solution growth: Solution - Solubility and super solubility –Expression of super saturation – Miers T-C diagram - Constant temperature bath and crystallizer - Seed preparation and mounting - Slow cooling and solvent evaporation methods.

Gel Growth Technique: Principle – Various types – Structure of gel – Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and decomplexion method – Advantages of gel method.

Unit – III Melt and Vapour Growth Techniques

Melt technique: Bridgman technique - Basic process – Various crucibles design – Thermal consideration – Vertical Bridgman technique – Czochralski technique – Experimental arrangement – Growth process.

Vapour technique: Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical Vapour Transport.

Unit – IV Thin Film Deposition Techniques

Thin Films – Introduction to Vacuum Technology - Deposition Techniques – Physical Methods – Resistive Heating, Electron Beam Gun, Laser Gun Evaporation and Flash Evaporations, Sputtering - Reactive Sputtering, Radio-Frequency Sputtering – Chemical Methods – Spray Pyrolysis – Preparation of Transparent Conducting Oxides.

Unit – V Characterization Techniques

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier transform Infrared analysis (FT-IR) – Elemental analysis – Elemental dispersive X-ray analysis (EDAX) -Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vickers Micro hardness.

Books for Study

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986)
2. A. Goswami, Thin Film Fundamentals, New Age International (P) Limited, NewDelhi (1996)

Books for Reference

1. P. SanthanaRagavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam (2001)
2. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS, Publishers and Distributors, New Delhi

Course Outcome:

- To introduce the knowledge of crystal growth
- To know the basic ideas of thin films

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
II	**17P2PHEL2B**	**Major Elective – II Medical Physics**	**4**	**4**

Objective:

- To gain the knowledge about Medical Physics

Unit – I Terminology, Modeling and Measurement

Terminology, Modeling and Measurement – Applications of Electricity and Magnetism in Medicine – Electrical Shock, High frequency Electricity in Medicine – Low – frequency Electricity and Magnetism in Medicine.

Unit – II Light in Medicine

Measurement of light and its units, Application of visible light in Medicine, Applications of Ultraviolet and Infrared light in Medicine, Lasers in Medicine - Physics of diagnostic X Rays – making an X- ray image – radiation to patient from X-rays - producing live X- ray images – Fluoroscopy.

Unit – III Radio isotopes in Medicine (Nuclear Medicine)

Sources of Radioactivity for Nuclear Medicine – Basic Instrumentation and its clinical applications – Nuclear Medicine imaging devices – Therapy with radioactivity - Radiation doses in Nuclear Medicines.

Unit – IV Radiation Protection in Medicine

Biological effects of ionizing radiation – Radiation protection in Diagnostic Radiology – Radiation protection in Radiation therapy – Radiation protection in Nuclear Medicine – Radiation Accidents.

Unit – V Computers in Medicine

History taking – Laboratory Automation – Electrocardiogram interpretation – Patient monitoring – Drug-test interactions – prescribing drug dosage – Pulmonary function testing - Medical record systems – Hospitals book keeping – other uses of computers in medicine.

Books for Study

1. Medical Physics: by John R. Cameron & James G. Skofronick, A Wiley – Interscience Publication, John Wiley & Sons.

Course Outcome:

To gain the knowledge about Medical Physics

Semester	Subject Code	Title of the Paper	Hours of Teaching /week	No. of Credits
III	**17P3PHC8**	**Solid State Physics**	**5**	**4**

Objective:

- This course deals with theoretical aspects of band theory, lattice vibration, dielectrics, ferroelectrics, superconductivity.

Unit – I Crystal Structure and Imperfections

Crystal symmetry – Bravais lattices – reciprocal lattice – X-ray diffraction – Bragg's law – experimental methods of x-ray diffraction: Rotating crystal method and Debye – Scherrer powder method- Atomic scattering factor – geometrical structure factor - Classification of imperfections: point defects – line defects – surface defects – volume defects – colour centres – Burger's vector – Schottky defects and Frenkel defects – Derivation.

Unit – II Conductors and Semiconductors

Conductors: Free electron theory – Classical and Quantum theory – Band theory of solids – Density of states – K- space – Bloch theorem – Kronig – Penny model – Construction of Brillouin Zones – Semiconductors: Intrinsic and Extrinsic semiconductors – Band gap –Effective mass – Carrier concentration – Electrical conductivity – Hall effect – Determination of type of conductivity – carrier concentration – mobility resistivity.

