ST. XAVIER'S COLLEGE (AUTONOMOUS)

Palayamkottai - 627 002

Recognized as "College with Potential for Excellence" by UGC)
(Accredited by NAAC at "A^{++}" Grade with a CGPA of 3.66 in IV Cycle)

SYLLABUS

M.Sc. PHYSICS

(w. e. f. June 2021)

Programme Name : M. Sc. Physics
Programme Code : PPH

Programme Outcome

St. Xavier's College (Autonomous), Palayamkottai aims at the holistic development of the individual. A post graduate student of Physics should be able to,

- ✓ Apply theoretical knowledge of principles and concepts of physics to practical problems.
- ✓ Demonstrate the ability to plan and execution of experiments and interpretation of experimental results.
- ✓ Identify, formulate, research literature survey and analyze complex problems reaching substantiated conclusions using the principles of physical mathematical and bio medical sciences.
- ✓ Have specific skills in planning, conducting advanced experiments, recording and analyzing the data and draw the relevant conclusions from it.
- ✓ Having problem solving ability to meet out social issues such as energy crisis.
- ✓ Prepare to take up challenges as globally competitive physicists/ researchers in diverse areas of theoretical and experimental physics.
- ✓ Develop the scientific communication skills of both written and oral for specialized and non specialized audience.
- ✓ Motivate the students to successfully compete for employment in research, teaching and commercial sector.

Programme Specific Outcomes

At the completion of the M.Sc., programme in Physics the students must be empowered to

1. Face the challenges of constantly evolving science world honing their ability
2. Apply and formulate the solutions of emerging scientific problems
3. Pursue Higher studies in physics
4. Handle any scientific equipments by providing hands on experience with practical instruments
5. Face competitive exams like NET/SET as the course papers designed based on the NET syllabus
6. Have the finer dimensions of physics by providing foundations for transparencies of scientific knowledge at specialization level
7. To be inspired and oriented to carry out research activities
8. Develop their employability skills by equipping students with multi practical dimensions

Programme Structure

Sem.	Status	Course	Title of the Course	Hours	Credits
I	Core - 1	21PPH11	Mathematical physics I	5	5
	Core - 2	21PPH12	Classical Dynamics	5	5
	Core - 3	21PPH13	Electronics	5	5
	Elective–1	21PPHE11	Communication physics / Energy Physics	5	4
	Core - 4	21PPH14	Practicals – I Electronics	4	2
	Core - 5	21PPH15	Practicals – II General Physics Experiments	4	2
			Library/Seminar	2	-
			Course total	**30**	**23**
II	Core - 6	21PPH21	Mathematical Physics II	5	5
	Core - 7	21PPH22	Thermo dynamics and statistical mechanics	5	5
	Core - 8	21PPH23	Quantum mechanics I	5	5
	Elective-2	21PPHE21	Medical Physics /General relativity and cosmology	5	4
	Core – 9	21PPH24	Practicals – III Electronics -II	4	2
	Core –10	21PPH25	Practicals – IV General Physics Experiments - II	4	2
			Library/Seminar	2	
			Course total	**30**	**23**
III	Core - 11	21PPH31	Condensed matter physics	5	5
	Core - 12	21PPH32	Quantum Physics II	5	5
	Core - 13	21PPH33	Electromagnetic Theory	5	5
	Elective–3	21PPHE31	Micro Processor and Micro controller / Semiconductor Physics	5	4
	Core – 14	21PPH34	Practicals-V Microprocessor 8086	4	2
	Core – 15	21PPH35	Practicals-VI Microcontrollers 8051	4	2
			Library/Seminar	2	
			Course total	**30**	**23**
IV	Core - 16	21PPH41	Nuclear physics and Elementary Particles	5	5
	Core - 17	21PPH42	Spectroscopic techniques	5	5
	Elective-4	21PPHE41	Numerical methods with C Programming / Nano Physics	5	4
	Core -18	21PPH43	Practicals –VII Numerical Methods with C Programming	4	2
	Core - 18	21PPH44	Project	10	5
			Library /Seminar	1	
			Course total	**30**	**21**
			STAND		**1**
			Total	**120**	**91**

ECC Courses

Sem	Course Code	Title of the Course	Credits
I	21PPH ECC01	Aptitude Physics	4
II	21PPH ECC02	Microprocessor based Physics Instrumentation	4
III	21PPH ECC03	Materials synthesis and characterisation	4
IV	21PPH ECC04	Non Destructive Testing	4

MATHEMATICAL PHYSICS I
(Course Code: 21 PPH 11)

Semester I	Hours -5	Credits 5

Course Outcomes: At the end of the course the students must be able to

1. Remember vector calculus and also able to write operators in different coordinate system (K1)
2. Understand the meaning of quantization and path integrals (K2)
3. Apply the concepts Gradient, Divergence and Curl in orthogonal curvilinear and their typical applications in physics.(K3)
4. Solve the analytical function in complex variable and use complex variable for solving the definite integrals (K4)
5. Evaluate basic group theory concepts used in spectroscopy and nuclear physics (K5)
6. Integrate linear vector space concepts in quantum mechanics (K6)

UNIT-I: VECTOR ANALYSIS AND VECTOR SPACES

Concepts of gradient, divergence and curl - Gauss's divergence theorem, Green's theorem and Stoke's theorem (statement and proof) - Orthogonal curvilinear coordinates - Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates (Theory). Linearly dependent and independent sets of vectors - Inner product (problems)- Schmidt's orthogonalization process.

UNIT-II: **MATRICES**

Types of Matrices and their properties, Rank of a Matrix, Eigenvalue Equations and their solutions, Theorems on Matrices; Diagonalisation and Diagonalisation of different matrices; Cayley-Hamilton's theorem; Problems.

UNIT–III: TENSOR ANALYSIS

Definition of Tensors – Contravariant, covariant and mixed tensors – addition and subtraction of Tensors – Summation convention- Symmetry and Anti-symmetry Tensor – Contraction and direct product – Quotient rule- Pseudo tensors, Levi-Civita Symbol - Dual tensors, irreducible tensors-Metric tensors-Christoffel symbols – Geodesics.

UNIT-IV: COMPLEX VARIABLE

Functions of complex variable-Analytic functions-Cauchy- Riemann equations-integration in the Complex plane-Cauchy's theorem- Cauchy's integral formula-Taylor and Laurent expansions- Singular Points- Cauchy's residue theorem - poles - evaluation of residues - evaluation of definite integrals.

UNIT-V: GROUP THEORY

Definition - Subgroups - Cyclic groups and abelian groups - Homomorphism and isomorphism of groups - Classes - Symmetry operations and symmetry elements - Representations of groups - Reducible and irreducible representations - Character tables for simple molecular types (C_{2v} and C_{3v})point group molecules.

BOOKS FOR REFERENCE:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 1995.
2. Mathematical Physics, B.S.Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Mathematical Physics, H.K. Dass and Rama Verma, S.Chand and Company Ltd, 2010.
4. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
5. Introduction to Mathematical physics, Charlie Harper, Prentice Hall of India Pvt.Ltd, 1993.
6. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, McGraw Hill Publications Co., 3rd Edition, 1971.
7. Theory and Problems of Laplace Transforms, Murray R. Spigel, Schaum's outline series, McGraw Hill, 1986.
8. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern limited, 3rd Edition, 1995.

CLASSICAL DYNAMICS
(Course Code: 21PPH12)

Semester I	Hours -5	Credits 5

Course Outcomes : At the end of the course the students must be able to

1. To remember the concepts of Lagrangian and Hamiltonian formulation.(K1)
2. To illustrate the two body central force problems and its solutions and also about the solving ability of scattering theory.(K2)
3. To understand the importance of variational principles and get familiar with Poisson and Lagrange brackets.(K3)
4. To analyse the dynamics of rigid body problems in detail and solve its various problems.(K4)
5. To access the theory of oscillations in detail with basis of free vibrations. (K5)
6. Creating basic ideas of theory of relativity and the concepts in relativistic mechanics.(K6)

UNIT I FUNDAMENTAL PRINCIPLES AND LAGRANGIAN FORMULATION

Mechanics of a particle - Conservation laws - constraints- generalized coordinates- D'Alembert's principle - Lagrange's equation- Hamilton's principle and Lagrange's equation- Newton's equation of motion from Lagrange's equation – simple pendulum – simple Atwood's machine - Generalised momentum – cyclic coordinates - conservation theorems

UNIT II TWO-BODY CENTRAL FORCE PROBLEMS

Reduction to the equivalent one body problem- 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- scattering in a central force field- Rutherford scattering cross section

UNIT III VARIATIONAL PRINCIPLES

Modified Hamilton's principle – Deduction of Hamilton's equation from variational principle –Deduction of Lagrange's equation - Principle of least action- Application- Canonical transformation- Lagrange and Poisson Brackets- Equation of motion and Conservation theorems in Poisson brackets - Hamilton-Jacobi equation- Action angle variables- kepler problem in action angle variables

UNIT IV DYNAMICS OF A RIGID BODY AND OSCILLATORY MOTION

Euler's Angles- Moments and Products of Inertia- Euler's equation of motion of a rigid body- symmetrical top applications- force free motion of a symmetry top – Sleeping top - General theory of small oscillations- Eigen value equation – normal frequencies of free vibration and normal coordinates – Vibrations of a linear tri atomic molecule

UNIT V THEORY OF RELATVITY AND RELATIVISTIC MECHANICS

Lorentz transformation- Consequenes – Relativisic energy – particle with zero mass - force in relativistic mechanics - Lagrangian and Hamiltonian formulation of relativistic mechanics - Minkowski space and Lorentz transformations in real four dimensional spaces- Covariant four dimensional formulations for a freely moving particle.

