M.Sc. Physics Course Structure under CBCS

(For the candidate admitted from the academic year 2017-2018 onwards)

SEM	Course Code	Course	Course Title	Ins.Hrs / Week	Credit	Marks		Total
						CIA	ESE	
I	17PPH1C1	Core– I	Classical Dynamics	6	5	25	75	100
	17PPH1C2	Core – II	Mathematical Methods for Physics	6	5	25	75	100
	17PPH1C3	Core– III	Electronic Devices and Circuits	6	4	25	75	100
	17PPH1C4P1	Core– IV	General Physics– Practical	3	2	10	40	50
	17PPH1C4P2		Optics and Heat– Practical	3	2	10	40	50
	17PPH1CE1A/B	Elective– I #		6	4	25	75	100
			TOTAL	**30**	**22**			**500**
II	17PPH2C5	Core– V	Advanced Mathematical Physics	6	5	25	75	100
	17PPH2C6	Core– VI	Atomic and Molecular Spectroscopy	6	5	25	75	100
	17PPH2C7	Core– VII	Electromagnetic Theory	6	4	25	75	100
	17PPH2C8P1	Core– VIII	Solid State Physics - Practical	3	2	10	40	50
	17PPH2C8P2		Analog Electronics – Practical	3	2	10	40	50
	17PPH2CE2A/B	Elective– II #		6	4	25	75	100
			TOTAL	**30**	**22**			**500**
III	17PPH3C9	Core– IX	Nuclear and Particle Physics	6	5	25	75	100
	17PPH3C10	Core– X	Quantum Mechanics	6	5	25	75	100
	17PPH3C11	Core– XI	Statistical Mechanics	6	4	25	75	100
	17PPH3C12P1	Core– XII	Digital Electronics - Practical	3	2	10	40	50
	17PPH3C12P2		Numerical Programming in Physics - Practical	3	2	10	40	50
	17PPH3CE3A/B	Elective– III #		6	4	25	75	100
	17PPH3EC1	Extra Credit Course – I	Nonlinear Electronics	-	5*	-	100	100*
			TOTAL	**30**	**22**			**500**
IV	17PPH4C13	Core– XIII	Solid State Physics	6	5	25	75	100
	17PPH4C14	Core– XIV	Electronic Communication	6	5	25	75	100
	17PPH4C15P1	Core– XV	Microprocessor and Microcontroller- Practical	3	3	10	40	50
	17PPH4C15P2		Numerical Simulations in Physics - Practical	3	2	10	40	50
	17PPH4CE4A/B	Elective-IV #		6	4	25	75	100
	17PPH4PW	Project		6	5	-	100	100
	17PPH4EC2	Extra Credit Course – II	Non-Conventional Energy Sources	-	5*	-	100	100*
			TOTAL	**30**	**24**			**500**
			GRAND TOTAL		**90**			**2000**

Electives

SEMESTER	COURSE CODE	COURSE TITLE
I	17PPH1CE1A	Medical Physics &Ultrasonics
	17PPH1CE1B	Crystal Growth and Thin Films
II	17PPH2CE2A	Computational Methods for Physics
	17PPH2CE2B	Nano science and Technology
III	17PPH3CE3A	Microprocessor and Microcontroller
	17PPH3CE3B	Fibre Optics
IV	17PPH4CE4A	Advanced Topics in Physics
	17PPH4CE4B	Physics of Liquid Crystals

*Not considered for grand total and CGPA

Semester – I

SEMESTER I: CORE – I
CLASSICAL DYNAMICS

Course Code : 17PPH1C1 **Max. Marks : 100**
Hours / Week : 6 **Internal Marks : 25**
Credit : 5 **External Marks : 75**

Objectives:

- To understand Lagrangian and Hamiltonian principles and its applications
- To study the canonical transformations of Poisson's Brackets & Hamilton – Jacobi Theory
- To study the general theory of small oscillations and Rigid body dynamics
- To study the energy concepts in relativistic mechanics.

Unit – I: Lagrangian Dynamics (18 Hours)

Constraints – generalized co-ordinates – principle of virtual work – D'Alembert's principle – Lagrange's equations from D'Alembert's principle – Hamilton's principle and Lagrange's equations – Applications – simple pendulum – At wood's machine –Motion under central force – LC circuit.

Unit – II: Hamiltonian Dynamics (18 Hours)

Generalised momentum and Cyclic co-ordinates – Hamilton's equations – deduction of Hamilton's principle from the D'Alembert's principle – Deduction of Hamilton's equation from the modified Hamilton's principle – Examples: Harmonic oscillator, charged particle moving in an electromagnetic field – compound pendulum – principle of least action

Unit – III: Poisson's Brackets & Hamilton – Jacobi Theory (18 Hours)

Poisson's bracket – canonical transformations – invariance of Poisson bracket with respect to canonical transformations – Hamilton-Jacobi theory – Action and Angle variable – Kepler's problem – solution of Harmonic oscillator problem by Hamilton-Jacobi equation – Hamilton's characteristic function conservative system.

Unit – IV: Small oscillations and Rigid-body dynamics (18 Hours)

General theory of small oscillation – Equation of motion for small oscillation – solution of eigen value equation – normal co-ordinates and normal frequencies of vibration – vibration of a linear triatomic molecule.

Euler's angle – equation of motion of Rigid body – Euler's equations – the motion of a symmetric top under action of gravity.

Unit – V: Relativistic Mechanics (18 Hours)

Relativistic energy – relation between momentum and energy and conservation law – transformation of momentum and energy – Force in relativistic mechanics – Minkowski space and Lorentz transformations – World point and world line – Four vectors.

Books for study:

1. Classical Mechanics, J.C. Updhaya, Himalaya Publishing House (2005)
   Unit – I: Section: 2.3 – 2.7, 2.8 (Examples:2, 3,7& 8), 2.11
   Unit – II: Section: 3.2, 3.5,3.7, 5.3, 5.5, 5.11
   Unit – III: Section: 6.3,7.2, 7.6, 8.2,8.3,8.4,8.5
   Unit – IV: Section: 9.2, 9.4 , 9.6, 10.3,10.7, 10.14
   Unit – V: Section: 13.3, 13.5, 13.6, 13.7, 13.8, 14.2, 14.3, 14.4, 14.5.

Books for reference:

1. Classical Mechanics, H.Goldstain, NarosaPublishing, (2008)
2. Classical Mechanics, N.C.Rana and P.S.Joag, Tata McGraw. Hill (1991).

SEMESTER I: CORE – II
MATHEMATICAL METHODS FOR PHYSICS

Course Code	**: 17PPH1C2**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 5**	**External Marks**	**: 75**

Objectives:

- To practice mathematical methods for physics through vector analysis, matrices, Tensors, complex variable, Fourier transform

Unit – I: Vector Analysis **(18 Hours)**

Differentiation of Vector Functions: The Derivative of a Vector- Gradient, Divergence, Curl and Laplacian Operators- Integration of Vector Functions: Line integral- Gauss Divergence Theorem –Green's theorem – Stoke's theorem – Statements and proofs only.

General Curvilinear Coordinates: Orthogonal Curvlinear Cylindrical Coordinates-Gradient, Divergence, Curl and Laplacian in Orthogonal Curvlinear Coordinates - Spherical Polar coordinates.

Unit – II: Linear Vector Spaces and Matrices **(18 Hours)**

Linear Vector Spaces**:** Definition – Linear independence, basis and dimension – Scalar Product- Orthonormal basis- Schwartz Inequality-Gram-Schmidt's Orthogonalization process – Linear operators

Special Types of Matrices: The Eigen Value Problem-Cayley Hamilton theorem –Coordinate Transformations: Rotation in two and Three Dimensions.