Unit – III Magnetic and Dielectric properties

Langevin's classical theory of diamagnetism and paramagnetism – Quantum theory of paramagnetism – Weiss theory of ferromagnetism – origin of domains – Hystersis – explanation on the basis of domain theory – Curie temperature and Neel temperature – Dielectrics – Macroscopic electric field – local electric field – dielectric constant and polarizability – types of polarization – Clausius - Mosotti relation – determination of dielectric constant – parallel plate method.

Unit – IV Lattice Vibrations and optical properties

Wave motions of one dimensional atomic lattice – wave motion of linear diatomic lattice – optical and acoustical modes – infrared absorption – inelastic scattering of neutrons – inelastic scattering of x-rays – Photoconductivity – Simple model of photoconductor – traps - influence of traps – Luminescence and its types – Emission and absorption spectra – Thermoluminescence and glow curve.

Unit – V Super Conductivity

Zero resistance – behaviour in magnetic field – Meissner effect – Type I and Type II superconductors – entropy – Isotopic effect - Thermal conductivity – London equations - penetration depth – Josephson Effect – AC and DC – Quantum tunneling – BCS theory – high Tc super conductors – SQUID.

Books for Study:-

1. Introduction to Solid State Physics – Charles Kittel, John Wiley,2004.
2. Solid State Physics – Gupta & Kumar, K. Nath & Co, Meerut, 2000.
3. Solid State Physics – Singhal, Kedarnath Ramnath & Co, Meerut,2005.

4. Material Science – M.Arumugam.

Books for Reference:

1. Elementary solid state physics–Ali Omar, Addison Wesley Publishing Company, 1975.
2. Elements of Solid State Physics – J.P.Srivastava, Second Edition.
3. Solid State Physics and Electronics – A.B.Gupta & Nurul Islam.

Course Outcome:

This course deals with theoretical aspects of band theory, lattice vibration, dielectrics, ferroelectrics, superconductivity.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
III	**17P3PHC9**	**Quantum Mechanics**	**5**	**5**

Objectives:

- To gain the knowledge about quantum mechanics.
- To introduce the ideas of relativistic quantum mechanics.

Unit – I Quantum Basics

Schrodinger time independent and dependent equations – solution of free particle (1 Dimensional) – particle in a box – arbitrary potential – physical Interpretation of Ψ-wave function in momentum representation – normalization – conservation of probability – expectation values: Ehrenfest theorem – Basic postulates – Operators: Definition and properties of self adjoint operator – Eigen values and Eigen functions – Parity operator - uncertainty principle. (Statement and Proof)

Unit – II Exactly solvable systems

One dimensional linear harmonic oscillator – solutions to a square well potential – spherically symmetric potential and Schrodinger equation – Rigid rotator: Eigen values and radial wave function – hydrogen atom: energy eigen values and complete wave function (Ψ_{100})

Unit – III Equation of motion and angular momentum

Quantum pictures: Schrodinger, Heisenberg and Interaction – Angular momentumoperator – Commutation rules – the eigenvalue spectrum – raising and lowering operators – C.G coefficients (no properties of C.G coefficients) – C.G coefficients when $J_1=J_2=1/2$

Unit – IV Approximation methods

Equations in various orders of perturbation theory – the non- degenerate case: first and second order – Stark effect – Zeeman effect – variation method - <E> in ground state - Application to excited states: Helium atom – Ground state energy of He – time dependent perturbation theory – Zeroth order calculation – Harmonic perturbation (Fermi-Golden rule)

Unit – V Relativistic Quantum Mechanics

K.G. equation – charge and current densities – Dirac's equation for free particle – plane wave solution – Dirac matrices – properties spinners – spin of Dirac's particle-Zitterbewegung – Negative energy states – spin magnetic moment.

Books for Study

1. A text book of quantum mechanics - P. M. Mathews and Venkatesan, 27th reprint, Tata McGraw Hill Company, New Delhi, 2002.
2. Quantum mechanics: Theory and Problems -S. L. Kakani and Chandyla, Sultan chand & Sons, (IV Edition).
3. Quantum mechanics - V. K. Thangappan, New age international, New Delhi.