BOOKS FOR STUDY:

1. J.C.Upadhyaya, Classical Mechanics, Himalaya publishing house, 2011.
2. Herbert Goldstein, Classical Mechanics, Narosa Publication House, 3nd Edition, 2012

BOOKS FOR REFERENCES:

1. Rana. N.C. and Joag, Classical Mechanics, Tata McGraw Hill, New Delhi, 1998
2. A.K. Saxena, Classical Mechanics, Tata McGraw Hill, New Delhi, 1998
3. S.L Gupta, V.Kumar, H.V. Sharma, Classical Mechanics, Pragathy prakasan, 6th Edition, 2000
4. V.B. Batia, Classical Mechanics, Narosa Pub. Ltd, New Delhi, 1997

ELECTRONICS
(Course code : 21 PPH13)

Semester I	Hours -5	Credits 5

Course Outcomes : At the end of the course the students must be able to

1. Remember the fundamentals of analog and digital electronics. (K1)
2. Understand the basic working principles of circuits. (K2)
3. Apply the theory to solve problems in electronics. (K3)
4. Analyse and design op-amp circuits. (K4)
5. Evaluate the fundamental principles of electronics. (K5)
6. Create and design analog and digital circuits for practical use. (K6)

UNIT I OP-AMP AND ITS CHARACTERISTICS

Ideal operational amplifier –Inverting amplifier- non-inverting amplifier- voltage follower-Differential amplifier- Difference mode and common mode Gains- Common mode rejection ratio- The basic differential amplifier- Transfer characteristics- input bias current- input offset current- input offset voltage- Total output offset voltage- slew rate- Analysis of data sheets of an op-amp.

UNIT II APPLICATIONS OF OP-AMP

Adder-subtractor –Instrumentation amplifier- Transconductance amplifier- Transresistance amplifier- op amp as halfwave rectifier-log and antilog amplifier- Multiplier and divider-Electronic analog computation-simulation of transfer functions- Active filters-first order low pass filter- Band pass filter- Band reject filter.

UNIT III D/A AND A/D CONVERTERS

D/A and A/D converters- Basic DAC techniques- weighted resistor DAC- R-2R ladder DAC- Multiplying DACS- Monolithic D/A and A/D converters- The parallel comparator (Flash) A/D converter-The countertype converter- servo tracking converter - successive approximation converter - Dual slope ADC- DAC/ADC specifications.

UNIT IV DIGITAL ELECTRONICS

Shift register- types of shift registers - counters- Asynchronous and synchronous counters- design of synchronous counters-Mod counters- Multiplexer- Demultiplexer- Decoder-Encoder- Semiconductor memories-

ROM- PROM- EPROM- EEPROM-RAM.

UNIT V NANOELECTRONICS

Introduction to nanoelectronics - Fabrication techniques for nanostructre - Lithography - Nano imprint lithography - Split gate technology - Density of states in lower dimensions - Transport of spin - Spintronic devices - Applications

BOOKS FOR STUDY:

1. Linear integrated circuits- D. Roychoudhry & Shail B. Jain-New age international publications (3rd Revised edition edition 2010) (For units 1,2,3 and 5)
2. Power electronics - J. Gnanavadivel & V. Malathy – Anuradha Publications (for unit 3)
3. Digital principles and applications-Malvino & Leach(seventh edition 2011) Tata McGraw-Hill (for unit 4)

REFERENCE BOOKS:

1. Power Electronics-Muhammad H.Rashid-PHZ (Third edition)
2. Power Electronics- P.C. Sen- Tata Mc Graw –Hill (Reprint 2002)
3. Digital design- M.Morrismano Prentice Hall of India Pvt Ltd , New delhi
4. Fundamentals of nano electronics – George W. Hanson - Pearson Publication

COMMUNICATION PHYSICS
(Course Code: 21PPHE11)

SEMESTER I	HOURS – 5	CREDITS 4

Course Outcomes: At the end of the course the student should be able to:

1. Remember the importance of communication systems and their applications. **(K1)**
2. Understand the concept of radiation and the various modulation techniques such as FM, AM and PM.**(K2)**
3. Apply the basic physical concepts on the orbital and functional principles of satellite communication systems. **(K3)**
4. Analyse and apply an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link. **(K4)**
5. Identify and characterize different components of an Optical Fiber Communication link. **(K5)**
6. Create skills to differentiate frequency, amplitude and pulse modulated signals.**(K6)**

UNIT I RADIO WAVE PROPAGATION AND ANTENNAS

Electronic Radiation – Fundamentals –Propagation of waves in free space - Attenuation in atmosphere – Effects of Earth's magnetic field - Extraterrestrial Communication.

Antenna - Basic Consideration - Term and Definitions – Effective area and length of Antenna – VHF-UHF Antenna - Helical Antenna - Microwave Antennas.

UNIT II ANALOG AND DIGITAL MODULATIONS

Amplitude Modulation Theory, Pulse Amplitude Modulation (PAM) - Pulse Code Modulation (PCM) - Pulse Frequency Modulation (PFM) - Pulse TIME Modulation (PTM) - Pulse Position Modulation (PPM) - Pulse With Modulation (PWM).Digital modulation schemes – Amplitude Shift Keying, Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Digital Communication – Advantages and disadvantages of digital communication.

UNIT III SATELLITE COMMUNICATION

Kepler's first law- Kepler's second law- Kepler's third law- Orbits- Geostationary Orbit- Power Systems- Altitude Control- Satellite station keeping- antenna look angles-limits of visibility- Frequency plans and polarization- Transponders.

UNIT IV FIBER OPTIC COMMUNICATION

Importance of optic fiber- propagation of light wave in optical fiber- acceptance angle and acceptance cone of a fiber- numerical aperture- Principles of Light Transmission in a Fiber - Losses in Fibers – Dispersion - Light Sources for Fiber Optics, Photodetectors, Fiber-optic Communication Link.

UNIT V MOBILE COMMUNICATION

Need for Mobile communication – Requirements of mobile communication – History of mobile communication – Properties of wireless medium – Radio propagation – Reflection, scattering and diffraction in propagation – Propagation coverage calculations – Cellular structure – Frequency reuse – System architecture – Authentication centre - Home location register – Visiting location register – Equipment identify register – Base station system - Advantages And disadvantages of using cellular mobile system.

BOOKS FOR STUDY:

1. Dennis Roddy and John Coolen, Electronic Communications, Fourth Edition, Pearson Education.
2. Wireless and mobile communication – T. G. Palanivelu, PHI Learning Pvt. Ltd, 2011.
3. Anokh Singh, Principle of Communication Engineering Published by S. Chand Edition, 2000

BOOKS FOR REFERENCE:

1. Wayne Tomasi, Electronic Communication systems, Pearson education, 2006
2. Kennedy, Electronic Communication System, Published by McGraw Hill
3. Simon Haykin, Communication systems, John Wiley & Sons
4. Robert. J. Schoenbeck, Electronic Communications, PHL, New Delhi, 2002

ENERGY PHYSICS
(Course Code 21 PPHE11)

Semester I	Hours 5	Credits 4

Course Outcomes : At the end of the course the students must be able to

1. Define the Physical concept of energy sources(K1)
2. Explain the Application of energy sources in our day today life(K2)
3. Acquire the knowledge about the Energy resources(K3)
4. Analyse the different energy sources (K4)
5. Measure the uses of Various Energy resources(K5)
6. Awareness of Solar energy applications(K6)

UNIT I INTRODUCTION

Introduction to energy source-Energy sources and their availability-Types of Energy-Prospects of renewable energy-Extraterrestrial solar radiation-Effect of Earth's atmosphere-Measurement and estimation of Solar radiation

UNIT II FOSSIL FUELS AND BIO-ENERGY

Fossil fuels – classification, composition, physiochemical characteristics; Energy content of coal, petroleum and natural gas; Formation, reserves, exploration/ mining and uses of Coal, Oil and Natural gas

Biomass composition and types; Conversion processes – pyrolysis, charcoal Production - compression, gasification and liquefaction - Energy plantation -Biogas – production and uses - anaerobic digestion - Environmental constrains - Energy from solid Wastes - Sources, types - energy production

UNIT III NUCLEAR AND SOLAR ENERGY

Fission and fusion, Nuclear fuels, – Mining and processing of Uranium – concentration, refining, enrichment, fuel fabrication and fuel cycle - Nuclear reactors and radioactive waste; Environmental implications.

Harnessing of solar energy - Solar collectors and concentrators - Solar thermal energy - Solar electricity generation - Solar heaters – dryers - and cookers - Photovoltaics.

UNIT IV WIND ENERGY

Wind power - Harnessing of wind energy - Power generation – wind mills, concentrators - wind characteristics and siting, environmental considerations - Wind energy potential in India with special reference to Northeast India.

UNIT V GEOTHERMAL AND HYDROTHERMAL ENERGY

Sources – crust - high temperature aquifers - low temperature aquifers, reserves; Harnessing of geothermal energy – problems and prospect - Geothermal energy prospect in India - Hydrothermal energy - Tidal and wave energy - Problems and prospects-Ocean thermal energy conversion.

BOOKS FOR STUDY:

1. Renewable Energy – Environment and Development: M. Dayal; Konark Pub. Pvt. Ltd.
2. G. D. Rai, Non-Conventional Energy Sources, Khanna Publisher, New Delhi, 5th Edition, 2012

BOOKS FOR REFERENCE:

1. Alternative Energy: S. Vandana; APH Publishing Corporation
2. Nuclear Energy – Principles, practice and prospects: S. K. Agarwal; APH Publishing Corporation
3. Bio-Energy Resources: Chaturvedi; Concept Pub.
4. National Energy – policy, crisis and growth: V S. Mahajan; Ashis Publishing House
5. Geography and Energy – Commercial energy systems and national policies: J.D. Chapman

PRACTICAL – 1
ELECTRONICS I (Any Eight experiments)
(Course Code: 21 PPH 14)

Semester I	**Hours - 4**	**Credits 2**

1. SCR characteristics
2. IC 555 timer-Schmitt trigger
3. Network analysis thevenin and Norton
4. PCB design
5. UJT- amplifier
6. BJT –amplifier
7. Instrumentation amplifier – Op amp
8. Average amplifier – Op amp
9. Differential amplifier (Transistor) – common mode gain, Differential mode gain & CMRR
10. Weins Bridge oscillator– Op amp
11. Pulse and astable Multivibrator – Op amp
12. Solving simultaneous equation– Op amp
13. Triangular wave generator
14. Active filter

PRACTICAL – 2
GENERAL PHYSICS EXPERIMENTS (Any Eight experiments)
(Course Code: 21 PPH 15)

Semester I	**Hours - 4**	**Credits 2**

1. Ultrasonic diffraction - Determination of compressibility
2. Determination of elastic constant – Elliptical fringes
3. XRD – Indexing of X-Ray diffraction pattern
4. Ultrasonic interferometer – determination of velocity of liquids
5. Determination of elastic constant – Hyperbolic fringes
6. Laser experiment
7. Diffraction of light using double slit
8. Spectrometer – hollow prism(Charge of an electron)
9. Solar constant
10. Spectrometer Cauchy's constant
11. Spectrometer i-d curve
12. Spectrometer d for i; i for d
13. Spectrometer i-i' curve hydrogen lamp

MATHEMATICAL PHYSICS – II

(Course code: 21 PPH 21)

Semester II	Hours -5	Credits 5

Course Outcomes : At the end of the course the students must be able to

1. Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations(K1)
2. Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms etc(K2)
3. Apply Fourier series and Fourier transform techniques to physics and engineering problems (K3)
4. Analyze different ways of solving second order differential equations and familiarized with singular points and Frobenius method (K4).
5. To find solutions to integral equations using different methods(K5)
6. Formulate the method of contour integration to evaluate definite integrals of varying complexity. (K6)

UNIT-I: DIFFERENTIAL EQUATIONS

Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods – extended power series method for indicial equations.

