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

# Question Pattern for UG and PG Programmes for students to be admitted during 2014 – 2015 and afterwards

**Total Marks: 75**

## QUESTIONS PATTERN

**SECTION – A**
**(Question 1 to 10)**

**10 x 2 = 20 Marks**

1. Short Answer Questions
2. Two Questions from each unit (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** | **14P1PHC1** | **Core – CLASSICAL DYNAMICS** | **6** | **5** |

**Objective:**

- 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 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: 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 - Action angle variables.

---

**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 a rigid body.

Theory of small oscillations - frequencies of free vibration and normal coordinates-two coupled harmonic oscillators - vibrations of a linear triatomic 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 Equations and Solutions.

---

**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.

| Semester | Subject Code | Title of the Paper | Hours of Teaching / Week | No. of Credits |
|---|---|---|---|---|
| **I** | **14P1PHC2** | **Core – MATHEMATICAL PHYSICS – I** | **6** | **4** |

**Objective:**

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

**Unit –I Vectors 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 - Stokes 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.

| Semester | Subject code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **I** | **14P1PHC3** | **Core - STATISTICAL MECHANICS** | **6** | **5** |

**Objective:**
- 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 equilibria.

**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 thermo dynamics.

**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 - Diffusion equation, random walk and Brownian motion- notion of 'non-equilibrium processes'.

**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.

| Semester | Subject code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **I** | **14P1PHCP1** | **Core- Practical – I** | **6** | **4** |

**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 Thomson's 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.

| Semester | Subject code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **1** | **14P1PHEL1A** | **Elective – NANOPHYSICS** | **6** | **4** |

**Objective:**

- To gain the knowledge about Nanotechnology.

**Unit I Background to Nanotechnology**

Scientific revolution – Emergence of Nanotechnology - Types of Nanotechnology – periodic table – Atomic structure – Molecules and phases – Energy – Molecular and atomic size – Surfaces alignment and dimensional space – Top down and bottom up approaches .

---

**Unit II Nanomaterials and Nanotubes**

Nanomaterials – Preparation – Plasma arcing – Quantum structures – carbon clusters – Bucky Ball – Tunneling - Quantum dots - Chemical vapour deposition – Sol gels – Electro deposition – Ball miling – Nanoparticles – Application of nanomaterials.

Carbon age – New form of carbon – Carbon Fullerenes – Fullerene derived crystals Nanotubes - Types of nanotubes – Formation of nanotubes – Assemblies – Purification of carbon tubes – Properties – Uses.

---

**Unit III Characterization and Fabrication of nanoscale systems**

Structural characterization: SPM, XRD, BET, TEM, SEM.

Optical characterization : UV – Vis fluorescence – Raman and IR XPS and Auger spectroscopy.

Fabrication: Nanolithography – Focused ion beam – Electron beam lithography

---

**Unit IV Optics & Photonics**

Properties of light and Nanotechnology – Interaction of light and Nanotechnology – Nano holes and photons – Nano optics - Nano photonics - Nano manipulation – Imaging – New low cost energy efficient windows – photonic crystals – Plasmon waveguides .

---

**Unit V Nano Electronics**

Nano electronics – Birth of electronics – Micro and Nano fabrication – Quantum electronic devices – Quantum information and Quantum computers – Experimental implementation of quantum computers – MEMS – Carbon nanotube FETs – Nano MOSFETs – Molecular diodes, transistors - Applications.

---

**Book 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.

**Book 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, 2ed, Iop (U.K), 1996.

| Semester | Subject code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **1** | **14P1PHEL1B** | **Elective – LASER AND FIBER OPTIC COMMUNICATION** | **6** | **4** |

**Objective:**

- 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- work principle- energy level diagram- argon ion laser- helium cadmium laser- molecular gas laser- $Co_2$ 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.

| Semester | Subject Code | Title of the Paper | Hours of Teaching / Week | No. Of Credits |
|---|---|---|---|---|
| **II** | **14P2PHC4** | **Core- ELECTROMAGNETIC THEORY** | **6** | **5** |

**Objective:**

- 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 - Derivation of Maxwell's electromagnetic equations - wave equation in one dimension - Equation of continuity - Displacement current - 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 – TEM 00, 01 modes.