Books for Reference

1. Quantum mechanics – Schiff, McGraw Hill book company.

2. Quantum mechanics – E. Merzbacker.
3. Quantum mechanics – A. Messiah, John Wiley & Sons.
4. Principles of Quantum mechanics–R. Shankar, Kluwer academic/ plenum press, 1994.
5. Quantum mechanics - G. Aruldhas, PHI learning private limited, New Delhi.

Course Outcome:

- To gain the knowledge about quantum mechanics.
- To introduce the ideas of relativistic quantum mechanics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
III	**17P3PHC10**	**Microcontroller-Programming and Applications**	**5**	**4**

Objectives:

- To introduce the concepts of microcontroller programming.
- To gain the knowledge about microcontroller based applications.

Unit – I Microcontroller Architecture

Microprocessor and Microcontrollers comparison–The Z80 and the 8051-A microcontroller survey–The 8051 architecture– 8051 oscillator and clock–program counter data pointer–CPU registers– Flags and the program status word (PSW)– Internal memory–internal RAM and ROM–The stack and the stack pointer–special function registers.

Unit – II I/O Ports and Interrupts and Introduction to Assembly Language

Input/output pins, ports and circuits - external memory – counter and timers – timer mode of operation – Serial data input/output: serial data interrupts – serial data transmission modes – Interrupts: Timer flag interrupt – serial port interrupt – external interrupts – Interrupt control – Interrupt priority – Assembly language: The mechanics of Programming – high level and low level assembly languages – why use assembly language? – The assembly language programming process.

Unit – III Assembly language Programming Concepts

Programming tools and techniques – understanding the problem to be solved – designing a program – Flow charts – writing and testing the program – Programming the 8051: 8051 instruction syntax – Moving data: Addressing modes– External data moves – code memory– read only data moves – push and pop opcodes– data exchanges – example programs – Logical operations: Byte level logical operations– Bit level logical operations – Rotate and swap operations – example programs.

Unit –IV Arithmetic Operations

Flags – incrementing & decrementing – Addition – subtraction – Multiplication and Division – decimal arithmetic – programs – Arithmetic operations – finding smallest and greatest in array – Ascending and Descending order – Jump and call instructions: Jump and Call program range –Jumps – bit jumps – byte jumps – Calls and subroutines – interrupts and returns – programs – pattern comparison – delay routines.

Unit – V Applications

Key boards – displays – Pulse measurement – D/A & A/D conversions – multiple interrupt – Stepper motor interfacing – traffic light control – water level indicator – temperature measurement and control – frequency measurement.

Books for Study

1. The 8051 Microcontroller – Architecture, Programming and Applications, Kenneth J. Ayala.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C. Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rolin D. Mckinlay– Chapter- V and VI.
3. Microprocessors and microcontroller - Krishna Kant-Chapter XIII

Books for Reference

1. Introduction to microprocessor – Aditya, P. Mathur
2. Programming and customizing the 8051 microcontroller- Myke Predco, Tata McGraw Hill Publishing company ltd, New Delhi.

Course Outcome:

- To introduce the concepts of microcontroller programming.
- To gain the knowledge about microcontroller based applications.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
III	**17P3PHC11**	**Biomedical Instrumentation**	**4**	**4**

Objective:

- To introduce the knowledge in Biomedical Instrumentation.

Unit - I Human Physiological Systems

Cells and their structure – Nature of Cancer cells – Transport of ions through the cell membrane – Resting and action potentials – Bio-electric potentials – Nerve tissues and organs – Different systems of human body – Biopotential Electrodes and Transducers Design of Medical instruments – components of the biomedical instrument system – Electrodes – Transducers.

Unit - II Biosignal Acquisition

Physiological signal amplifiers – Isolation amplifiers – Medical preamplifier design – Bridge amplifiers – Line driving amplifier – Current amplifier – Chopper amplifier – Biosignal analysis – Signal recovery and data acquisition – Drift Compensation in operational amplifier – Pattern recognition – Physiological Assist Devices – Pacemakers – Pacemakers batteries – Artificial heart valves – Defibrillators – nerve and muscle stimulators Heart – Lung machine – Kidney machine.

Unit - III Biopotential Recorders

Characteristics of the recording system – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electroretinogrphy (ERG) and Electroculography (EOG) – Recorders with high accuracy – recorders for OFF line analysis.