UNIT-II: SPECIAL FUNCTIONS – I

Gamma and Beta function- Legendre's differential equation: Legendre polynomials - Generating functions - Recurrence relation - Rodrigue's formula - Orthogonality; Bessel's differential equation: Bessel polynomials - Generating functions - Recurrence relation -Rodrigue's formula – Orthogonality.

UNIT-III: SPECIAL FUNCTIONS – II

Hermite differential equation – Generating functions – Hermite polynomials - Recurrence relations – Rodrigue's formula - Orthogonality: Laguerre differential equations – Generating functions - Laguerre polynomials - Recurrence relation - Rodrigue's formula – Orthogonality.

UNIT-IV: PARTIAL DIFFERENTIAL EQUATIONS

Solution of Laplace Differential Equation - Two dimensional flow of heat in cartesian and cylindrical co-ordinates - Solution of heat flow equation in one dimension - Solution of wave equation - Transverse vibrations of a stretched string. (Theory).

UNIT - V: INTEGRAL TRANSFORMS

Fourier transforms - cosine and sine transforms - Linearity theorem - Parseval's theorem - solution of differential equation. Laplace transforms - Definition - Linearity, shifting and change of scale properties. Inverse Laplace transforms – Definition - Problems - Solution of differential equation

BOOKS FOR STUDY

1. Mathematical Physics, B.D. Gupta, Vikas Publishing, 1995.
2. Mathematical Physics, B.S. Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Mathematical Physics, H.K. Dass and Rama Verma, Chand and Company Ltd, 2010.

BOOKS FOR REFERENCE:

1. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
2. Introduction to Mathematical Physics, Charlie Harper, Prentice Hall of
3. India Pvt. Ltd, 1993.
4. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, 3rd Edition, McGraw Hill, 1971.
5. Theory and problems of Laplace Transforms, Murray R. Spigel, fInternational edition,McGraw Hill, 1986.

THERMODYNAMICS AND STATISTICAL MECHANICS
(Course Code : 21 PPH 22)

Semester II	Hours - 5	Credits 5

Course Outcomes : At the end of the course the students must be able to

1. Define the fundamental laws of thermodynamics and its consequences (K1)
2. Understand and discuss the concepts of Microstates and macro states of a system (K2)
3. Apply the knowledge in statistical mechanics using various ensemble theory (K3)
4. Analyse the importance of quantum mechanical formulation of statistical mechanics (K4)
5. Evaluating the specific heat capacity and apply it in various applications (K5)
6. Creating the interests in the significance of distribution laws and discusses its applications in Einstein theory and Debye's theory (K6)

UNIT I THERMODYNAMICS

Energy and first law of thermodynamics - entropy and second law of thermodynamics – Clasius Clapeyron equation - principle of increase of entropy – thermodynamic potentials – thermodynamic equilibrium – Nernst's heat theorm – consequences of third law – chemical potential.

UNIT II ENSEMBLES AND PARTITION FUNCTION

Phase space – Energy states and energy levels - micro and macro states – thermodynamic probability – ensembles – law of equipartition of energy - partition functions – thermodynamic quantities – Partition function in micro canonical – canonical and grand canonical ensembles - Gibb's paradox.

UNIT III ENSEMBLES AND PERFECT GASES

Statistical interpretation of entropy - Ensembles in quantum statistical mechanics - Classical ideal gas in micro canonical ensembles - perfect gas in canonical and grand canonical ensemble – mono atomic and diatomic ideal gas.

UNIT IV QUANTUM STATISTICS

Equation of state of ideal Fermi gas – High temperatures and low densities – low temperature and high density – free electron theory of metals – Quantized linear oscillator – specific capacity of diatomic gas.

UNIT V SPECIFIC HEAT OF GASES

Fermi gas – Black body radiation – Planck's distribution law - Einstein's theory of specific heat capacity of solid – Debye's theory of specific heat capacity of solids - negative temperatures – electron gas – Bose Einstein gas – Bose Einstein condensation– Landau theory .

BOOKS FOR STUDY :

1. Francis W.Sears and Gerhard L. Salinger, Thermodynamics, kinetic Theory And statistical thermodynamics, 3rd Edition , Narosa publishing house.
2. Satya Prakash, Statistical Mechanics, Kedalnath Ramnath Co.

BOOKS FOR REFERENCES :

1. Kerson Haung, Statistical Mechanics, Wiley Eastern Ltd., New Delhi.
2. S.K.Sinha , Statistical Mechanics theory and applications , Tata Mc Graw Hill.
3. F.Reif, Fundamentals of Statistical Mechanics and Thermal Physics, Mc Graw Hill(1965)
4. R.K.Pathira, Statistical Mechanics, Pergamon (1972)
5. D.Jeyaraman, K.Elangovan, Thermal Physics and Statistical Mechanics, Viswanathan Publishers (2009)
6. Mark W Zemansky, Richard H Dittman and Amit K Chattopadhyay Heat and Thermodynamics, McGraw Hill, 8th Edition 6th reprint 2013.

QUANTUM MECHANICS I
(Course code: 21 PPH 23)

Semester II	Hours -5	Credits 5

Course Outcomes: At the end of the course the students must be able to

1. Familiarize the students about microscopic particles and its energy levels (K1)
2. Understand the inadequacy of classical mechanics, Eigen values & Eigen Functions, Postulates used in QM (K2)
3. Apply the same formalism to understand Schrödinger equations in physical problem which includes the hydrogen atom, harmonic oscillator and total angular momenta (K3)
4. Analyze the differences, implications and descriptions of micro physical world from macro physical world under different potentials and scaling (k4)
5. Compute to systems quantum particles through solving them with appropriate techniques (K5)
6. Acquire conceptual knowledge in learning QM through Dirac's Matrix Formalism and alternate approach of Schrodinger's Differential Equation. (K6)

UNIT I BASIC FORMALISM

Inadequacy of classical physics- Wave packets - Physical interpretation of the wave function-Time dependent Schrodinger wave equation- Time independent Schrodinger wave equation-Normalized and orthogonal wave function-Admissibility conditions -Energy eigen function-Boundary conditions-Continuity condition-Particle current density- Stationary state solutions -Expectation value of dynamical variables- Ehrenfest's theorem.

UNIT II GENERAL FORMALISM OF QUANTUM MECHANICS

Fundamental postulates of wave mechanics -Commutator bracket- Adjoint of an operators and self adjointness- Degeneracy- Linear dependence -Eigen values and Eigen functions of self adjoint operators- Normalization- Kronecker and Delta functions- Completeness and closure property-Minimum uncertainty product.

UNIT III ANGULAR MOMENTUM

Angular momentum and Unitary groups-Eigen values and eigen functions of L^2 and L_z operators- ladder operators L_+ and L_- -Diagonalization of J^2 and J_z -Explicit representation of angular momentum- Momentum as a generator of infinitesimal rotations- Angular momentum matrices- Addition of angular momentum- Clebsch Gordon coefficient- Computation of Clebsch Gordon coefficient.

UNIT 4 EIGEN VALUE PROBLEMS

Particle in a box-Square well potential: bound states (E<0) and One dimensional square potential barrier.

Simple harmonic oscillator-The Schrodinger equation-Energy eigen values-Energy eigen functions-Series solution-Asymptotic behavior and Orthonormality-properties of stationary states.

Hydrogen atom-Solution of radial equation-Energy levels-Stationary state wave functions-Discussion on bound states.

UNIT 5 MATRIX FORMULATION

Matrix Algebra: Null, unit, constant, trace, determinant and inverse matrices - Hermitian and unitary matrices- Transformation Theory: unitary matrix W-Transformation of Hamiltonian with W –Transformation of Hamiltonian with U-Hamiltonian with V- Row and column matrices-Hilbert space-operators as matrices - Dirac's bra and ket notations - Projection operator- Equations of motion: Schrodinger- Heisenberg picture and Interaction picture.

BOOKS FOR STUDY:

1. A Text book of Quantum Mechanics – G. Aruldhas, Prentice Hall of India Pvt., Ltd., 2002
2. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath and Co. Publications, 2018.

BOOKS FOR REFERENCE:

1. Quantum Mechanics – Theory and applications - A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, Fifth Edition, 2015.
2. Quantum Mechanics - Leonard I. Schiff, McGraw-Hill International Publication, Third Edition, 1968.
3. Quantum Mechanics - V. K. Thankappan, New Age International (P) Ltd. Publication, Second Edition, 2003.
4. Quantum Mechanics - E. Merzbacher, John Wiley Interscience Publications, Third Edition, 2011.
5. Quantum Mechanics (Vol .I) - Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë , JohnWiley Interscience Publications, First Edition, 1991.
6. Quantum Mechanics - Pauling & Wilson, Dover Publications, New Edition, 1985.
7. Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, Second Edition, 1994

MEDICAL PHYSICS

(Course **Code: 21 PPHE21)**

Semester II	**Hours 5**	**Credits 4**

Course Outcomes: At the end of the course the students must be able to

1. Acquire more Knowledge of the normal structure and function of the body and its major organ systems with emphasis on content applicable to clinical diagnostics (k1).
2. Understand the operation and principles used in the systems and procedures associated with the clinical track (K2).
3. Apply the radiation safety practices and procedures including the determination of radiation shielding requirements (K3)
4. Analyze all applicable regulations and requirements regarding health and safety of self and of others, and of clinical and research ethics and procedures (K4)
5. Apply integral approach to the physics and theory behind the bio electric signal recording, physiological assist devices, operation theater equipment's and biotelemetry and their safety measures(K5)
6. Acquire conceptual knowledge about Biomaterials, measurements and new trends in Medical Physics (K6)

UNIT I FORCES ACTING AND ELECTRICITY WITHIN THE BODY

Statics - Frictional forces – Dynamics - Conservation of Energy in the body, Heat losses from body - Pressure in the body. Physical properties of bone - Mechanics of joints - Nervous system and neuron - Electric properties of Nerve - Electrical potential of nerve - Nernst Equation, Bio potentials EMG – ECG - EEG-EOG – ERG - Magnetic signals from heart and Brain.