**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.

| Semester | Subject Code | Title of the Paper | Hours of Teaching /week | No. of Credits |
|---|---|---|---|---|
| **II** | **14P2PHC5** | **Core-<br>MATHEMATICAL PHYSICS – II** | **6** | **4** |

**Objective:**

- 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-Faltung's theorem-Solution of simple differential 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)
4. Mathematical physics–A.K.Ghattak, T.C.Goyal and S.J.Chua, Macmillan, New Delhi, 1995.

| Semester | Subject Code | Title of the Paper | Teaching Hours/ Week | No. Of Credits |
|---|---|---|---|---|
| **II** | **14P2PHC6** | **Core – ELECTRONICS AND INSTRUMENTATION** | **6** | **4** |

**Objective:**

- To gain the knowledge in Electronics and Instrumentation.

**Unit - I ANALOG ELECTRONICS**

Precision and accuracy –Error analysis – Propagation of errors- Introduction: Op-amp – op-amp based circuits: Integrator- Differentiator- Summing-Differential – Logarithmic amplifier- comparators and controls –Analog simulation – Wein Bridge oscillators using op-amp – 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 (Feed back only) - 4 bit asynchronous Ripple counter- Ring counter- A/D Convertor: Simultaneous conversion-Dual slope method- D/A convertor: Variable resistor network- R 2R method- 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 – Instrumentation amplifiers - digital signal processing.

---

**Books for Study and Reference:**


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

| Semester | Subject code | Title of the paper | Hours of Teaching / Week | No. of Credits |
|---|---|---|---|---|
| **II** | **14P2PHCP2** | **Core - Practical – II** | **6** | **4** |

**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.

| Semester | Subject code | Title of the paper | Hours of Teaching / Week | No. of Credits |
|---|---|---|---|---|
| **II** | **14P2PHEL2A** | **Elective - NUMERICAL METHODS IN PHYSICS** | **6** | **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.

**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.

**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.

| Semester | Subject code | Title of the paper | Hours of Teaching / Week | No. of Credits |
|---|---|---|---|---|
| **II** | **14P2PHEL2B** | **Elective – BIOMEDICAL INSTRUMENTATION** | **6** | **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 acquistion – 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 disathermy – 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.

**Book for study:**

1. Dr. M. Arumugan – Biomedical instrumentation, Anurada Agencies Publishers – 1992.

**Book for Reference:**

1. L. Growell, F. J. Welbell, E. A. Pfeitter – Biomedical instrumentation and Measurements – PHI – 1993.

| Semester | Subject Code | Title of the Paper | Hours of Teaching/ Week | No.Of Credits |
|---|---|---|---|---|
| **III** | **14P3PHC7** | **Core – SOLID STATE PHYSICS** | **6** | **5** |

**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 – Electronic specific heat.

**Unit –III Magnetic and Dielectric properties**

Langevin's classical theory of diamagnetism and para magnetism – paramagnetic susceptibility – Quantum theory of para magnetism – feero magnetism – Weiss theory of ferro magnetism – 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.

**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.

Simple model of photoconductor – influence of traps – Luminescence and its types – Emission and absorption spectra – Efficiency of phosphor – Thermoluminescence and glow curve.