Unit – IV Operation Theatre Equipment

Surgical diathermy- shortwave diathermy – Microwave diathermy – Ultrasonic diathermy – Therapeutic effect of heat – Range and area of irritation of different techniques – Ventilators – Anesthesia machine – Blood flow meter – Cardiac Output measurements – Pulmonary function analyzers – Gas analyzers – Blood gas analyzers – Oxymeters – Elements of intensive care monitoring.

Unit - V Specialized Medical Equipments

Blood Cell counter – Electron microscope – Radiation detectors – Photometers and colorimeters – digital thermometer – audiometers – X-rays tube – X-ray machine – image intensifiers – Angiography – Application of X-ray examination – Safety instrumentation: Radiation safety instrumentation – Physiological effects due to 50Hz current passage – Micro shock and macro shock – electrical accident Hospitals – Devices to protect against electrical hazards – Hospitals architecture.

Books for study

1. Dr. M. Arumugan–Biomedical instrumentation, Anurada Agencies Publishers, 1992.
2. R.S Khandpur, "Handbook on Biomedical Instrumentation", Tata McGraw Hill Company, New Delhi, 1989
3. Ohn G Webster, Ed., "Medical Instrumentation Application and Design", Third edition, John Wiley & Sons, Singapore, 1999

Books for Reference

1. L. Cromwell, F. J. Weibell, E. A. Pfeiffer – Biomedical instrumentation and Measurements, PHI second edition, 1993.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education Asia, New Delhi, 4th Edition, 2001.

Course Outcome:

To introduce the knowledge in Biomedical Instrumentation.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
III	**17P3PHCP3**	**Major Practical - III**	**6**	**4**

List of Experiments – Any 10 Experiments

1. Op. Amp- Solving linear equations.
2. Op. Amp- Waveform generation- sine, square and ramp.
3. Solving Boolean expressions using gate circuits.
4. Counters construction and 99
5. Op. Amp - Wien's Bridge Oscillator.
6. 555timer - Astable multivibrator and VCO
7. Determination of Thickness of transparent sheet using Michelson interferometer.
8. Determination of wavelength of monochromatic source using Michelson interferometer.
9. Determination of Magnetic Susceptibility of a liquid by Guoy method.
10. Determination of Magnetic Susceptibility of a liquid by Quincke's method.
11. Spectrograph - ALO band/ Iodine absorption spectrum.
12. Design of arithmetic and logic unit.
13. Construction -1x1 RAMS.
14. Construction of A/D converter.
15. Construction of D/A converter.
16. Op Amp – low pass and high pass filters.
17. Hall effect- Determination of Hall coefficient and carrier concentration.
18. Determination of g- factor using Electron spin Resonance spectrometer
19. Magneto- resistance of power samples.
20. Laser- Grating- Determination of wavelength.
21. Fiber optics experiments.
22. Determination of wavelength and thickness using Biprism
23. Resistivity of semiconductor.
24. Study of Transducers.
25. Multiplexer and Demultiplexer using gates.

Course Outcome:

Students acquire skills in writing and executing assembly language programs (microcontroller) and C++ programs.

Semester	Subject Code	Title of the Paper	Hours of Teaching /week	No. of Credits
IV	**17P4PHC12**	**Atomic and Molecular Spectroscopy**	**6**	**4**

Objectives:

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

Unit – I Atomic and Molecular Structure

Central field approximation – Thomas - Fermi statistical model – Spin – orbit interaction – Alkali atoms – Doublet separation – intensities – Complex atoms – Coupling schemes – energy levels – Selection rules and intensities in dipole transition – Paschen-Back effect- Hitler – London theory – atomic and molecular hybrid orbital's – Hartee Fock equation – method of self consistent field.

Unit – II Raman Spectroscopy

Raman scattering- basic principle – classical and quantum theory of Raman effect- Emission and absorption coefficients – experimental techniques of Raman spectroscopy – spontaneous and induced emission of radiation – Rayleigh scattering – Kramers – Heisenberg dispersion formula – basic principles of Raman Scattering – determination of molecular structure – XY, XY2, XY3 type molecules.

Unit – III Infrared and Microwave Spectroscopy

Characteristic features of pure rotation – vibration – rotation vibration – of a diatomic molecule – theory – evaluation of molecular constants – IR spectra of polyatomic molecules – experimental techniques of IR – Dipole moment studies – molecular structure determination – microwave spectra of polyatomic molecules – experimental techniques of microwave spectroscopy – inversion spectrum of ammonia – Maser principles – Ammonia maser– applications of Masers.