UNIT II PHYSICS OF HEARING AND VISION

Basic definition of Audibility - Physics of ear - Human Audibility Curve, Sensitivity of ear - testing of hearing - Deafness and hearing aids - Sound in medicine, Sound pollution - Effects of sound pollution on living body - Methods to minimize sound pollution--Optics of eye, Diffraction effects of eye, Refractive effect in eye and its correction, Contact Lenses - Color vision and chromatic aberration - Instruments used in Ophthalmology.

UNIT III X-RAY AND LASER

Production of X-ray- Basic components of X ray machine, Making of X-ray image, Fluoroscopy - Computer tomography (CT Scan) - X-ray in diagnosis, Xray in therapy – Hazards of X-ray -- Endoscopes – Thermography – Liquid Crystal thermography – Microwave thermography – Basic Principles of ultrasonography – Laser – Uses of Lasers in Medicine.

UNIT IV NUCLEAR MEDICINE

Radioactivity – Sources of Radioactivity – Nuclear medicine imaging device rectilinear scanner – Positron emission tomography – Magnetic resonance imaging (MRI), Laser in medicine – Ionizing Radiation, Interaction of radiation with matter, Dosimetry – Radiation isotopes, Biological effects of radiation, Radiation protection in therapy.

UNIT V BIOMATERIALS, MEASURMENS AND NEW TRENDS IN MEDICAL PHYSICS

Biomaterials – Introduction – Bio-ceramics – Bio-polymer – Bio-steel – Bio-chip, Blood as a Biomaterial – Introduction to Bio- Nanomaterial , Telemedicine, -- Blood Pressure measurements – Sphygmomanometer Measurement of heart rate – Basic Principles of EGC – Basic Principles of Electroneurography(ENG)--New trends in Medical informatics Embedded system in Hospital.

BOOKS FOR STUDY:

1. Medical Physics by John R. Cameron, J. G. Skofronick, John Wiley and Sons,Inter.Publ.
2. Biomedical Instrumentation – Dr. M. Arumugam, Anuratha Agencies Publishers (2002).

BOOK FOR REFERENCE

1. Essential of Biophysics by Narayanan, New age Publication.
2. Radiation Biophysics by Edward Alphan, prentice Hall Advance Referes.
3. T.B. of Biophysics by R.N. Roy, Central Publication.
4. Medical Informatics by Smita Mishra and K. C. Mishra, ICFAI University.
5. Biomedical Engineering by S.N. Sarbadhikari, University press.
6. Biophysics by Mohan Arora, Himalaya Publication House, Mumbai (2004).
7. Opthalmology by A.K. Khurana, New age Publication.

GENERAL RELATIVITY & COSMOLOGY
(Course code: 21PPH E21)

Semester II	Hours - 5	Credits 4

Course Outcomes : At the end of the course the students must be able to

1. Understand the mathematical basis of general relativity(K1)
2. To know about field equations and its exact solutions.(K2)
3. To access the basic understanding about the theory of cosmology(K3)
4. To aware of physics behind galaxies.(K4)
5. To analyse and understand the history of early universes(K5)
6. To have a deep knowledge about cosmic radiations and neutrinos (K6)

UNIT I MATHEMATICAL BASIS OF GENERAL RELATIVITY

Metric Connection – Geodesics as extremas – Covariant derivative – Curvature and its significance – Bianchi Identities – Four-dimensional space time, gravitational Red Shift – Equivalence Principle - Necessity to introduce non-flat space time – Principle of covariance.

UNIT II FIELD EQUATIONS AND EXACT SOLUTIONS

Einstein's equations – The original approach and the VariationalApproach; Symmetry and conservation laws; Schwarzschild solution – Classical Tests; Birkhoff's Theorem (Statement only) – Concept of Horizon and of the Black Hole; Kruskal embedding; Kerr Metric and Kerr Solution.

UNIT III COSMOLOGY

Basic Postulates – Observational Background – Isotropy and Homogeneity– Friedmann Metric – Open and Closed Models – Singularity – Raichoudhury Equations – Big Bang model and Steady State model, their comparisons and contrasts based onobservational evidence.

UNIT IV PHYSICS OF GALAXIES

MilkyWay Galaxy – Spiral and Elliptical galaxies; Galaxies as self gravitating systems – Spiral structure – Super massive black holes – Active galactic nuclei - Microwave Background – Observation and Inference.

UNIT V EARLY UNIVERSE

Thermal history of the universe:Temperature-redshift relation – distribution functions in the early universe- relativistic and non-relativistic limits. Decoupling of neutrinos and therelic neutrino background – nucleo synthesis - decoupling of

matter and radiation; Cosmic microwave background radiation - - origin and growth of density perturbations.

BOOKS FOR STUDY:

1. Lectures on General Relativity & Cosmology*J V Narlikar*
2. Introduction to General Relativity Adler, M Bazin& M Schiffer
3. The Physics of Stars, A.C Phillips, 2nd Edn. John Wiley & Sons Ltd.

BOOKS FOR REFERENCES :

1. Theoretical Cosmology -- A K Raichoudhury
2. Lectures in General Relativity -- A Papapetrou
3. Stellar Interiors, Hansen and Kawler, Springer Verlag.
4. Astrophysics – Stars and Galaxies, K.D.Abyankar, UniversitiesPress.
5. Stars: their structure and evolution, R.J. Taylor, CambridgeUniversity, Press.
6. Introduction to Modern Astrophysics, B.W. Carroll &D.A.Ostie, Addison Wesley.
7. A Course on Theoretical Astro physics, Vol. II, T. Padmanabhan,Cambridge Uni. Press.
8. An Introduction to Astrophysics, BaidyanathBasu, Prentice Hall, India.

PRACTICALS III
ELECTRONICS II (ANY EIGHT EXPERIMENTS)
(Course Code: 21 PPH 24)

Semester II	**Hours - 4**	**Credits 2**

1. BCD adder/Course traction
2. Verification of demorgan's law- Karnaugh map
3. BCD to 7 segment display
4. Shift registers-serial in and out, parallel in and out
5. Up-down counter
6. Mod counter
7. Ring counter
8. Binary adder and Course traction
9. Multiplexer, Demultiplexer,
10. Encoder and decoder
11. Parity Generator / Checker
12. ALU operations (74181)
13. 8 bit D/A converter and A/D converter

PRACTICALS IV

GENERAL PHYSICS EXPERIMENTS (ANY EIGHT EXPERIMENTS)

(Course Code: 21 PPH 25)

Semester II	**Hours - 4**	**Credits 2**

1. Conductivity of thin films – Four probe method
2. Magnetic susceptibility measurements – Guoy's method
3. Determination of magnetoresistance of a semiconductor
4. Dielectric constant of crystals – Parallel plate capacitor method
5. Dielectric constant of liquids using Colpitts oscillator
6. Magnetic susceptibility – Quincke's method
7. Measurement of Hall voltage and Hall coeffecient – Hall Probe apparatus
8. Measurement of dielectric constant – LCR METHOD
9. Band gap determination - Four Probe method
10. Conductivity of semiconductor crystal – Two probe method
11. Determination of dielectric loss using CRO

CONDENSED MATTER PHYSICS
Course Code:21PPH31

Semester III	Hours - 5	Credits 5

Course Outcomes: At the end of the course the students must be able to

1. Remember and determine different crystal structures of materials and Provide in–depth knowledge of structure of solids. **(K1)**
2. Understand the knowledge on the theory of lattice vibration and correlate it with materials thermal Properties. **(K2)**
3. Apply the knowledge level from theoretical physical subjects towards the understanding of basic properties of solid state matter. **(K3)**
4. Analyse the magnetic properties of material and predict magnetic properties of atoms and molecules based on their electronic configurations. **(K4)**
5. Evaluate the applications of superconductors in the cryogenics and industry. **(K5)**
6. Create the basic knowledge and also give an overview of current problems within the field of condensed matter/materials science mainly on functional materials. **(K6)**

UNIT I CRYSTAL STRUCTURE AND DIFFRACTION

Basic concepts- crystal systems - Bravais lattices – primitive vectors, primitive unit cell, conventional unit cell, Wigner-Seitz Unit Cell, Crystal Structures : basis, crystal class, point group- Space group (information only) – Common crystal structures : NaCl, CsCI, ZnS and Diamond - Packing density - hcp and ccp; Reciprocal lattice and Brillouin zone; Atomic scattering factor and crystal structure factor – Explanation of experimental methods (Laue, Rotation and Powder) on the basis of Ewald's sphere construction.

UNIT II TYPES OF BONDING, LATTICE VIBRATION AND THERMAL PROPERTIES OF SOLIDS

Crystal bindings – Ionic bond- covalent bond- molecular bond- Hydrogen bondmetallic bond- Vanderwaal's bond-Binding energy of crystals- polaron – Lattice vibrations: Concept of phonons- momentum of phonons- normal and Umklapp process- vibrations of one dimensional monoatomic and diatomic linear lattices- inelastic scattering of neutrons by phonons .

Thermal properties: Theories of specific heat- Dulong and Petit's law- Einstein theory and Debye's theory- Widemann Franz law.

UNIT III SEMICONDUCTORS AND DIELECTRICS

Analysis of elastic strains – Elastic compliance and stiffness constants- Semi conductor crystals: Band gap – equations of motion – Hall effect - surface crystallography- surface electronic structure- magneto resistance in a 2 dimensional channel- IQHE- ferroelectric crystals- antiferroelectricity- ferroelectric domain- piezoelectricity.

UNIT IV MAGNETIC PROPERTIES OF SOLIDS

Langevin diamagnetism equation- quantum theory of diamagnetism of mononuclear systems - quantum theory of paramagnetism- paramagnetic susceptibility of conduction electron- ferromagnetic order- curie point- magnons : quantization of spin waves- ferri & antiferromagnetic order- ferromagnetic domains.