Unit – III: Tensors **(18 Hours)**

Notations and Conventions - Contravariant vector – covariant vector – Tensors of second rank –General Definition - addition and subtraction - outer products of tensors – Inner products of tensors – symmetric and anti symmetric tensors – Quotient Law - Kronecker Delta – Metric tensor – Orthogonal Transformations- Stress and Strain tensors-Hooke's law – moment of inertia tensor

Unit – IV Complex Variables **(18 Hours)**

The Derivative of a Complex Function $f(z)$ of its Analyticity – Cauchy – Riemann conditions –Harmonic Functions- Cauchy's Integral theorem - Cauchy's Integral formula – Taylor's series – Laurent's series – Zeros of a Complex Function-Evaluation of Residues-Cauchy Residue theorem –Evaluation of definite integrals - Integrals of the form $\int_0^{2\pi} f(sin\theta, cos\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$]

Unit – V: Fourier Transforms **(18 Hours)**

Fourier Integral Theorem and its proof- Fourier transform of time dependent functions-Integral Representation of the Delta Function - Parseval's Theorem-Linearity Theorem- Fourier transform of derivatives –Shifting of the origin- Convolution theorem – Sampling Theorem-Use of Fourier Transforms in Solving Differential Equations

Books for Study:

Units	Book	Chapters/Topics
Unit - I	Introduction to Mathematical Physics- Charlie Harper, PHI,New Delhi,2006	Chapter: 1 Topics: 1.3.1,1.3.2,1.4.1,1.4.2,1.4.3,1.4.4,1.6.1, 1.6.2,1.6.3,1.6.4,1.6.5,1.6.8
Unit - II	Mathematical Physics – Sathya Prakash, Sultan chand& sons,New Delhi,2011	Chapter: 2 Topics: 2.5,2.31, 2.32,2.39
	Mathematical Physics –P.K. Chattopadhyay, New Age International,new Delhi,1990	Chapter: 7 Topics: 7.1-7.6
Unit - III	Matrices and Tensors in Physics- A.W. Joshi, New Age International,new Delhi,1995	Chapter: 15,16,17,18 & 19 Topics: 15.2 – 15.6, 16.2 – 16.7, 17.1,18.1,19.2,19.5,19.7
Unit - IV	Introduction to Mathematical Physics- Charlie Harper, PHI,New Delhi,2006	Chapter: 3,4 Topics: 3.3.1 – 3.3.5, 3.4.1,3.4.2, 4.1,4.2,4.3,4.4,4.5,4.6.1,4.6.2
Unit - V	Mathematicap Physics-A.K. Ghatak, I.C. Goyal & S.J. Chua,Macmillman India Ltd, New Delhi,1995	Chapter: 10 Topics: 10.1- 10.7,10.10

SEMESTER I: CORE – III

ELECTRONICS DEVICES AND CIRCUITS

Course Code	**: 17PPH1C3**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 4**	**External Marks**	**: 75**

Objectives:

- To study the fabrication of semiconductor devices
- To study the constructions, operations and characteristics of solid state devices
- To learn the circuit ideas of Op-amp and 555 timer applications.

Unit – I: IC Fabrication and Transducers (18 Hours)

Introduction – Construction of Monolithic bipolar transistors – Fabrication of PNP transistors – Fabrication of Monolithic Diodes, Resistors, Capacitors and Inductors – Fabrication of Junction Field Effect Transistors and MOSFET – NMOS fabrication.

Unit –II: Solid State Devices (18 Hours)

Construction, operation and V-I characteristics of special devices: Tunnel diode – Gunn diode – MOSFET – Enhancement MOSFET – Biasing of Enhancement MOSFET.

SCR – SCR half wave rectifier – SCR Full wave rectifier – TRIAC – DIAC – UJT – UJT relaxation Oscillator

Unit – III: Operational Amplifier (18 Hours)

Instrumentation Amplifier – Op-Amp circuits using diodes: Half wave rectifier, Full wave rectifier, Peak detector, Clipper and Clamper circuits – Sample and hold circuit – Logarithmic and Antilogarithmic amplifier.

Multiplier – Divider – Differentiator – Integrator –Electronic analog computation: Simulation of 2^{nd} order differential equation – simulation of transfer function

Unit – IV: Comparators, Waveform Generators and Filters (18 Hours)

Comparator – Zero crossing detector – window detector – Schmitt trigger – Astable multivibrator – Monostable Multivibrator – Triangular wave generator.

RC phase shift oscillator – Wien's bridge oscillator – Function generator – RC active filters: I order low pass, high pass and band pass filters.

Unit – V: 555 Timer and Phase –Locked Loops PLL (18 Hours)

Introduction – Description of functional diagram of 555 timer – Monostable operation – Frequency divider – Astable operation – Frequency Shift Keying(FSK) generator.

PLL Basic principle – Analog phase detector – Digital phase detector – Voltage controlled oscillator – PLL applications – frequency multiplication/division – Frequency Translation

Book for Study:

- Electronic Devices and Circuits, S Salivahanan, N Suersh Kumar & A Vallavaraj, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition, 2009.
  Unit – I: Pages: 666, 677, 682, 685, 689, 693.
  Unit – II: Page : 136, 139, 206, 215, 227, 230, 235, 237,584, 586.

- Linear Integrated Circuits (third edition), D.Roy Choudhury and Shail B.Jain, New Age International Publishers.
  Unit – III: Pages:141, 148, 153, 155, 159, 164, 168, 176.
  Unit –IV: Pages: 297, 212, 216, 218, 220, 223, 226, 229, 262.
  Unit – V: Pages: 311, 312, 318, 327, 329, 334, 342.

SEMESTER I: CORE – IV
GENERAL PHYSICS

Course Code : 17PPH1C4P1	**Max. Marks : 50**
Hours / Week : 3	**Internal Marks : 10**
Credit : 2	**External Marks : 40**

Objectives:

- To realize the physics principles through advanced physics experiments
- To determine a physical coefficients through electromagnetic and optical experiments.
- To develop the skills in measuring physical quantities and determining coefficients through optics and heat experiments.

List of Experiments:

1. e/m Thomson method
2. e/m Helical method
3. Determination of the specific charge [e/m] of an electron by magnetron method.
4. Determination of q, n, σ by elliptical fringes method.
5. Determination of Specific Rotatory Power of Liquids - Laurent's Half-shade Polarimeter
6. Fourier Analysis of Periodic Waveforms
7. Determination of magnetic susceptibility by Quincke's method.
8. Determination of λ and μ using Fresnel Bi-prism.

SEMESTER I: CORE – IV
OPTICS AND HEAT PRACTICALS

Course Code : 17PPH1C4P2	**Max. Marks : 50**
Hours / Week : 3	**Internal Marks : 10**
Credit : 2	**External Marks : 40**

List of Experiments:

1. Determination of wavelength and $\Delta\lambda$ using Michelson's interferometer.
2. Determination of q, n, σ by Hyperbolic fringes method.
3. Rydberg's Constant – Hydrogen Spectrum.
4. Charge of an electron by spectrometer.
5. Determination of Stefan's constant.
6. Lorentz number determination – Forbe's method.
7. Ultrasonic Diffraction – Bulk modulus.
8. Magnetic Susceptibility of a liquid - Guoy's Method.