**Unit –V Super Conductivity**

Zero resistance – behaviour in magnetic field – Meissner effect – Type I and Type II super conductors– 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.

| Semester | Subject Code | Title of the Paper | Hours of Teaching/ Week | No. Of Credit |
|---|---|---|---|---|
| **III** | **14P2PHC8** | **Core - QUANTUM MECHANICS** | **6** | **5** |

**Objective:**

**Unit –I Quantum Basics**

Schrodinger time independent and dependent equations- solution of free particle (1 Dimensional)- arbitrary potential – physical Interpretation of $\Psi$- 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 ($\Psi_{100}$)

**Unit – III 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 – IV Equation of motion and angular momentum.**

Quantum pictures: Schrodinger, Heisenberg and Interaction– Angular momentum operator- 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 – 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.

| Semester | Subject code | Title of the paper | Teaching Hours/ Week | No. Of Credits |
|---|---|---|---|---|
| **III** | **14P3PHC9** | **MICROCONTROLLER - PROGRAMMING AND APPLICATIONS** | **6** | **5** |

**Objective:** To gain knowledge in Advanced Electronics

**Unit 1 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.

**Book 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

| Semester | Subject Code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **III** | **14P3PHCP3** | **Core - Practical - III** | **6** | **4** |

**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 RAM.
14. Construction of A/D converter.
15. Construction of D/A converter.
16. Opamp – 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.

| Semester | Subject Code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **IV** | **14P4PHC10** | **Core – ATOMIC PHYSICS AND MOLECULAR SPECTROSCOPY** | **6** | **5** |

**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**

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 – vibrational and rotational Raman spectra (linear and non linear only) – molecular structure studies ( xy , xy2, xy3, type)

**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 spectroscopy-Basic principles- classical and quantum mechanical detechniques - Bloch equations- spin- spin and spin- lattice relaxation times- experimental technique - single coil and double coil methods – applications 0f 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 Resonance 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, McGraw Hill.
2. Introduction to Atomic Spectra – White, McGraw Hill.
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, Tata McGraw Hill.

**Books for Reference:**

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

| Semester | Subject Code | Title of the paper | Hours of Teaching / Week | No. of Credits |
|---|---|---|---|---|
| **IV** | **14P4PHC11** | **Core- NUCLEAR PHYSICS** | **6** | **5** |

**Objective:**

a. To understand the basic properties of nucleus.
b. To have an idea on the nature of nuclear forces.
c. 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**

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- Elementary ideas of fission reaction- theory of fission- elementary ideas of fusion- 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.

**Reference:**

Particle Physics - Khanna.

Quantum Mechanics - Mathews & Venkatesan, 27$^{th}$ reprint, Tata McGraw Hill Company, New Delhi, 2002.

**Book 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.

**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.

| Semester | Subject Code | Title of the paper | Hours of Teaching / Week | No. of Credits |
|---|---|---|---|---|
| **IV** | **14P4PHCP4** | **Core - Practical - IV** | **6** | **4** |

**Any 12 Experiments**

Micro controller- Addition, subtraction (8 bit)

Micro controller- Addition, subtraction (array)

Micro controller- Multiplication 8 bit by 8 bit & 16 bit by 8 bit.

Micro controller- Division 8 bit by 8 bit & 16 bit by 8 bit.

Micro controller- To find the largest and smallest number in an array

Micro controller- Pattern comparison

Micro controller- Ascending and descending order

Micro controller- wave form generation

Studies of 2x2 bit RAM

Program to find simple and compound Interest

Program to find the sum and difference of two matrices

Program for picking the largest and smallest number in an array

Program to find the product of two matrices

Program to find the inverse of a matrix

Numerical Integration – Simpson Rule.

**Reference:**

1. Introduction to microprocessor – Aditya, P. Mathur
2. Programming and customizing the B051 micro controller- Myke predco, Tata McGraw Hill Publishing company ltd, New Delhi.
3. Hardware reference manual for, micro controller Intel Corporation- San Francisco

| Semester | Subject Code | Title of the paper | Hours of Teaching/ Week | No. of Credits |
|---|---|---|---|---|
| **IV** | **14P4PHEL3A** | **Elective – ADVANCED OPTICS** | **6** | **4** |

**Objective:**

**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 and Nd – YAG Laser – He-Ne and 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.

**Book 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.

| Semester | Subject Code | Title of the Paper | Hours of Teaching/ Week | No.Of Credits |
|---|---|---|---|---|
| **IV** | **14P4PHEL3B** | **Elective–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,mAand 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.