UNIT V SUPER CONDUCTIVITY:

Meissner effect - energy gap- thermodynamics of the superconducting transitions- London equations- BCS theory- type I and type II super conductors- DC and AC Josephson effects- high temperature super conductors.

BOOKS FOR STUDY:

1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, Wiley India Pvt. Ltd. , New Delhi, 2004.
2. Rita John, Solid State Physics, Tata Mc Graw Hill Publications, 2014.
3. M. A. Wahab, Solid State Physics – Structure and Properties of Materials. Narosa, New Delhi, 1999.
4. J.D. Patterson, B.C. Bailey Solid-State Physics: Introduction to the Theory, Springer Publications, 2007.
5. M. Ali Omar, Elementary Solid State Physics – Principles and Applications, Pearson, 1999.

BOOKS FOR REFERENCE:

1. J. Blakemore, Solid State Physics, 2nd Edition, W. B. Saunders Co, Philadelphia, 1974.
2. C. M. Kachhava, Solid State Physics, Tata Mcgraw Hill, New Delhi, 1990.

3. N. W. Aschroft and N. D., Mermin, Solid State Physics, Rhinehart and Winton, New York. 1976.
4. M. Tinkham, Introduction to Superconductivity, Tata Mcgraw Hill, New Delhi, 1996.
5. K.K.Chattopadhyay, A.N.Banerjee, Introduction to Nanoscience and Nanotechnolog, PHI Learning private Ltd., Delhi 2014.
6. A. J. Dekker, Electrical Engineering Materials, Prentice Hall of India, 1975.
7. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age international Publishers, New Delhi, 1994.
8. A.K. Bain, P. Chand, Ferroelectrics, Wiley, 2017.
9. Kwan Chi Kao, Dielectric phenomena in solids with emphasis on physical concepts of electronic processes, Elsevier Academic Press, 2004
10. Alexander O. E. Animalu, Intermediate Quantum Theory of Crystalline solids, Prentice Hall of India, New Delhi, 1978.

QUANTUM MECHANICS II
(Course code: 21 PPH 32)

Semester III	Hours -5	Credits 5

Course Outcomes: At the end of the course the students must be able to

1. Familiarize the students about different approximation methods (K1)
2. Understand the techniques followed in choosing the appropriate wave functions, semi classical and relativistic approach of quantum system (K2)
3. Apply the same formalism to understand hard core physical problem Which includes the perturbation problems and spin symmetry (K3)
4. Analyze the differences, implications and descriptions of the different methodologies applied in the study of scattering, relativistic behavior of particles (k4)
5. Apply integral approach to solve simple problems using Born's Approximation, Partial Wave Approximation, Green's Function (K5)
6. Acquire conceptual knowledge in the phenomena of scattering, Interactions of different types of single and many particle systems, Their behavior under relativistic phenomenon (K6)

UNIT - I APPROXIMATION METHODS

Time independent perturbation theory -First and second order perturbation- Perturbed oscillator- Application- Helium atom- First order Stark effect in hydrogen atom- Zeeman effect -WKB approximation method-Connection formulae-Time dependent perturbation theory- Fermi's golden rule- Selection rules-Transition probability.

UNIT - II THEORY OF SCATTERING

Scattering theory- Scattering amplitude differential and total cross sections- Method of partial waves analysis- Phase shifts- Optical theorem- Green's function- Born approximation. Yukawa and Coulomb potential.

UNIT-III SYMMETRY IN QUANTUM MECHANICS

Symmetry Parity- Identical particles- Symmetric and Antisymmetric wave functions- Slater determinant- Collision of identical particles- Spin functions for system two and three electron-Collision between classical and quantum particles- Density matrix.

UNIT-IV SEMI CLASSICAL THEORY OF RADIATION

Semi classical theory-Einstein's coefficients for spontaneous and stimulated emission of radiation-Relation between them- Transition probability for absorption and induced emission-Electric and magnetic dipole-forbidden transition-selection rule.

Unit-V RELATIVISTIC WAVE MECHANICS

Relativistic wave mechanics introduction- The Klein Gordon equation- Difficulties- The Dirac equation- Dirac matrices and their properties-Free particle solution of Dirac matrices- Dirac matrices negative energy -Positrons- Dirac particle in an external electromagnetic field- The non-relativistic limit of the Dirac equation.

TEXT BOOKS:

1. A Text book of Quantum Mechanics - P. M. Mathews and K. Venkatesan, Tata McGraw – Hill Publications, Second Edition, 2010.
2. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath and Co. Publications, 2018.
3. Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë , Quantum Mechanics (Vol. II), Quantum Mechanics (Vol. II), John Wiley Publications, 2008.

REFERENCE BOOKS:

1. Quantum Mechanics V. K. Thankappan, New Age International (P) Ltd. Publication, Second Edition, 2003.
2. Quantum mechanics - Franz Schwabl, Narosa Publications, Fourth Edition, 2007.
3. Molecular Quantum mechanics - P.W.Atkins and R.S. Friedman,), Oxford University Press publication, Fifth Edition, 2010.
4. Quantum Mechanics – Theory and Applications, A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, Fifth Edition, 2015.
5. Quantum Mechanics - Leonard I. Schiff, McGraw-Hill International Publication, Third Edition, 1968.
6. Quantum Mechanics - E. Merzbacher, John Wiley Interscience Publications, Third Edition, 2011.
7. Fundamental principles of Quantum mechanics with elementary applications - Edwin C. Kemble, Dover Publications, Re Issue Edition, 2005.
8. Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, Second Edition, 1994.

ELECTROMAGNETIC THEORY
(Course code: 21 PPH 33)

Semester III	Hours 5	Credits 5

Course Outcomes : At the end of the course the students must be able to

1. Remember the fundamentals of Maxwell equations. (K1)
2. Understand electric and magnetic fields and apply the principles of Coulomb's Law and Gauss's law to electric fields in various coordinate systems. (K2)
3. Apply the theory to solve problems in electromagnetic field. (K3)
4. Analyse the behavior of EM waves in conducting surface through absorption, dispersion and reflection. (K4)
5. Evaluate the electrostatic boundary-value by applying Poisson's and Laplace's equations. (K5)
6. Develop the knowledge about wave guides based on the theory of EM waves. (K6)

UNIT I - ELCTROSTATICS

Electric charge-Coulombs law -Electric field - Electrostatic potential- Gauss's Law-Applications of Gauss's Law-electric dipole-multipole expansion of electric fields-Poisson's equation - Laplace equation - Polarization -Field outside of a Dielectric medium-The electric field inside a dielectric-Gauss law in dielectric- The electric displacement – electric susceptibility and dielectric constant.

UNIT II - MAGNETOSTATICS

Magnetic Field-Magnetic induction- force on a current carrying conductor- Biot-Savart Law- Application of Biot-Savart Law-Ampere's circuital law - Magnetic vector potential-magnetic field of a distant circuit- Magnetic Scalar potential-magnetic Flux-Magnetization –Magnetic field produced by magnetized material - Magnetic scalar potential and magnetic pole density.

UNIT III - ELECTRODYNAMICS

Electromagnetic Induction-Faradays Law – The induced electric field – Energy in magnetic fields -Maxwell's equations- electrodynamics Before Maxwell – How Maxwell fixed Ampere's law - Maxwell's equations –Magnetic charge Maxwell's equations in matter - Boundary Conditions.

UNIT-IV-ELECTROMAGNETIC WAVES

Waves in one dimension –The wave equation – sinusoidal waves –energy and momentum in electromagnetic waves- electromagnetic waves in Matter-

propagation in linear media – reflection and transmission at normal incidence-absorption and dispersion - electromagnetic waves in conductors -waveguides definition- TE waves in rectangular waveguide- the coaxial transmission line.

UNIT-V –POTENTIALS AND FIELDS

The Potential formulation - Scalar and Vector Potentials- Gauge Transformation - Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form – continuous distributions – retarded potentials –Jefimenko's equations – point charge –Lienard-Wiechert potentials

BOOKS FOR STUDY:

1. John R.Reitz, Fredrick J.Milford, Robert W.Christy, Foundations of Electromagnetic theory, Third edition, Norosa Publishing House, New Delhi,1989.
2. David J. Griffiths, introduction to electrodynamics, prentice hall of India, New Delhi (2003)

BOOKS FOR REFERENCES:

1. P. Lorrain and D. Corson, electromagnetic fields and waves, CBS publishers and distributors (1986)
2. B.H Chirgwin, C.Plumpton and C.W.Kilmister, elementary electromagnetic theory vols 1,2 and 3, pergamon press (1972)
3. D.R. Corson and P.Lensain, introduction to electromagnetic fields and waves, D.B Tanaporevala & sons, 2000.
4. J.D Jackson, classical electrodynamics, wiley eastern ltd., New Delhi, 2nd edition 2000.
5. B.B. Laud, Electromagnetic, Second edition, Wiley Eastern Limited, 1990.

MICROPROCESSOR AND MICRO CONTROLLER
(Course code: 21PPHE31)

Semester III	Hours - 5	Credits 4

Course Outcomes : At the end of the course the students must be able to

1. Understand the internal architecture and organization of microprocessor 8086.(K1)
2. Access the various semiconductor memories and memory organisation of 8086.(K2)
3. Discuss the classification of interrupts and the internal architecture of 8259.(K3)
4. Analyse the various pheriperal devices and the architecture of 8255.(K4)
5. Gather knowledge about the architecture and instructions of micro controller 8051.(K5)
6. Develop the knowledge about the basics of serial communication and interrupt registers.(K6)

UNIT I : ARCHITECTURE AND INSTRUCTION SET OF 8086

Pins and signals – Architecture – Instruction and data flow – even and odd memory banks - Bus cycles and timing diagram – Instruction format – Addressing modes - Instructions affecting flags – Data transfer instructions – Arithmetic - Logical – String manipulation – Control transfer instructions – CALL and RETURN instructions – Unconditional and conditional jump instructions – Loop instructions .

UNIT II : MEMORY AND I/O INTERRUPS

Semiconductor memory - ROM, PROM, EPROM - Static RAM – Dynamic RAM – NVRAM – Interfacing RAM and EPROM – Memory organization – I/O structure of a typical micro computer - Comparison of memory and I/O mapping I/O devices .

Interrupts and its need – classification – sources - interrupts of 8086 - implementing interrupt scheme in 8086 – INTR and its expansion – programming interrupt controller - INTEL 8259 – Interfacing 8259 with 8086 – Functional block diagram of 8259 – Processing of interrupts by 8259.