SEMESTER I: ELECTIVE – I
MEDICAL PHYSICS AND ULTRASONICS

Course Code	**: 17PPH1CE1A**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 4**	**External Marks**	**: 75**

Objectives:

- To acquire knowledge in biomedical instrumentation
- To learn the applications of Laser and Ultrasonics in Medicine

Unit – I: Diagnostic Devices **(18 Hours)**

Blood Pressure and its Measurement – Eye Pressure Measurement - Electrical Signals from Heart: Electrocardiography (ECG) – Electrical Signals from brain: Electroencephalogram (EEG) - Electrical Signal from muscles: Electromyogram (EMG) – Magnetic Resonance Imaging (MRI).

Unit – II: Therapeutic Devices **(18 Hours)**

Microprocessor based ventilators – AC and DC defibrillator – Pacemaker – Versatile Electro Therapeutic Stimulator – Anesthesia Machine – Ventilator – Dialysis Process – Comparison between Hemodialysis and Peritoneal Dialysis - Peritoneal Dialysis unit - Nuclear Therapy: Tele-Therapy (Co^{60}) and Brachytherapy.

Unit – III: Medical Applications of Lasers **(18 Hours)**

Laser Based Blood Cell Counter – Laser Doppler Blood Flow meter – Laser in Angioplasty – Principle and theory of fluorescence – Reflectance and Light Scattering Spectroscopy – Laser Spectroscopy Cancer Detection Techniques: Fluorescence and Raman Spectroscopy – Photodynamic Therapy of Tumors.

Unit – IV: Ultrasonic Study of Liquid Mixtures and Solutions **(18 Hours)**

Preparation of multi component liquid mixtures: Mole fraction – Weight fraction – Volume fraction. Measurement techniques: Ultrasonic Interferometer – Continuous wave method – Density – Viscosity

Pure liquids and binary Mixtures :Free Length Theory – Collision Factor Theory – Nomoto's Relation Acoustical Parameters – Adiabatic Compressibility – Acoustic Impedance – Intermolecular Free Length – Molar Volume – Free Volume – Internal Pressure.

Unit – V: Applications of Ultrasound **(18 Hours)**

Low Frequency – High Intensity Applications: Ultrasonic Welding – Applications – Ultrasonic Cleaning – Applications – Food Industry – Length Meters.

High Frequency – Low Intensity Applications: Level Meters – Thickness Measurements – Ultrasonic Microscopy – Acoustic Holography (Transmission Acoustic Holography)

Books for Study:

1. Biomedical Instrumentation – Dr .M. Arumugam, Tenth Reprint Anuradha publications, Chennai.
   (Unit I : Page no : 117 – 161, 394 – 400 & Unit II : Page no: 187 - 226)
2. Atomic & Molecular Spectroscopy (Basic aspects & Practical applications) – S.Svanberg, 4th Edition.
   (Unit III : Page no : 441 – 460)
3. Science and Technology of Ultrasonics – Baldevraj, V.Rajendran and P.Palanichamy, Narosa Publications, New Delhi
   (Unit IV : 136 – 158 & Unit V : 107 – 124)

Book for Reference:

1. Medical Physics – John R. Cameron and James G.Skofronick, John Wiley Interscience Publication, Canada.

SEMESTER I: ELECTIVE – I
CRYSTAL GROWTH AND THIN FILMS

Course Code	**: 17PPH1CE1B**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 4**	**External Marks**	**: 75**

Objectives:

- To learn the crystal growth and characterization techniques
- To study the formation of thin film and its analysis

Unit – I: Crystal growth Phenomena **(18 Hours)**

Nucleation: Theories of nucleation – Classical theory of nucleation: Gibbs Thomson equation for vapour – Gibbs-Thomson equation for solution – Energy formation of a nucleus – Spherical nucleus – Cylindrical nucleus.

Unit – II: Low Temperature Solution growth **(18 Hours)**

Solution, Solubility and Super solubility – Expression of Super saturation – Methods of Crystallization: Crystallization by Slow Cooling of Solutions – Crystallization by Slow evaporation Method – Temperature gradient Method – Crystal growth system – Melt Method

Unit – III: Other Crystal growth techniques **(18 Hours)**

Physical vapour deposition – Chemical vapour deposition – Gel growth – Principle of gel growth – various types of gel – Structure of gel – Growth of Crystals in gels – Importance of gel technique – Experimental procedure.

Unit – IV: Preparation of Thin film **(18 Hours)**

Physical Method : DC sputtering – Laser beam evaporation – Electron Beam Evaporation – Chemical methods: Chemical vapour deposition – Pyrolysis – Vapour phase reaction – Vapour Transportation method – Disproportionation method – Chemical deposition – Electrodoposition – Mass method (Micro balance technique) – Optical method (Photometric).

Unit – V: Thin film Analysis **(18 Hours)**

Electron Diffraction Technique – Electron Microscopy – Scanning Electron Microscopy (SEM) – Electron Probe micro analysis – X-Ray Photo Electron spectroscopy (XPES) – Mass Spectroscopy.

Books for Study:

1. Crystal Growth, Dr. P. Santhana Raghavan and Dr. P. Ramasamy, KRU Publications.

Units	Page Numbers
I	19 – 30
II	151 – 164
III	198 – 247

2. Thin Film Fundamentals, A. Goswami, Reprint, 2008, New Age International Publishers.

Units	Page Numbers
IV	29 – 40
V	111 – 137

SEMESTER – II

SEMESTER II: CORE – V
ADVANCED MATHEMATICAL PHYSICS

Course Code	**: 17PPH2C5**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 5**	**External Marks**	**: 75**

Objectives:

- To learn the mathematical functions and problem practice
- To learn the concept of group theory

Unit – I: Partial Differential Equations **(18 Hours)**

Definitions – method of separation of variables – solution of one-dimensional wave equation – one dimensional heat conduction equation – modes of an optical fiber – transformation and classification of PDE's – characteristic co-ordinates – canonical forms of hyperbolic, parabolic and elliptic equations.

Unit – II: The Beta, Gamma and special functions **(18 Hours)**

Definition of the Beta function and Gamma function – symmetry property of Beta function – Transformation of Beta function – Transformation of Gamma function – Relation between Beta and Gamma functions – Legendre differential equation – Hermite differential equation – generating function – Rodrigue's formula– orthogonal properties – Bessel's differential equation – Recurrence formula for $J_n(x)$.

Unit – III: Dirac-Delta function and Green's Function **(18 Hours)**

Dirac-Delta function – Properties of Delta function – three dimensional delta function – Green's function for one-dimensional case – Application to Boundary value problem – general proof of symmetry property of Green's function – Green's function for Poisson's equation and solution of Poisson's equation – Green's function for quantum mechanical scattering problem.

Unit – IV: Laplace's Integral transform **(18 Hours)**

Condition for the existence of Laplace transform – Properties of Laplace transform – Laplace transform of derivative of a function – Laplace transform of integral – Laplace transform of special function – evaluation of inverse Laplace transform – convolution theorem.

Unit – V: Group theory **(18 Hours)**

Concept of a group – Abelian group – the cyclic group – the group multiplication table – Rearrangement theorem – Isomorphism and Homomorphism – the group of symmetry of an equilateral triangle – group of symmetry of a square – representation of groups – reducible and irreducible representations – Schur's Lemma I and II – The orthogonality theorem.