Unit – IV NMR & ESR Spectroscopy

NMR spectroscopy – Basic principles- classical and quantum mechanical techniques – Bloch equations – spin-spin and spin-lattice relaxation times – experimental technique – single coil and double coil methods – applications of P NMR and C NMR to identify the structure of carboxylic group elements and alcoholic group elements – ESR spectroscopy – basic principles – ESR spectrometer – Nuclear interaction and hyperfine structure – Relaxation effects - 'g' factor – biological applications – simple experimental set up for ESR.

Unit – V NQR & Mossbauer Spectroscopy

NQR spectroscopy – basic principles – quadruple Hamiltonian – Nuclear quadruple energy levels – for axial and non axial symmetry – NQR spectrometer – chemical bonding – molecular structure and molecular symmetry studies – Mossbauer spectroscopy – principle experimental arrangement – chemical shift – quadruple splitting – applications.

Books for Study

1. Basic principles of spectroscopy – R. Chang.
2. Introduction to Atomic Spectra – White.
3. Fundamentals of Molecular spectroscopy - C.N. Banwell, McGraw Hill Education, Europe, 1994.
4. Molecular structure and spectroscopy, G. Aruldhas, PHI learning private limited, New Delhi.
5. Atomic spectra & Chemical bond - Manes Chandra.

Books for Reference

1. Quantum mechanics – Schiff.
2. Molecular spectra and molecular structure – G. Herberg.
3. Quantum mechanics – Pauling & Wilson, McGraw Hill Education, 1935. Chap – 3.
4. High resolution NMR- people Schneider and Bernstein.
5. Nuclear quadruple resonance spectroscopy - T.P. Das and E. L. Hahn, Academic Press, 1958.

Course Outcome:

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

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
IV	**17P4PHC13**	**Nuclear Physics**	**6**	**5**

Objectives:

- To understand the basic properties of nucleus.
- To have an idea on the nature of nuclear forces.
- To gain the knowledge on elementary particles.

Unit – I Nuclear Structure

Basic properties: size, shape Mass, charge distribution, spin and parity – magnetic dipole moments – Electric quadrupole moments – Binding energy – Semi empirical mass formula – Nuclear stability – Liquid drop model – Shell model – Collective Model – Unified model(Nilsson Model).

Unit – II Nuclear Forces

Nature of nuclear forces – Form of Nucleon – Nucleon Potential - Spin dependence – Charge Independence and charge symmetry of nuclear forces – Repulsion at short distances – Exchange forces – Meson theory – Ground state of deuteron – magnetic dipole moment of deuteron – Proton – Neutron scattering at low energies – scattering amplitude –Scattering length and effective range – Phase shift.

Unit – III Radio Activity

Alpha particle emission – Geiger Nuttal law – Gamow's theory of alpha decay – fine structure of alpha spectra – beta decay – Neutrino hypothesis – Fermi's theory of beta decay – Curie plot – Energies of beta spectrum – Fermi and G.T. Slection rules – Non- Conservation of parity in gamma decay – Gamma emission – selections rules – transition probability – internal conversion – nuclear isomerism.

Unit – IV Nuclear Reactions

Energies of Nuclear reaction – level widths – cross sections – compound nucleus model – resonance scattering – Breit-Wigner one level formula – optical model – direct reactions – Stripping and pick-up reactions – fission and fusion reactions – theory of fission – controlled thermonuclear reactions – ideas of nuclear reactors – plasma confinement – fusion power.

Unit – V Elementary Particles

Classification of fundamental forces – Elementary particles and their quantum numbers(Charge, Spin, Parity, Isospin, Strangeness) – GellMann Nishijima's formula – Multiplets – Invariant under time reversal (T), Charge conjugation (C) and parity (P) – CPT Theorem – Parity Non – conservation in Weak interactions – Eight – Fold way SU(3) symmetry- Quark model-Baryons and Mesons.

Books for Study

1. Nuclear Physics- D.C. Tayal, Himalaya Publishing house, New Delhi.
2. Nuclear Physics – An introduction – S. B. Patel, Wiley Eastern Limited.
3. Nuclear Physics – S.N.Ghoshal, S.Chand & Co., New Delhi.