UNIT III : PERIPHERAL DEVICES

Programmable peripheral devices - parallel data communication interface – parallel data transfer schemes - Programmable peripheral interface 8255 – INTEL 8255 – Pins – signals – internal block diagram – Interfacing 8255 with 8086 - DMA data transfer scheme – Serial data communication – Keyboard interface using ports .

UNIT IV : MICROCONTROLLER - 8051

Microprocessor and Microcontroller - Overview of 8051 Family – Pin description of 8051 - Registers - Program Counter, ROM space, RAM space,Stack, PSW, SFR - Addressing Modes - Jump Call Instructions - Time delay generations and Calculations - Arithmetic and Logic Instructions – Bit Instructions - Assembly Language Programming - Data Types and Directives.

UNIT V : MICROCONTROLLER SFRS AND PROGRAMMING

Counter / Timer - Counter Programming - Basics of Serial Communication - RS232 Connections and ICs Max 232 - 8051 Serial Communication Registers - Serial Communication Programming - Interrupts - Interrupts Registers - Internal and External Interrupt Programming.

BOOK FOR STUDY :

1. A. Nagoorkani, Microprocessor 8086 programming and interfacing –RBA Publications – 1st Edition
2. Muhammed Ali Mazidi, The 8051 Microcontroller and Embedded System, Pearson Publications, 13th Edition.

BOOKS FOR REFERENCES :

1. A.P.Godse and D.A.Godse – Microprocessors and micro controllers – Technical Publications.
2. Barry Brey , Intel Microprocessor 8086/ 8088, 80186, 80286 , 80386 , 80486 , Prentice Hall India ((1996)

SEMICONDUCTOR PHYSICS
(Course Code : 21 PPHE31)

SEMESTER III	HOURS – 5	CRDEITS 4

Course Outcomes : At the end of the course the students must be able to

1. Understanding the fundamental concepts of semiconductor devices.(K2)
2. Ability to recall the theory, construction, and operation of PN junction diodes.(K1)
3. Analysing the various configuration of Field effect Transistors.(K4)
4. Apply the knowledge of various configuration of Metal Oxide Semiconductor Field Effect Transistor.(K3)
5. Access the comparison of JFET and MOSFET and generate its applications.(K5)
6. Creating the ideas of optoelectronic devices and its importance in the applications of solar cell.(K6)

UNIT I SEMICONDUCTOR BASICS

Semi conductor materials and their properties – Valence band model of semi conductors – Energy band model - Equillibrium concentration of electrons - Holes inside the energy bands - Heavily doped semi conductors.

UNIT II DIODES

P – N junction –Description action – Diffusion junction – Ideal diode model – Break down in P – N junction – Avalanche break down in P-N junction – Distinction between Zener and Avalanche break down.

UNIT III FIELD EFFECT TRANSISTOR

Advantages and disadvantages of FET – Basic concepts of JFET – Characteristics of JFET – Principles of operations of JFET – Effect of VDS on Channel Conductivity – Effects of temperature on FET – Parameters - Common source ac amplifier fixed bias with self bias - Source follower – Common gate FET amplifier – Frequency response of FET amplifier.

UNIT IV METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTO

The depletion of MOSFET – The enhancement MOSFET – Difference between JFET and MOSFET – Handling precautions of MOSFET – Dual gate MOSFET - Applications of dual gate MOSFET in an AGC amplifier field effect diode.

UNIT V OPTO ELECTRONIC DEVICES

Solar cells, photodectors, light emitting diodes, p-n junction lasers diodes, semiconductor requirements for laser diodes, Hetrojunction and quantum well lasers.

BOOKS FOR STUDY:

1. Semi conductor devices – Physics and technology – SM Size Willey (1985)
2. Introduction to semi conductor devices – M.S. Tyagi , John Wiley and sons

BOOKS FOR REFERENCE

1. Measurement , Instrumentation and Experimental design in physics and engineering - M. Sayer and A. Mansingh – Prentice hall , India (2000)
2. Optical Electronics – Ajoy Ghatak and K. Thyagarajan , Cambridge University Press.

PRACTICALS V
MICROPROCESSOR 8086 (Any Twelve experiments)
(Course Code: 21PPH 34)

Semester III	**Hours - 4**	**Credits** 2

Programs using Microprocessor

1. Addition of two 16 – bit data
2. Course traction of two 16- bit data
3. Multibyte addition
4. Multibyte Course traction
5. Sum of elements in an array
6. Addition of two BCD numbers
7. Course traction of two BCD numbers
8. Multiplication of two 16 – bit numbers
9. Division of 32 – bit by 16 – bit data
10. Smallest data in an array
11. Largest data in an array
12. Sorting an array in ascending order
13. Sorting an array in descending order
14. Matrix addition
15. Matrix Multiplication
16. BCD to binary conversion
17. Binary to BCD conversion
18. Interfacing LED's using 8255
19. Interfacing 4 x 4 keyboard
20. Interfacing 8 digit 7 segment LED display
21. Interfacing Traffic light controller

PRACTICALS VI
MICROCONTROLLER 8051(Any Twelve experiments)
(Course Code: 21 PPH 35)

Semester III	**Hours - 4**	**Credits 2**

Programs using Microcontroller

1. 6 - Bit Addition
2. 8 - Bit Course traction
3. 8 - Bit Multiplication
4. One's and Two's Complement
5. setting bits in an 8 - bit number
6. Masking bits in an 8 - bit number
7. Arithmetic Operations
8. Sum of the elements in an array
9. Multiprecision Addition
10. 8 - Bit Division
11. ASCII to Decimal Conversion
12. Word Disassembly
13. Hex to Decimal Conversion
14. Decimal to Hex Conversion
15. Largest element in an array
16. Ascending order of an array
17. Stack and Course routines
18. Delay Loops

NUCLEAR PHYSICS AND ELEMENTARY PARTICLES
(Course code: 18PPH41)

Semester IV	Hours - 5	Credits 5

Course Outcomes: At the end of the course the student should be able to:

1. Remember the knowledge of the fundamental physics underpinning atomic and nuclear physics and Learn about basic properties of nuclei. **(K1)**
2. Understand what happen when charged particles and radiation passed through matter by various experimental procedures. **(K2)**
3. Compare and contrast different nuclear models, explain the need of standard model and its limitations. **(K3)**
4. Analyse the deuteron behavior at ground and excited states and apply deuteron physics and the Nucleon-Nucleon scattering for explaining the nuclear forces. **(K4)**
5. Evaluate the classification and properties of elementary particles, symmetry in baryon decuplets and octets with the fundamental constituents of matter (quarks, leptons and gluons) **(K5)**
6. Create the capability of doing back-of the envelope calculations in a diversity of situations. **(K6)**

UNIT I NUCLEAR MODELS

Nuclear shell model: magic numbers- evidence for magic numbers- Extreme Single Particle model – Single Particle model - Predictions of Shell model - Liquid drop model: Weizsaker's mass formula- The behavior of stable isobar in a decay - collective model- Rotational states- Vibrational states - Optical model.

UNIT II NUCLEAR FORCES

Introduction – Meson Theory of Nuclear Forms - Deuteron - n-p scattering and p-p scattering at low energies- Similarity between nn and pp forces – Non-Central forces – High energy n-p and p-p scattering.

UNIT III NUCLEAR DECAY

Gamow's theory of alpha decay - The Neutrino hypothesis - Fermi's theory of Beta decay – Violation of parity conservation in Beta decay - Gamma emission: multipole radiation - internal conversion and nuclear isomerism.

UNIT IV NUCLEAR REACTIONS AND NUCLEAR REACTORS

Nuclear reactions- compound nucleus - Reciprocity theorem-neutron sources: classification of neutrons- neutron diffusion- neutron current density- leakage rate- Fermi age equation- four factor formula – Classification of nuclear reactors.

UNIT V ELEMENTARY PARTICLES

Classification of elementary particles- particle interactions- conservation laws- invariance under charge, parity- time reversal- CPT- Particles and anti particles – Mesons – Hyperons - Electrons and posiclassification of hadrons- SU2 and SU3 symmetry- baryon octet- meson octet- baryon decuplet- Gellmann Okuba mass formula- quark theory of nuclei.

BOOKS FOR STUDY:

1. S.B Patel, nuclear physics an introduction wiley eastern ltd.1992-93.
2. D.C Tayal, nuclear physics, Himalaya publishing house 2011.

BOOKS FOR REFERENCES:

1. K. Heyde, basic ideas and concepts in nuclear physics, institute of physics publishing.
2. Walter E.Mayerhf, elements of nuclear physics, McGraw hill 1993-94.
3. R.D.Evans , the atomic nucleus, Mc Graw hill
4. Herald engae, introduction to nuclear physics.
5. S.M Wong introductory nuclear physicsd PHI,2000.
6. Arthur Beisser, modern physics .
7. R.R Roy and B.P Nigam, nuclear physics, new age international ltd 1st edition 2008.
8. Bernard L.Cohen, concept of nuclear physics, TATA Mcgraw hill 2010.
9. M.L Pandya and R.P.S Yadav, elements of nuclear physics, kendall/ hunt publishing co.3rd edition 2000.

SPECTROSCOPIC TECHNIQUES
(Course Code: 21PPH42)

Semester IV	Hours - 5	Credits 5

Course Outcomes : At the end of the course the students must be able to

1. Remember the basics on characterization of electromagnetic radiation and quantization of energy (K1)
2. Understand the applications microwave, infrared, Raman, electronic and Mossbauer and resonance spectroscopy (K2)
3. Apply the spectroscopic techniques to analyze different mechanism and properties of the Materials (K3)
4. Analyze and interpret the FTIR, Raman and resonance spectrum (K4)
5. Evaluate linear, vibrational and rotational motion of the molecules and can evaluate corresponding energy transitions (K5)
6. Learn different spectroscopic techniques to analyse molecular structure (K6)

UNIT I MICROWAVE SPECTROSCOPY

Interaction of radiation with rotating molecule – Rotational spectra of rigid diatomic molecules- Isotope effect in rotational spectra- Non-Rigid rotator – Linear polyatomic molecules-Symmetric top molecules – Asymmetric top molecules- Stark effect – microwave spectrometer- Applications of microwave spectroscopy.