Books for Study:

1. Mathematical Physics, A.K. Ghatak, IC Goyal & S.J. Chua, Mac Millan India Ltd., (1995)
   Unit – I : Section: 15.2, 15.3, Examples: 15.2, 15.6, 15.5, 15.6, 15.7
2. Mathematical Physics, Satya Prakash, Sulthan Chand and Sons, NewDelhi (2001)
   Unit – II: 4.1, 4.2, 4.4, 4.6, 4.7, 7.11, 7.12, 7.13, 7.14, 7.21, 7.25, 7.33,7.36, 7.37, 7.40
   Unit – III: 11.1, 11.2, 11.7, 11.8 – 11.10, 11.12, 11.13
   Unit – V: 11.13, 13.1, 13.2, 13.5, 13.6, 13.13,13.16, 13.17, 13.18, 13.19, 13.20, 13.21.
3. Mathematical Physics, Satya Prakash, Sulthan Chand and Sons, NewDelhi (2005)
   Unit – IV: Sec.9.9 , 10.9, 10.11, 10.12,10.14,10.15,10.18

SEMESTER I: CORE – VI
ATOMIC AND MOLECULAR SPECTROSCOPY

Course Code : 17PPH2C6 **Max.Marks : 100**
Hours / Week : 6 **Internal Marks : 25**
Credit : 5 **External Marks : 75**

Objectives:

- To understand the principles of Vibrational, Rotational, Electronic, mass and Resonance Spectroscopies.
- To study the component of the spectrometer and to determination molecular structure.

Unit – I : Rotation of molecule **(18 Hours)**

Classification of molecule –rotational spectra of rigid diatomic molecules – isotopic effect in rotational spectra – non-rigid rotator – linear poly atomic molecules – microwave spectrometer

Unit II: Infrared spectroscopy **(18 Hours)**

vibrational energy of a diatomic molecule – infrared selection rules – vibrating diatomic molecule – diatomic vibrating rotator – rotation-vibration spectra of polyatomic molecules – IR spectrometer-instrumentation – Fourier transform Infrared spectroscopy

Unit – III : Raman spectroscopy **(18 Hours)**

Rotational Raman spectra - vibrational Raman spectra – Raman spectrometer – Hyper-Raman effect – stimulated Raman scattering – inverse Raman Scattering – coherent anti-stokes Raman scattering

Unit – IV : Electronic spectroscopy **(18 Hours)**

Vibrational coarse structure – vibrational analysis of band systems-Deslandres table – Franck-condon principle-intensity of vibrational electronic spectra – rotational fine structure of electronic-vibration spectra – dissociation – Principle of ESR – ESR spectrometer – ESR spectra of free radicals in solution

Unit – V : Resonance spectroscopy **(18 Hours)**

Magnetic properties of nucleui – Resonance condition – NMR instrumentation – chemical shift – the quardupole nucleus – principle of nuclear quadrupole resonance – transitions for nonaxially symmetric systems – NQR instrumenation

Books for study:

1. Molecular Structure and Spectroscopy - G. Aruldhas, 2nd edition, PHI Publishers.

   Unit I :6.1, 6.3, 6.4, 6.6, 6.8, 6.9, 6.10, 6.14

   Unit – II : 7.1, 7.3, 7.4, 7.5, 7.11, 7.16, 7.18

   Unit III : 8.3, 8.4, 8.6, 15.5-15.8

   Unit –IV : 9.2, 9.3, 9.6, 9.7, 9.9, 11.2, 11.3, 11.6

   Unit – V : 10.1,10.2,10.3,10.8,12.1,12.2,12.4,12.5

Books for Reference:

1. Lasers and Nonlinear Optics - B.B. Laud, Revised 2nd edition, New Age International Publishers.

SEMESTER II: CORE – VII
ELECTROMAGNETIC THEORY

Course Code : 17PPH2C7 **Max.Marks : 100**
Hours / Week : 6 **Internal Marks : 25**
Credit : 4 **External Marks : 75**

Unit – I: Electrostatics and Boundary value problems (18 Hours)

Gauss law and its applications – field due to an infinite, straight, uniformly charge wire - Multipole expansion of charge distribution – Method of separation of variables: Cartesian coordinates – technique - Potential at a point between the plates of a parallel plate capacitor – Spherical coordinates – technique - potential at a point between the plates of a spherical capacitor – cylindrical coordinates - technique - potential at a point due to a cylindrical capacitor.

Unit – II: Magnetostatics (18 Hours)

Biot-Savart law and its application - Long straight wire – Ampere's circuital law and its application - toroidal solenoid – Magnetic scalar and vector potential – Magnetic boundary conditions for B and H between two media – Magnetic intensity – Magnetic susceptibility and permeability.

Unit – III: Field Equations and Potentials (18 Hours)

Maxwell's equations and their physical significance – Continuity equation – Displacement current – Poynting theorem – Electromagnetic potentials (Electric Scalar and magnetic vector potentials) – Gauge transformations – Coulomb and Lorentz gauges – Retarded potentials.

Unit – IV: Electromagnetic waves and their propagation (18 Hours)

Electromagnetic wave in free space – Propagation of electromagnetic waves in dielectrics and in conductors. Laws of Reflection and refraction of electromagnetic waves: Kinematic and dynamic properties – Fresnel's law – Wave guide – rectangular wave guide – TM and TE modes – Multicavity klystron.

Unit – V: Relativistic Electrodynamics (18 Hours)

Einstein's postulates of special theory of relativity – Concept of four vectors – Covariance of electrodynamic equations – Maxwell's equations in 4-Vector – Transformations of electromagnetic fields – 4-Vector form of Lorentz equation – Lagrangian and Hamiltonian force equations for a relativistic charged particle.

Books for Study:

1. K.K. Chopra and G.C. Agarwal, Electromagnetic Theory, (5thedition),K. Nath & Co., Meerut.

   Unit I:- Chapters: 1.3, Ex: 3(a), 1.4, 2.2(A), 2.2(B), 2.3 (A), 2.3(B),2.4(A), 2.4(B)

   Unit II:- Chapters: 3.2,3.3, 3.2(B), 3.2(C), 3.3, 3.3(C), 3.5, 3.6, 3.10 (a), 3.10(b)

   Unit III:- Chapters: .3(A), 4.1, 4.2, 4.4, 4.7, 4.9, 4.10, 4.11, 8.1

   Unit IV:-Chapters: 5.1, 5.2, 5.4, 6.2, 6.2 (A), 6.2 (B), 6.3, 6.8,

2. N. Ghosh, Electromagnetic theory and wave propagation, (2nd edition), Narosa publishers, New Delhi.

   Unit V:- chapters: 17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.7.

Book for reference

1. David J. Griffiths, Introduction to Electrodynamics (3rd edition), Prentice-Hall of India.
2. J.D. Jackson, Classical Electrodynamics, (3rd edition), John-Wiley, New York.

SEMESTER II: CORE – VIII

SOLID STATE PHYSICS PRACTICALS

Course Code	**: 17PPH2C8P1**	**Max.Marks**	**: 50**
Hours / Week	**: 3**	**Internal Marks**	**: 10**
Credit	**: 2**	**External Marks**	**: 40**

Objectives:

- To develop the skills in measuring physical quantities, determining coefficients for semiconducting materials.
- To realize the magnetic properties of materials.

List of Experiments:

1. Band gap energy – Four Probe method
2. Determination of carrier concentration and Hall coefficients in semiconductors.
3. Determination of Planck's constant.
4. Di-electric Constant : Determination of the Curie Temperature for a Dielectric Specimen
5. Determination of magnetic susceptibility of powered sample – Guoy's method.
6. Hystersis loop tracer
7. B-H Curve – Determination of the energy loss of a magnetic specimen due to hysteresis using Anchor Ring and Spot Galvanometer
8. "g" factor determination – ESR spectrometer

SEMESTER II: CORE – VIII

ANALOG ELECTRONICS PRACTICALS

Course Code	**: 17PPH2C8P2**	**Max.Marks**	**: 50**
Hours / Week	**: 3**	**Internal Marks**	**: 10**
Credit	**: 2**	**External Marks**	**: 40**

- To develop the skills analog electronic experiments and to practice the circuit ideas.