Books for Reference

1. Basic Nuclear Physics - D.N. Srivatsava, Pragati Prakashan publishers, Meerut.
2. Nuclear Physics - Roy & Nigam, Wiley Eastern Publishers.
3. Nuclear Physics – V.Devanathan.Narosa Publishing house, New Delhi.
4. Concepts of Nuclear Physics – B.L.Cohen. Tata –McGraw Hill, New Delhi.

Course Outcome:

- To understand the basic properties of nucleus.
- To have an idea on the nature of nuclear forces.
- To gain the knowledge on elementary particles.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
IV	**17P4PHCP4**	**Major Practical - IV**	**6**	**4**

List of Experiments – Any 12 Experiments

1. Microcontroller - Addition, subtraction (8 bit)
2. Microcontroller - Addition, subtraction (array)
3. Microcontroller - Multiplication 8 bit by 8 bit & 16 bit by 8 bit.
4. Microcontroller - Division 8 bit by 8 bit & 16 bit by 8 bit.
5. Microcontroller - To find the largest and smallest number in an array
6. Microcontroller - Pattern comparison
7. Microcontroller - Ascending and descending order
8. Microcontroller - wave form generation
9. Microcontroller – Interfacing – Stepper Motor
10. Microcontroller – Interfacing – Traffic light Control
11. Studies of 2x2 bit RAM
12. Program to find simple and compound Interest
13. Program to find the sum and difference of two matrices
14. Program for picking the largest and smallest number in an array
15. Program to find the product of two matrices
16. Program to find the inverse of a matrix
17. Numerical Integration – Simpson Rule

Books for Reference

1. Introduction to microprocessor – Aditya P. Mathur.
2. Programming and customizing the 8051 micro controller- Myke predco, Tata McGraw Hill Publishing company ltd, New Delhi.
3. Hardware reference manual for, micro controller Intel Corporation- San Francisco

Course Outcome:

To gain practical knowledge by applying the experimental methods to correlate with the physics theory.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
IV	**17P4PHEL3A**	**Major Elective – III Advanced Optics**	**6**	**4**

Objectives:

- To enhance the knowledge about optics.
- To acquire the basic concepts of nonlinear optical materials.
- To know the advanced concepts of laser & Fiber optics.

Unit - I Introduction to Nonlinear Optics

Wave propagation in an anisotropic crystal – Polarization response of materials to light – Harmonic generation – Second harmonic generation – Sum and difference frequency generation – Phase matching – Third harmonic generation – bistability – self focusing.

Unit - II Nonlinear Optical Materials

Basic requirements – Inorganics – Borates – Organics – Urea, Nitroaniline – Semiorganics – Thiourea complex – X-ray diffraction FTIR, FINMR – Second harmonic generation – Laser induced surface damage threshold.

Unit - III Multiphoton Processes

Two photon process – Theory and experiment – Three photon process Parametric generation of light – Oscillator – Amplifier – Stimulated Raman scattering – Intensity dependent refractive index optical Kerr effect – photorefractive, electron optic effects.

Unit - IV Laser Optics

Basic principle of laser – Einstein Coefficients – Condition for light amplification – Population Inversion – Threshold condition – Line shape function – Optical resonators – Three level and four level systems – Solid State lasers – Ruby laser and Nd-YAG laser – He-Ne laser – CO2 lasers – Semiconductors lasers – Hetero junction lasers – Liquid dye lasers – Q switching and mode locking.

Unit - V Fiber Optics

Source and detectors for fiber optic communication – Laser and LED – Analog and digital modulation methods – Principle of optical detection – Pin and APD Photodetectors – Noise – Design consideration of a fiber optic communication system.

Books for Study

1. Nonlinear optics and lasers – B.B. Laud.
2. Laser theory and application, K.Thyagarajan, Ajoy Ghatak, Cambridge University, 1999.
3. An Introduction to laser theory and application, M.N.Avadhanulu, S.Chand and Co., New Delhi 2001.

Course Outcome:

- To enhance the knowledge about optics.
- To acquire the basic concepts of nonlinear optical materials.
- To know the advanced concepts of laser & Fiber optics.

Semester	Subject Code	Title of the Paper	Hours of Teaching/ week	No. of Credits
IV	**17P4PHEL3B**	**Major Elective – III Radiation Physics**	**6**	**4**

Objective:

- To gain the knowledge in radiation physics.