UNIT II INFRARED SPECTROSCOPY

Vibrational energy of the diatomic molecule – vibrating diatomic molecules – diatomic vibrating rotator and vibration band – vibration of polyatomic molecules- Fermi Resonance- Hydrogen- Rotation vibration spectra of polyatomic molecule- Normal modes of vibration in crystal- Fourier transform infrared spectroscopy- applications.

UNIT III RAMAN SPECTROSCOPY

Theory of Raman Scattering – Rotational Raman spectra – Vibrational Raman spectra- Mutual exclusion principle – Raman spectrometer – Polarization of Raman scattered light- Structure determination using IR and Raman Spectroscopy- Raman investigation of phase transitions- stimulated Raman Scattering- Inverse Raman Effect-Photo acoustic Raman scattering.

UNIT IV ELECTRONIC AND MOSSBAUER SPECTROSCOPY

Vibrational coarse structure – Vibrational analysis of band systems – Frank Condon principle – Rotational fine structure of vibration spectra – The Fortrat parabola- Dissociation- Pre-dissociation- Electronic angular momentum in diatomic molecules- photo electron spectroscopy- Recoilless emission and absorption- experimental techniques- Isomer shift- Quadrupole interaction- application.

UNIT V RESONANCE SPECTROSCOPY

NMR – Magnetic properties of nuclei – Resonance conditions – NMR Instrumentation – Relaxation processes- Bloch Equations – Chemical Shift – NMR spectra of solids – Magic angle spinning NMR- Nuclear Quadrupole effects- NMR imaging

ESR- Principle of ESR- ESR Spectrometer – Fine and Hyperfine spectrometer- Double resonance in ESR

NQR-The Quadrupole nucleus- Principle of nuclear quadrupole resonance- NQR Instrumentation

BOOKS FOR STUDY:

1. G. Arul Dhas, Molecular Structure and Spectroscopy, Prentice Hall India, 3rd Edition 2009

BOOKS FOR REFERENCE

1. B.P. Straughan and S.Walker, Spectroscopy, Chapman and Hall Edition, 2000
2. P.K. Sharma, Spectroscopy, Goel Publishing House, 7th Edition, 2000
3. P.S. Sindhu, Molecular McGrawhill,2000
4. N. Banwell & E.M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, Edition 2003

NUMERICAL METHODS WITH C PROGRAMMING
(Course Code: 21 PPHE41)

SEMESTER IV	HOURS – 5	CRDEITS 4

Course Outcomes: At the end of the course the students must be able to

1. To remember the exposure of Numerical Differentiation and Integration (K1)
2. Understand the curve fitting methods and its significance (K2)
3. Apply the problem solving skills in algebraic, transcendental and simultaneous equation (K3)
4. Enhance the analytic skill to crack the competitive examinations (K4)
5. Process, analyze and Evaluate data from a variety of physical phenomena and interpret their meaning (K5)
6. Create new programming methods in computational methods in physics (K6)

UNIT I NUMERICAL SOLUTION OF LINEAR EQUATIONS

Iterative method- Bisection method- Newton Raphson's method-convergence and error in the Newton method- Solution of simultaneous equations-direct methods-Gauss elimination-Gauss –Jordon methods-Iterative methods- Gauss-Seidal and Gauss- Jocobi methods.

UNIT II INTERPOLATION AND FINITE DIFFERENCES

Linear interpolation- Gregory-Newton forward and backward interpolation - error in Newton's interpolation – Lagrange's Interpolation- Newton's divided difference interpolation- finite difference operators.

UNIT III NUMERICAL INTEGRATION AND DIFFERENTIATION

Trapezoidal rule- Simpson's $1/3^{rd}$ and $3/8^{th}$ rule- ODE: Numerical solution of differential equation- Taylor series- Euler's method-Runge kutta 2^{nd} and 4^{th} order methods.

UNIT IV STATISTICAL METHODS

Curve fitting: Method of least-squares- normal equations - straight-line, exponential fits and parabola fits- Discrete Probability distribution - Continuous distribution - Expectations - Moments and Standard Deviations - Binomial Distribution – Poisson Distribution - Gaussian Distribution.

UNIT V PROGRAMMING IN C

Introduction-Constants-variables - User defined types-Mathematical expres sion - Arithmetic operators - arrays - comments - format specifications-Example numerical programs- Bisection method-Lagrange's interpolation-RungeKutta method- method of least squares

BOOK FOR STUDY:

1. Numerical methods in science and engineering by Dr. M.K. Venkataraman, The national publishing company, Chennai.
2. Numerical methods with Programs in C & C++ by Dr. B.S. Grewal , Khanna Publishers, New Delhi.
3. Numerical methods by E.Balagurusamy Tata McGraw Hill , New Delhi.

BOOK FOR REFERENCES:

1. Pipes, L.A. & Harvil, L.R., Applied Mathematics for Engineers and Physicists, McGraw Hill Company, New Delhi.
2. Kandasamy. P, Thilagavathy. K and Gunavathy. K Numerical methods, S. Chand and Co. New Delhi 1999.
3. Applied numerical methods by A. Goudin, M. Boumahrat, PHI, New Delhi, 1996.
4. Numerical methods for scientific and engineering computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain – Wiley Eastern Ltd.

NANO PHYSICS
(Course Code: 21PPHE41)

SEMESTER IV	HOURS – 5	CRDEITS 4

Course Outcomes : At the end of the course the students must be able to

1. Acquire more knowledge in nanoscience(K1)
2. Understand different types and synthesis of nanocrystals(K2)
3. Know the various types and synthesis of nanotubes and its applications(K3)
4. Understand the theory and working of the different Characterization techniques for nanomaterials(K4)
5. Acquire more knowledge about the application of nanoscience(K5)
6. understand the meaning of quantization (K6)

UNIT – I : Basics of Nanotechnology

Introduction - Difference between bulk and nanoscale materials and their significance, zero dimensional, one dimensional and two dimensional nanostructures, quantum dots, calculation of the density of states (DOS) in 1, 2 and 3 dimensions, nano ribbons and nanowires, carbon nanotubes, chiral vector and chiral angle, different types of carbon nanotubes, fullerenes/buckyballs/C60.

Unit-II: Properties of nanomaterials

Properties at the nanoscale, effect of confinement, quantum confinement, size quantization effect on electronic state, the Brus equation, relation between metal nanoparticle size with colour, surface plasmon, surface-to-volume ratio, chemical properties of nanomaterials.

Unit-III: Synthesis of nanomaterials

Top-down approach and bottom-up approach, nanolithography, photolithography, electronbeam lithography, bottom-up approach, chemical methods, sol-gel processing, hydrothermal process.

Unit-IV: Characterization of materials

Optical characterization (UV-Vis, PL, Raman), Phenomena of diffraction radiation, X-ray diffraction, phase identification, Scherrer formula, strain and grain size determination, Scanning electron microscope (SEM), Transmission electron microscope (TEM), atomic force microscope (AFM), Scanning tunneling microscopy (STM-basic).

Unit-V: Applications of nanomaterials

Applications: nanoparticle-based drug delivery, storage devices and nanomaterial based Li-ion battery, TiO2 photocatalysis, spintronic devices and spin field effect transistors (SPINFET), magnetic tunnel junction based devices and tunnel magnetoresistance effect in tunnel junction. Tutorials: Tutorial sheet with relevant problems will be provided by the Instructor.

BOOKS FOR STUDY:

1. T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education, 2012.
2. G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, 2 nd Ed., Imperial College Press, 2004.
3. D. Bucknall, Nanolithography and Patterning Techniques in Microelectronics, CRC Press, 2005. 45 M.Sc.(Physics) 2017-18
4. T.K. Sau, A.L. Rogach, Complex-shaped Metal Nanoparticles: Bottom-Up Syntheses and Applications, 1 st Ed., Wiley-VCH, 2012.
5. P. Bandyopadhyay, M.Cahay, Introduction to Spintronics, 2 nd Ed., CRC Press, 2015.

BOOKS FOR REFERENCES :

1. D. Sangeeta, J.R. LaGraff, Inorganic Materials Chemistry Desk Reference, 2nd Ed., CRC Press, 2004.
2. B.S. Murty, P. Shankar, B. Raj, B.B.Rath, J.Murday, Textbook of Nanoscience and Nanotechnology, Springer-Verlag Berlin Heidelberg, 2013.
3. B.Bhushan, Springer Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg, 2004.
4. G. L. Hornyak, H.F. Tibbals, J.Dutta, J. J. Moore, Introduction to Nanoscience and Nanotechnology, CRC Press, 2008.

PRACTICALS VII
PROGRAMMING IN C (ANY EIGHT EXPERIMENTS)
(Course Code: 21 PPH 43)

Semester IV	**Hours - 4**	**Credits 2**

1. Bisection method
2. Newton's Raphson's method
3. Gauss Jordon
4. Gauss seidal
5. Newton's forward and backward Interpolation
6. Lagrange's Interpolation
7. Simpson's 1/3 & 3/8 rule
8. Taylor series
9. Euler's method
10. R.K 4^{th} order method
11. Method of least squares – straight line & parabola fit
12. Exponential fit

APTITUDE PHYSICS
(Course Code: 21 PPHECC 01)

SEMESTER-I	**CREDITS - 4**

Course Outcomes : At the end of the course the students must be able to

1. Identify the subject knowledge in the competitive exams(K1)
2. Aware of physical laws(K2)
3. Solve the physics problems(K3)
4. Analyse the Physics concepts(K4)
5. Evaluate the performance in competitive exam field(K5)
6. Generate interest towards writing competitive exams(K6)

UNIT I: GENERAL MECHANICS AND PROPERTIES OF MATTER

Physical quantities – S I system of units – Dimensions, Scalars and Vectors – (Concepts) – Newton's Equations of Motion– impulse, Principle of conservation of Linear momentum – Projectiles,Kepler's Laws– Newton's Law of Gravitation, acceleration due to gravity – Escape velocity – Angular momentum – banking of roads – simple harmonic motion – Viscosity – Surface Tension.

UNIT II:HEAT AND THERMODYNAMICS

Different scales of temperatures– thermal expansions – Calorimetry – specific heat, latent heat – triple point, transmission of heat, heat conductivity – Black bodies– Stefan Boltzmann Law – Wien's Displacement Law – Gas Equation – Boyle's Law– Charle's Law – Law of equipartition of energy - Laws of Thermodynamics.