List of Experiments:

1. Characteristics of LDR.
2. Relaxation oscillator using UJT
3. D/A converter – Binary Weighted Method
4. D/A converter – R-2R ladder Network method
5. Filters – low pass, high pass & band pass filters
6. Wien's Bridge Oscillator
7. Verification of Richardson-Dushmann Law: Thermionic Work Function
8. Dielectric Constant using Radio Frequency Hartley Oscillator

SEMESTER II: ELECTIVE – II
COMPUTATIONAL METHODS FOR PHYSICS

Course Code	**: 17PPH2CE2A**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 4**	**External Marks**	**: 75**

Objectives:

- To understand the numerical computations for algebraic, transcendental and linear simultaneous equations.
- To understand the concept of linear interpolation and curve fitting.
- To understand the numerical differentiation and integration.

Unit- I : Overview of C Language **(18 Hours)**

Importance of C Language, Character set, Keywords and Identifiers – **Constants:** Integer Constants and Real Constants – Variables – Data Types – **Declarations of Variables:** Primary Type Declaration - Assigning values of variables. **Operators :** Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional and Bitwise operators.

Expressions: Arithmetic expressions – Operator Precedence and Associativity, **Input, Output and Control Statements:** formatted I/P and O/P functions - `scanf ()` & `printf()` functions, format specifiers.

Unit –II: Control Structures, Arrays , Functions and File Operations **(18 Hours)**

Decision making statements: `if`, `if-else`, `switch`, `go-to`, `break` and `continue` statements, **Loop Constructs:** syntax and flow charts for `for loop`, `while loop`, `do-while loop`. **One–dimensional and two dimensional arrays:** declaration and initializing of arrays- storing arrays in memory – accessing elements of an array.

Functions: `main()` function, User defined and library functions- function declaration, function definition- function call –passing arguments to a function: passing by value – functions with a return value. **FILE Operations:** Opening and closing of files using `fopen()` and `fclose()` functions-writing to files using `fprintf()` function-reading from files using `fscanf()` function.

UNIT –III: Solving Polynomial, Simultaneous Linear Equations and ODEs **(18 Hours)**

Polynomial Equations: Newton-Raphson's Algorithm for solving polynomial equations-Convergence of Newton-Raphson Method-Limitation of Newton-Raphson's Method-C-Program for implementing Newton-Raphson Algorithm. Direct Solution of Simultaneous Linear Equations: Basic Gauss Elimination Method-Gauss Elimination with Pivoting-C-program to implement Gauss elimination Method with partial pivoting.

Ordinary Differential Equations: Order and Degree of ODE's- Euler's Method – Runge-Kutte Fourth Order Method-Systems of Differential Equations -C Program to implement RK4 Method for a First Order differential Equation.

UNIT - IV Curve Fitting and Numerical Integration (18 Hours)

Interpolation and Regression: Interpolation of tabulated data and well defined functions- Lagrange's interpolation Formula for polynomial functions-C program for implementing Lagrange's interpolation formula- Curve Fitting of Linear Equations: Linear Least Squares Regression Method- Fitting of Transcedental Equations, C-Program for implementing Linear Least Square Fit.

Numerical Integration: the trapezoidal rule, Simpson's 1/3 rule –C program to evaluate integrals using trapezoidal and Simpson's 1/3 rules.

Unit-V: Matrix Operations, Evaluation of Special Functions & Statistical Parameters (18 Hours)

Matrix Operations: Determinant of a matrix, characteristic polynomial of a matrix-determination of the largest eigen value and the corresponding eigen vector of a matrix using power method. C-programs to implement these. **Special Functions:** Analytic expressions for Legendre, Laguerre and Hermite polynomial functions- C-programs to implement these.

Statistical Parameters: Classification and tabulation of data- Expressions for finding mean, median, mode and standard deviation of tabulated data. C-Programs to implement these.

Books for study

1. E. Balagurusamy, Programming in ANSI C, Tata Mc-Graw Hill, New Delhi, Sixth Edition, 2012.
2. K.R. Venugopal and S.R. Prasad, Mastering C, Tata Mc-Graw Hill, New Delhi, Third Edition,2007
3. E. Balagurusamy, Numerical Methods, Tata Mc-Graw Hill, New Delhi, Second Edition, 1999.
4. Suresh Chandra, Computer Applications in C, Narosa, Publishing House, NewDelhi, Second Edition, 2006

UNIT I Sections 1.2,2.2, 2.4,2.5-to-2.8,2.10,3.1-to-3.8,3.10,3.15 of T.B 1

UNIT II Sections 4.1-to-4.3,4.11,4.13,4.10,4.12, 4.7,4.8,4.9,7.2,7.3,5.1,5.2,5.5,5.6,10.1 of T.B 2

UNIT III Sections 6.1, 6.2, 6.8,7.1,7.4,7.5,13.1,13.3 &13.6 of T.B 3

UNIT IV Sections 9.1,9.2,9.4,10.1,10.2,10.3,12.1,12.2,12.3 & 12.4 of T.B 3

UNIT V Sections 6.1,6.2,6.4,10.2,10.5,10.7,11.1,11.2, 11.3,11.4,11.5 & 11.6 of T.B 4

SEMESTER II: ELECTIVE – II

NANOSCIENCE AND TECHNOLOGY

Course Code : 17PPH2CE2B **Max.Marks : 100**
Hours / Week : 6 **Internal Marks : 25**
Credit : 4 **External Marks : 75**

Objectives:

- To learn the nano technology and nano materials
- To study the application of nano materials in medicine
- To understand Evaluation techniques and Green technology

Unit-I: Nano Technology and Nano materials (18 Hours)

Nanotechnology – Basics and Basis – Four generations of Nano-technology development – Thermal, optical, electrical and magnetic properties of nanomaterials- Classification of Nano materials – Techniques of preparation – Bottom up methodology (Sol-Gel technique) – Top down methodology – Fullerenes – Properties of fullerenes.

Unit – II: Carbon Nanotube (18 Hours)

Introduction – types of Carbon Nanotubes – Single walled (SWNT) Nanotubes – Multi walled (MWNT) Nanotubes – Properties – Kinetic property – Electrical property – Thermal property – defects of Nanotubes – One dimentional transport – toxicity – Synthesis – Arc discharge – Laser ablation – Chemical Vapour deposition – Applications of Carbon Nanotubes in Chemical, Mechanical and current fields.

Unit – III: Nanophysics (18 Hours)

Quantum dot – Quantum confinement in semi conductors – Optical properties – Fabrication – Computing field – Photo voltaic and Light emitting devices – quantum wire – quantum well – Fabrication – Quantum Point – Applications – Nanocrystals – Nanocrystal solar cell – Moore's law and nano circuitary – Nano wire.

Unit – IV: Nanomedicine and Nanobiology (18 Hours)

Basic concepts and applications – Drug delivery – Cancer diagnosis and therapy – Neuro – electronic devices – nanobiotechnology devices – nano particles – nanoshell – biosensors – principle of detection – optical and electro chemical biosensors – applications of nano bio sensors – nano-DNA technology – Applications.

Unit – V: Evaluation techniques and Green technology (18 Hours)

Scanning Probe Microscope - types -Tunnelling Electron Microscope (TEM) – Instrumentation - Atomic Force Microscopy(AFM) – Scanning Tunneling Microscopy (STM) - Green Nano technology - Methodology – Health risk and environmental issues – Positive, negative aspects and implications of Nano Sciences for Society.