Unit – I Nuclear physics

Review of ideas on atomic and nuclear physics, special units and quantities in atomic and nuclear physics – nomenclature of nuclei – relative abundance of chemical elements-stability of nuclei – binding energy – General properties alpha, beta and gamma rays – laws of equilibrium – alpha and beta ray spectra – theory of beta decay and artificial emission – electron capture – internal conversion – nuclear isomerism – natural artificial radioactivity – reactor and cyclotron produced isotopes – fission products – gamma ray sources for medical and industrial uses.

Unit – II Interaction of e.m wave with matter

Thomson scattering – photoelectric and Compton process and energy absorption -Klein Nishima cross section – pair production – attenuation coefficient mass energy absorption coefficient – relative importance of various process – interaction of charged particles with matter – energy loss per ion pair, primary and secondary ionization - dependence of collision energy on the physical and chemical state of the absorber.

Unit – III Radiations characteristics

Cerenkov radiation – electron absorption – Bremmsstrahlung – Range-energy relation – passage of heavy charged through matter – loss of collision – Bragg curve - stopping power – Beth Bloch formula – interaction of neutron with matter – scattering – capture – neutron induced nuclear reactions.

Unit – IV X ray generators

Discovery, production and properties – different X ray tubes – basic requirements -for medical diagnostic and therapeutic tubes – rotating anode – hooded anode tubes - industrial X ray tubes – safety devices in the X ray tubes.

Unit – V Applications

Faults in X ray tubes – electrical accessories for X ray tubes – circuits and components – measuring instruments – measurement of Kv, mA and time – control panel -low energy and dental X ray machine – testing of X ray equipment – determination of HVL -inherent filtration – high voltage waveform.

Books for Study and Reference

1. The Physics of Radiology – H .E. Jones and J. R. Cunningham, Charles C. Thomas publisher, 4th sub edition, 1983.
2. Fundamental Physics of Radiology -W. J. Merredith and J. B. Massey, Wright publications 2nd Edition, 1972.

Course Outcome:

To gain the knowledge in radiation physics.

Semester	Subject Code	Title of the paper	Hours of Teaching / Week	No. of Credits
III	**17P3PHEDC**	**Extra Departmental Course – Environmental Physics**	**4**	**-**

Objective:

- To give general ideas on Environmental Physics

Unit –I The Atmosphere

Origin of earth and the solar system – nebula theory, Age of earth – radioactive dating, the evolution of the earth's atmosphere – Formation of ozone layer – Effects of Ozone depletion – Thermal structure of terrestrial systems – Green house effect – Global Warming – Influence of solar radiations on earth atmosphere – Diffuse solar radiations – controlling factors, Distribution of sunshine hours, Effect of geomagnetic disturbances.

Unit – II Physical Basis of Environment

Definition of ecosystem – structural features and function of system – Ecological pyramids – First and second laws of thermodynamics and energy flow in the system –Water cycle – Carbon cycle – oxygen cycle – cycle – forest and aquatic eco system – Biodiversity – Importance of bio-diversity and its conservation.

Unit – III Transport of Pollution

Air pollution – water pollution – soil pollution – marine pollution – noise pollution – thermal pollution clear waste disposal – nuclear accidents – Electromagnetic pollution due to communication devices – ironic waste and disposal – Plastic waste disposal – Solid waste management – Role of individual in the mention of pollution.

Unit – IV Radioactivity

Characteristics of radioactive radiations – Measurement and application of radioisotopes – Units of radiation dose – Biological effects of nuclear radiation and safety measures.

Unit – V Techniques in environmental physics

Common Weather and Doppler Radar, SODAR, LASER, LIDAR, Biosensor – principle and application – Bioacoustics – perception of loudness – combination of tones – Sound analysis – Noise pollution index – interference level and measurement of noise level – Ultrasound imaging.

Books for Study and Reference

1. Environmental Studies, ErachBharucha, Universities Press,2005.
2. Atmosphere, weather and climate, K.Siddhartha, Kisalaya Publication, 2005.
3. Fundamental of Ecology, Eugene P.Odum,W.B.Saunders, London,1971.
4. Environmental Physics, Egbert Boeker&Risenk Van Grondelle, Wiley,2000.

Course Outcome:

Students acquire knowledge and problem solving skills in quantum mechanics.