UNIT III:LIGHT AND SOUND

Reflection – Refraction and total internal reflection of light and their applications– propagation of light– Refractive index – Prism – Lenses – mirrors – Aberration in Lenses – Optical instruments – microscopes – telescopes– binoculars– Defects of Human Eye Wave motion– longitudinal and Transverse waves – velocity of sound -Newton's formula, Laplace correction, effects of pressure – beats – laws of vibrating strings– open and closed organ pipes– Resonance .

UNIT IV:ELECTRICITY AND MAGNETISM

Electric charge – field– potential, Resistances – Capacitancev cells and their combinations – Kirchoff's laws, Ohm's law – Faraday's laws – Lenz's law– Galvanometer – Voltmeter – Ammeter – Current Electricity – Earth's Magnetism– bar magnet – Magnetic moment – Magnetic field – magnetic Course stances– torque

of a bar magnet placed in a magnetid field– electromagnet - Classification of magnetic materials.

UNIT V:MODERN PHYSICS AND ELECTRONICS

Bohr's theory H spectrum – Nuclear Physics, Binding Energy – X–rays – Alpha–Beta and Gamma rays – Einstein's photoelectric effect and mass-energy relations-Semi-conductors, Diodes – Transistors – Rectifiers – Amplifiers – Oscillators–Boolean Algebra – Logic gates – Electronics in Communication.

BOOK FOR STUDY

Steven Holzner, Physics Workbook For Dummies, Wiley Publishing, Inc., 2007

BOOK FOR REFERENCE

S.S. Krotov, Science for Everyone: Aptitude Test: Prob. Physics CBS; 1st edition, 2000

MICROPROCESSOR- BASED PHYSICS INSTRUMENTATION
(Course Code: 21 PPHECC 02)

SEMESTER-II	CREDITS 4

Course Outcomes : At the end of the course the students must be able to

1. Gain knowledge about architecture, instruction set, peripheral devices of 8086 microprocessor (K1)
2. Understand different computational techniques for physical application(K2)
3. Apply circuit systems to construct electronic devices (K3)
4. Learn the ALP program of microprocessors/microcontrollers-based systems (K4)
5. Evaluate an expanded system by connecting several hardware as needed also integrates timer and counter functions (K5)
6. Interface specific software with devices/instruments (K6)

UNIT I: INTRODUCTION TO MICROPROCESSORS

Tristate logic – buffers – transceivers– Bus structure of micro computers– 8086-8088 microprocessors – introduction – internal architecture – Assembly language programming – Examples involving basic data transfer – arithmetic operations.

UNIT II: CODE CONVERSIONS AND TIMER

Binary – BCD – ASCII – Timing - delay generation - sorting of numbers and names – etc - 8086/8088 hardware features - minimum and maximum modes of operation - clock generator - bus interface device - memory decoding - Input and output decoding schemes machine cycle- instruction cycle- fetch and execution cycle.

UNIT III: PRINCIPLES OF INTERFACING

Data transfer schemes- port operation- Peripheral chips 8255, 8279, 8259, 8250, 8251- Programme development tools- Top-Down design Assemblers Editors- Compilers- Interpreters- In-circuit emulators (IE).

UNIT IV: INTERFACING

Interfacing using single board computers and PCs - Basic input output operations using ports – Interfacing LED's - 7-segment LED displays- LCD alphanumeric displays (dot matrix) - stepper motor - DC motor with and without feedback control. - DAC's ADC's.

UNIT V: INSTRUMENTATION

Single chip controllers (80848, 8051, 8096 families) - one of them in detail with a specific prototype- Sensors and transducers in physical measurements – Optical- Mechanical- Magnetic- Displacement- Temperature- Pressure.

BOOK FOR REFERENCE

1. Ramesh S. Goanker, Microprocessor Architecture, Programming and Applications, VViley Eastern (1986).
2. Douglas V. Hall, Micro processors and Interfacing, Tata McGraw-Hill, 2nd Indian Edition (1991).
3. John Uffenbeck, 8086/8088 Family Design, Programming and Interfacing, Prentice hall, 2nd Edition (1987).
4. J.B. Peatman, Design with Microcontrollers, McGraw-Hill (1988)
5. Mohammad Rafiguzzaman, Microprocessors and Microcomputer-based System Design, Universal Book Stall, New Delhi, 2nd Indian Edition (1990).

MATERIALS SYNTHESIS AND CHARACTERIZATION
(Course Code: 21 PPHECC 03)

Semester III	**Credits - 4**

Course Outcomes : At the end of the course the students must be able to

1. Know the basic ideas of crystal growth and nucleation(K1)
2. Understand different crystal growth methods (K2)
3. Understand the different deposition methods of thin flim (K3)
4. Identify the different Characterization techniques of materials (K4)
5. Acquire more knowledge about different new materials(K5)
6. Develop the interests on the application of semiconductor devices (K6)

UNIT I : FUNDAMENTALS OF CRYSTAL GROWTH

Importance of crystal growth – Classification of crystal growth methods – Basic steps: Generation, transport and adsorption of growth reactants – Nucleation: Kinds of nucleation – Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – Kinetic theory of nucleation – Becker and Doring concept on nucleation rate – Energy of formation of a spherical nucleus – Statistical theory on nucleation: Equilibrium concentration of critical nuclei, Free energy of formation.

UNIT II : GROWTH TECHNIQUES

Solution growth technique : low temperature solution growth : solution – Solubility – constant temperature bath an 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 – Advantage of gel method.

Melt technique : Bridgman technique – czochralski technique – Experimental arrangement – Growth process.

UNIT III: THIN FILM DEPOSITION TECHNIQUES

Thin films – Introduction to vaccum technology –deposition techniques – physical methods – resistive heating – electron beam gun and laser gun evaporation – sputtering : Reactive sputtering – radio frequency sputtering – chemical methods – spray pyrolsis – preparation of transport conducting oxides.

UNIT IV : CHARACTERIZATION TECHNIQUE

X-ray Diffraction (XRD) – power and single crystal – fourier transform infrared analysis – FT –Raman analysis – Elemential dispersive x-ray analysis (EDAX) – scanning electron microscopy (SEM) – UV –VIS Spectrometer Vickers micro hardness – Auger emission spectroscopy. Photolumine scene (PL) – UV –Vis – IR spectrometer- AFM- Hall effect – SIMS – X-ray – photoemission spectroscopy (XPS) – dynamic light scattering – ellipsmety method.

UNIT V : APPLICATIONS

Micro electrochemical systems (MEMS) – optoelectronic devices : LED , LASER and solar cell – polymer films – Fabrication and characterization of thin film transistor, capacitor , resistor , inductor and FET – Sensor – quantum dot – Applications of ferromagnetic and super conducting films : Data storage , Giant magneto resistance (GMR).

BOOKS FOR STUDY

1. K.Sangawal , Elementary crystal growth – shan publisher , UK ,1994.
2. P.Santhana Ragavan , P.Ramasamy ,Crystal Growth and processes. KRU publications. Kumbakonam(2000).

REFERENCE

1. J.C.Brice , Crystal Growth Process , John wiley publications , NewYork (1996).
2. Crystallization' by J.W. Mullin, 2004, Elsevier Butterworth-Heinemann, London.
3. J.L. Vossen and W.kern ,Thin films process , Academic press ,1978.
4. M.Ohring , The materials science of Thin Films, Academic press , 1992.
5. M.William and D.Steve , Instrumental Methods of analysis (CBS publishers) Newdelhi. (1986).

NON - DESTRUCTIVE TESTING
(Course Code: 21 PPH ECC 04)

Semester IV	**Credits 4**

Course Outcomes : At the end of the course the students must be able to

1. Describe the conditions to be checked without disconnecting or damaging the test sample(K1)
2. Explain the basic principles behind various non-destructive testing(K2)
3. Examine the applications of various non-destructive testing methods(K3)
4. Illustrate the terminology used in non-destructive testing(K4)
5. Assess appropriate testing methods and identify equipment required for the testing process(K5)
6. Develop the interest towards Non Destructive Testing(K6)

UNIT I INTRODUCTION AND SURFACE NDT METHOD

Definition of terms, discontinuities and defects/flaws – fracture mechanics concept of design and the role of NDT – life extension and life prediction – penetrant testing and magnetic particle testing, basic principle of penetrant testing – limitations and advantages – basic principle involved in magnetic particle testing – development and detection of large flux – longitudinal and circular magnetization – demagnetization.

UNIT II RADIOGRAPHIC TESTING

Properties of X-rays and gamma rays – attenuation and differential attenuation – interaction of radiation with matter – Principle of radiographic testing and recording medium – films and fluorescent screens – nonimaging detectors – film radiography – calculation of exposure for X-ray and gamma rays – quality factors – Image quality indications and their use in radiography – neutron radiography.

UNIT III ULTRASONIC TESTING

Ultrasonic waves – velocity, period, frequency and wavelength – reflection and transmission – near and far field effects and attenuation – generation – piezoelectric and magnetostriction methods – normal and angle probes – methods of Ultrasonic testing – Principle of pulse echo method – Equipment – examples – rail road inspection, wall thickness measurement – range and choice of frequency.

UNIT IV EDDY CURRENT TESTING

Introduction – Principles of eddy current inspection – conductivity of a material – magnetic properties – coil impedance – lift off factor and edge effects – skin effect – inspection frequency – coil arrangements – inspection probes – types of circuit –

Reference pieces – phase analysis – display methods – typical applications of eddy current techniques.

UNIT V THERMAL AND OPTICAL METHODS

Imaging – principle and applications – testing of composites – acoustic emission testing – application of AET – on-line monitoring or continuous surveillance and applications in materials science – Optical methods of NDT – photo elasticity – evaluation procedure – Holographic NDT procedure – speckle phenomenon – speckle interferometry – speckle shear interferometry – Fourier optics – Fourier filtering techniques for non-destructive testing.

BOOKS FOR STUDY

1. Non destructive testing of welds – Baldev Raj , C.V.Course ramaniam , T. Jayakumar, Narosa Publishing House (2006)

REFERENCES

1. B.Hull and V.John. Nondestructive Testing. Mc Millan Education Ltd., London, 1988.
2. Metals Hand Book, Vol.2, 8th Edition, ASTM, Metals Park, Ohio.
3. Dainty, Laser Speckle & Related Phenomena, Springer-Verlag, New York, 1984.
4. Mc Gonnagle, W.J. Non-destructive testing methods, Mc Graw Hill Co., NY, 1961.