Books for Study and References:

1. Nano Technology - S. Shanmugam, MJP Publishers

Units	Page Numbers
I	5 – 34
II	40 – 54
III	65 – 90
IV	151 – 185
V	193 – 209, 215 – 233

2. Introduction to Nano Science and Technology- KK. Chattobpadhyay, PHI, New Delhi.

SEMESTER – III

SEMESTER III: CORE – IX
NUCLEAR AND PARTICLE PHYSICS

Course Code	**: 17PPH3C9**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 5**	**External Marks**	**: 75**

Objectives:

- To understand the properties and models of nucleus
- To study about nuclear radioactivity and reactions
- To study about the properties of elementary particles

Unit – I : General properties of Atomic Nucleus **(18 Hours)**

Binding energy – Stability Curve - semi empirical mass formula – optical model – shell model: evidence for the existence of magic numbers – extreme single particle model – spin orbit potential.

Nuclear Forces: Exchange forces – Yukawa potential – ground state and excited state of deuteron – low energy n-p scattering - scattering length – phase shift – effective range theory.

Unit – II: Radioactive Decays **(18 Hours)**

Alpha decay – Gamow's theory of Alpha decay – Geiger-Nuttal law – neutrino hypothesis – Fermi's theory of beta decay – selection rules – Wu's experiment – non conversion of parity in beta decay – parity in β – decay – gamma decay – selection rules – internal conversion – nuclear isomerism.

Unit – III: Nuclear Fission and Fusion **(18 Hours)**

Types of Fission – distribution of Fission products – Nuclear chain reactions – Q-equation - Four factor formula – Bohr-Wheeler's theory of nuclear fission – liquid drop model.

Nuclear Fusion – Thermo nuclear reactions as source of stellar energy – controlled thermo nuclear reactions – Plasma confinement.

Unit – IV: Nuclear reaction **(18 Hours)**

Nuclear Transmutation by alpha , protons and neutron - neutron spectroscopy – Nuclear reaction cross sections – the compound nucleus – reciprocity theorem – Direct reactions – Stripping reactions – Partial wave analysis of nuclear reaction cross sections – Breit-Wigner dispersion formula for $l = 0$ neutrons.

Unit – V: Elementary particles **(18 Hours)**

Classification of elementary particle - fundamental interactions – conservation laws and their validity – the C-P-T theorem – Properties of elementary particles: the Massless Bosons – the Leptons – the mesons – symmetry schemes of elementary particles – SU(3) multiplets of Hardons – Gellmann – Okubo mass formula for SU(3) multiplets – Gellmann-Nishijima formula - Quarks. Flavours and colours.

Books for study:

1. Nuclear Physics – D.C. Tayal, Himalaya Publishing House – New Delhi
   Unit – I: Chapter-I: 1.6, 1.7, 8.3, 8.4, 8.9-A, 9.4, 9.4- 10.21
   Unit – II: Chapter-V: 5.4, 5.5, 5.7, 6.3, 6.5, 6.6, 6.9, 7.4, 7.6
   Unit- III: Chapter-XIII: 13.1A, 13.2
   Unit – IV: Chapter-X: 10.4, 10.7, 10.9, 10.12, 10.14, 10.20, 10.24
   Unit – V: Chpater-XVIII: 18.1-18.4

Books for reference:

1. Nuclear Physics - R.R.Roy and B.P.Nigam, New Age Publishers.
2. Nuclear Physics – R.C. Sharma, Kedar Nath Ram Nath, New Delhi.
3. Nuclear and particle Physics – S.L.Kakani, Shubhra Kakani, Viva books, First Pub, 2008. Elements of nuclear Physics – M.L. Pandya, R.P.S. Yadav , Kedar Nath Ram Nath, New Delhi.
4. Nuclear Physics & Particle Physics – Satya Prakash, Sultan Chand & Sons, New Delhi

SEMESTER III: CORE – X
QUANTUM MECHANICS

Course Code	**: 17PPH3C10**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 5**	**External Marks**	**: 75**

Objectives:

- To understand the concepts and Formalism of Quantum Mechanics
- To practice Eigen value problems and matrix formulation
- To learn approximation methods to study perturbation theory
- To study the concepts of Angular Momentum and Spin States and Relativistic Wave Equations.

Unit – I: Concepts and Formalism of Quantum Mechanics (18 Hours)

Time dependent Schrödinger equation- Physical Interpretation of Wave function ψ: Normalization and Probability Interpretation -Conservation of Probability: Equation of Continuity – Expectation Values: Ehrenfest's Theorem -Admissibility conditions on wave functions-Stationary states: Time-independent Schrödinger wave equation.

Unit – II: Exactly Soluble Eigen Value Problems and Matrix Formulation (18 Hours)

Angular Momentum Operators [L^2 & L_z] – Angular Momentum Commutation Relations – Eigen values and Eigen functions of Angular Momentum Operators-One Dimensional Linear Harmonic Oscillator - Reduction of a Two Body Hamiltonian-Hydrogen Atom

Hilbert space - Dirac's Notation - Hermitian Operators -Matrix Representation of Wave functions and Operators- Unitary Transformations- Matrix theory of a linear harmonic oscillator - Equations of Motions - Schroedinger, Heisenberg and Interaction Pictures

Unit – III: Approximation Methods (18 Hours)

Stationary State Perturbation theory: WKB approximation - non-degenerate and degenerate cases- Applications: Stark Effect in the ground state of Hydrogen atom

Variation Method: The Variational Principle – Rayleigh-Ritz Method –Ground State of Helium Atom

Time Dependent Perturbation Theory: First Order Perturbation–Harmonic Perturbations-Transition to Continuum States - Fermi's Golden Rule

Unit – IV: Angular Momentum and Spin States (18 Hours)

Raising & lowering operators – Eigen values of J^2 and J_Z –Angular Momentum Matrices – Addition of Angular Momenta: Clebsch–Gordan coefficients – Recursion relation for C.G. coefficients – Computation of C.G. matrix for simple cases [(j_1 =½, j_2 = 1/2),(j_1 = ½,j_2 =1)]

Spin angular momentum- spin ½ states -Pauli's spin matrices and their properties- Particle Exchange Operation - symmetric and antisymmetric wave functions- Construction of symmetric and antisymmetric wave functions from unsymmetrized wave functions –Pauli's Exclusion Principle – Wave function for a particle including spin

Unit – V: Relativistic Wave Equations **(18 Hours)**

Klein-Gordon Equation for free particle- Merits and its Demerits-Dirac's Relativistic Equation for a free particle-Dirac's Matrices-Covariant form of Dirac's Equation-Probability Densities for charge and current-Plane wave solutions of the Dirac's Equation- Negative Energy States -Dirac's Equation for a particle in a Central Potential– Spin of a Dirac Particle

Books for Study and Reference:

Units	References	Chapters/Topics
Unit – I	A Text Book of Quantum Mechanics-P.M. Mathews and K. Venkatesan, Tata Mc Graw Hill, New Delhi,2005.	Chapter: 2 Topics: 2.1,2.2,2.3,2.4,2.6,2.7,2.8,2.9
	Quantum Mechanics – G. Aruldhas, PHI, New Delhi, Second Edition,2009	Chapter: 3 Topics: 3.5,3.6,3.7
Unit - II	A Text Book of Quantum Mechanics-P.M. Mathews and K. Venkatesan, Tata Mc Graw Hill, New Delhi,2005.	Chapter: 2, 4 & 6 Topics: 2.10,2.11,4.1,4.2,4.3,6.17,4.15, 4.16 & 4.17
	Quantum Mechanics – G. Aruldhas, PHI, New Delhi, Second Edition,2009	Chapter: 3,6 & 8 Topics: 3.8, 6.2,6.3,6.7,6.8,3.9, 8.1,8.2 & 8.3
Unit - III	A Text Book of Quantum Mechanics-P.M. Mathews and K. Venkatesan, Tata Mc Graw Hill, New Delhi,2005.	Chapter: 5 Topics: 5.1,5.2,5.3,5.4
	Quantum Mechanics – G. Aruldhas, PHI, New Delhi, Second Edition,2009	Chapter: 10 &12 Topics: 10.1,10.2,10.3,10.5, 122.1,12.2,12.3,12.4,12.5 & 12.6
Unit - IV	Quantum Mechanics – G. Aruldhas, PHI, New Delhi, Second Edition,2009	Chapter: 8 & 13 Topics: 8.4,8.5,8.6,8.7,8.8,8.9 13.1,13.2 & 13.3
Unit - V	Quantum Mechanics – G. Aruldhas, PHI, New Delhi, Second Edition,2009	Chapter: 15 Topics: 15.1,15.2,15.4,15.5,15.6,15.7,15.8, 15.9 & 15.10

SEMESTER III: CORE – XI
STATISTICAL MECHANICS

Course Code	**: 17PPH3C11**	**Max.Marks**	**: 100**
Hours / Week	**: 6**	**Internal Marks**	**: 25**
Credit	**: 4**	**External Marks**	**: 75**

Objectives:

- To understand the classical and quantum statistics for energy distributions
- To study the kinetic theory of gases and principles of entropy.

Unit – I: Classical Statistics **(18 Hours)**

Phase space – Density of distribution in phase space - Ensembles – Canonical – micro canonical and grand canonical - Liouville's theorem – statistical equilibrium – partition function w.r.t grand canonical ensemble – properties – relation between partition function and thermodynamic quantities – thermo dynamic probability – Relation between statistical and thermodynamical quantities.

Unit – II: Kinetic theory **(18 Hours)**

Binary collisions – Boltzmann transport equation – Boltzmann's H-theorem and its analysis – transport phenomenon – mean free path – zero order approximation – viscosity of a gas – Navier-Stoke's equation – Application to incompressible liquids.

Unit – III: Entropy and Thermodynamics **(18 Hours)**

Entropy – Principle of increase of entropy – entropy and disorderness – entropy and probability – Gibb's paradox – resolution of paradox – Sackur-tetrode equation – thermodynamic potentials and reciprocity relations – equilibrium conditions (thermal Mechanical and Concentration).

Unit – IV: Quantum statistics **(18 Hours)**

Ideal Bose systems – Photon gas – Thermal properties of Bose-Einstein gas – B-E condensation – B-E degeneracy – Mean energy of Fermions – Electron gas in metals – Thermionic emission work function – white dwarfs.

Unit – V: Advanced Statistical Mechanics **(18 Hours)**

Super fluids – Liquid Helium – λ-transition – Tisza's two fluid model – Pauli's theory of para magnetism – general formulation of Ising model – One dimensional Ising model – Critical phenomenon – order parameter.

Books for study:

1. Statistical Mechanics, Gupta and Kumar, Pragath Prakasan Publication, 22nd Edition.
   Unit – I: Page No: 67 – 142
   Unit – IV: Page No: 243 – 276

2. Statistical Mechanics, B.K. Agarwal and Melvin Eisner, Newage Publication, Second Edition.
   Unit – III: Page No: 37 – 53.

3. Statistical Mechanics, KERSON HUANG, Wiley India Publication, Second Edition.
   Unit – II: Page No: 56 – 117
   Unit – V: Page No: 307 – 396

SEMESTER III: CORE – XII

DIGITAL ELECTRONICS - PRACTICALS

Course Code : 17PPH3C12P1 | **Max.Marks : 50**
Hours / Week : 3 | **Internal Marks : 10**
Credit : 2 | **External Marks : 40**

Objectives:

- To realize the digital circuits
- To practice the circuit constructions

List of Experiments:

1. IC Regulated Dual Power Supply
2. Verification of De Morgan's theorem and simplification of Boolean expressions using K-Map.
3. Adders and Subtractors using Logic Gates.
4. Counters & Displays. [0 – 9 counter using IC 7490, 7 segment display using decoder driver 7447]
5. Flip flops – RS, JK & D flip flops.
6. Shift registers (Shift left and shift Right)
7. Comparators (1-bit and 2-bit)
8. Multiplexer and Demultiplexer.

SEMESTER III: CORE – XII

NUMERICAL PROGRAMMING IN PHYSICS - PRACTICALS

Course Code	**: 17PPH3C12P2**	**Max.Marks**	**: 50**
Hours / Week	**: 3**	**Internal Marks**	**: 10**
Credit	**: 2**	**External Marks**	**: 40**

Objectives:

- To practice the numerical computation for solving scientific application problems using 'C' programs.

List of Experiments:

1. False position method: Roots of a Quadratic equation
2. Newton's Raphson's method: Roots of a polynomial equation.
3. Gauss elimination Method: Application to electrical network.
4. Linear Least Squares Fitting: Determination of the charge of an electron.
5. The characteristics equation of matrix using Fadeev- Leverrier method.
6. Determinant of a matrix- Decompose method
7. Evaluation of statistical parameters: Mean deviation, Standard deviation
8. Random number generation – Determination of the value of π.

SEMESTER III : ELECTIVE - III
MICROPROCESSOR AND MICROCONTROLLER

Course Code : 17PPH3CE3A **Max. Marks : 100**
Hours/Week : 6 **Internal Marks : 25**
Credit : 4 **External Marks : 75**

Objective:

- To *know the hardware and software functions of Intel 8085 microprocessor and 8051 microcontroller.*
- *To develop programming skills in assembly language.*
- *To Study the functions of peripheral ICs.*
- *To understand the concept of microprocessor/microcontroller interfacing for data processing and control applications.*

UNIT–I: Intel 8085 Microprocessor Hardware (18 Hours)

Intel 8085 architecture – Pin configuration – Timing diagram for opcode fetch cycle and memory read and write - Address space partitioning – memory mapped I/O and I/O mapped I/O schemes – memory and I/O interfacing – data transfer schemes – programmed and DMA data transfer – synchronous, asynchronous and interrupt driven data transfer – interrupts of Intel 8085.

Unit – II: Intel 8085 Assembly language (18 Hours)

Addressing modes – Intel 8085 instructions – data transfer, arithmetic, branch, stack, I/O and machine control group – stack – addition, subtraction, multiplication and division of 8-bit numbers – find the largest number in a data array – sum of the series of 8-bit numbers.

Unit – III: Intel 8051 Microcontroller (18 Hours)

Differences between microprocessor and microcontroller – architecture of 8051 – memory organization – pin details of 8051 – special function registers – Timers/Counters – Timer and control registers – Timer modes of operation – counters – serial data I/O – SCON – PCON – Serial data transmission modes – Interrupts in 8051- Interrupt control

Unit – IV: 8051 Assembly Language (18 Hours)

Instruction set: data transfer, arithmetic, logical, Boolean variable manipulation and program branching groups – addressing modes.

Programming examples: BCD addition - sum of elements in an array – Arrange the given ten 8-bit numbers in the ascending order - the average of given numbers.

Unit-V: Peripheral Devices and Interfacing of 8051 (18 Hours)

Programmable Peripheral Interface (8255) – Pin and Block diagrams – operating modes – BSR and I/O modes – Programmable key board/display interface (8279) – pin and block diagrams.

Interfacing: LCD, ADC, Stepper motor and DAC with 8051

Book for study:

Unit– I and II : B.Ram, *Fundamentals of Microprocessors and Microcontrollers*, Dhanpath Rai Publications(P) Ltd.

Unit – I : Chapter: 3.1-3.1.5, 3.3.1,3.3.2, 3.3.4, 7.2,7.2.1, 7.2.2, 7.3.1,7.3.2, 7.4, 7.4.1,7.4.2, 7.4.3, 7.5, 7.5.1,7.5.2,7.5.3

Unit – II : Chapter: 4.3, 4.6, 5.5, 6.3, 6.4, 6.21, 6.26, 6.29, 6.30.

Unit–III, IV, V: P.S. Manoharan, *Microprocessor & Microcontroller*, Charulatha Publication,2011

Unit III : Chapter: 4.1.1, 4.2, 4.3, 4.5, 4.6, 4.6.1,4.6.2,4.6.3,4.6.4, 4.7, 4.8, 4.8.2, 4.8.3, 4.8.6, 4.9, 4.9.1, 4.9.2, 4.9.3

Unit – IV : Chapter : 5.2,5.3, 5.3.1,5.3.2, 5.3.3, 5.3.4, 5.3.4, 5.4

Unit – V : Chapter : 2.2.1,2.2.2, 2.2.4, 2.2.5, 2.5.2, 2.5.3, 5.10, 5.12, 5.14, 5.15

Reference:

1. Ramesh S.Gaonkar, *Microprocessor architecture, Programming and applications with the 8085*, Penram International Publishing (India) , Fourth edition.

2. A.P.Godse D.A. Godse, *Microprocessor and Microcontroller*, Technical Publication Pune, First edition-2009.

3. V.Vijayendran, *Fundamentals of Microprocessors-8085 Architecture*, Programming & Interfacing, S.Vishvanathan (Printers & Publishers), PVT. LTD.

SEMESTER III: CORE BASED ELECTIVE – III
FIBRE OPTICS

Course Code : 17PPH3CE3B | **Max.Marks : 100**
Hours / Week : 6 | **Internal Marks : 25**
Credit : 4 | **External Marks : 75**

Objectives :

- To learn the various optical fibre modes and configurations.
- To study the various optical fibre sources and their use in the optical communication system.
- To understand the working of a modern optical fibre communication system.

Unit I : Optical fibre **(18 Hours)**

Propagation of light waves in an optical fibre – Basic structure and propagation of ligtht of an optical fibre – Acceptance angle and Acceptance cone of a fibre – Numerical aperture – Numerical aperture of a graded index fibre - Modes of propagation – Meridional and Skew rays – Number of modes and cut-off parameters of fibres – Single mode propagation –- #Applications of fibres#.

Unit II : Classification of optical fibres **(18 Hours)**

Stepped Index fibre – Stepped Index monomode fibre – Disadvantages - Graded Index multimode fibre - Comparison of step and graded index fibres – #Plastic fibres# – Other latest developed types of optical fibres – Fibre strength - Mechanical strength measurement of fibres.

Unit III : Fibre Losses **(18 Hours)**

Attenuation in optic fibres – Material losses - Impurity losses - Rayleigh scattering loss - Absorption loss – Leaky modes - Bending losses – Radiation Induced losses – Inherent defect losses – Inverse square law losses – Transmission losses - Temperature dependence of fibre losses – # Core and cladding losses #.

Unit IV: Light sources for optical fibres **(18 Hours)**

LED – Structures of LED - LED materials – Output power characteristics of LED – Fibre – LED Coupling – Modulation bandwidth of LED – Spectral emission of LEDs .

Laser – semiconductor laser diode – Current vs Output power characteristics of a Laser – Modulation response of Laser – Laser chirp - Organic LEDs – Power efficiency - Structure and Operation – # Quantum efficiency #.

Unit V: Fibre Optic communication systems **(18 Hours)**

Simplex and Duplex communication systems – Transmitter for fibre optic communication – High performance transmitter circuit – Comparison between analog and digital transmitter – Laser Transmitter – Digital Laser transmitter - Analog Laser Transmitter - Fibre optic receiver – High performance receiver – # Digital signal Transmission in fibre #.

Text Books:

Dr. Subir kumar sarkar, Optical fibres and fibre optic communication systems, S. Chand & Company Ltd, Revised 4th Edition, 2010.

Unit 1	Chapter 2	Section 2.2 – 2.12
Unit II	Chapter 3	Section 3.1 – 3.10
Unit III	Chapter 7	Section 7.1 – 7.12
Unit IV	Chapter 9	Section 9.2.2 – 9.4.5
Unit V	Chapter 15	Section 15.1 – 15.13 & 15.7

Books for reference:

1. John M. Senior, Optical Fiber Communication, Pearson Education, 2nd edition, 2007
2. Gerd Keiser,Optical Fiber Communication, Mc Graw Hill, 3rd edition, 2000.

SEMESTER III: EXTRA CREDIT – I
NONLINEAR ELECTRONICS

Course Code : 17PPH3EC1 **Max.Marks : 100**
Hours / Week : -- **Internal Marks: --**
Credit : 5 **External Marks: 100**

Objectives:

- To understand the concept of nonlinearity its mathematical implications in oscillators.
- To study the characterisation of nonlinear oscillations
- To understand the concepts of Chaos in nonlinear electronics circuits

Unit- I: Linear and Nonlinear Oscillators

Nonlinearity - Mathematical Implications of Nonlinearity-Linear Superposition Principle-Effects of Nonlinearity-Linear Oscillators and Predictability: Free Oscillations, Damped Oscillations, Damped and Forced Oscillations-Nonlinear Oscillators and Bifurcations: Free Oscillations, Damped Oscillations, Forced Oscillations: Primary Resonance and Jump Phenomenon (Hysteresis), Secondary Resonances (Subharmonic and Superharmonic), Bifurcations.

Unit- II: Qualitative Features of Dynamical Systems

Autonomous and Nonautonomous Systems-Equilibrium Points of Dynamical Systems-Phase Space/Phase Plane and Phase Trajectories: Stability, Attractors and Repellers-Classification of Equilibrium Points of a Two-Dimensional Dynamical System: General Criteria for Stability - Limit Cycle Motion- Periodic Attractor- Poincar'e-Bendixson Theorem - Lorenz System - More Complicated Attractors: Torus, Quasiperiodic Attractor, Poincar'e-Map, Chaotic Attractor.

Unit- III: Bifurcations and Onset of Chaos in Dissipative Systems

Some Simple Bifurcations: Saddle-Node Bifurcation, The Pitchfork Bifurcation, Transcritical Bifurcation, Hopf Bifurcation - Discrete Dynamical Systems-The Logistic Map: Equilibrium Points and their Stability, Periodic Solutions or Cycles, Period Doubling Phenomenon, Onset of Chaos: Sensitive Dependence on Initial Conditions â€“ Lyapunov Exponent, Bifurcation Diagram-Other Routes to Chaos: Quasiperiodic Route, Intermittency Route, Type-I Intermittency, Standard Bifurcations in Maps.

Unit- IV: Chaos in Dissipative Nonlinear Oscillators and Criteria for Chaos

Bifurcation Scenario in Duffing Oscillator: Period Doubling Route to Chaos, Intermittency Transition, Quasiperiodic Route to Chaos, Strange Nonchaotic Attractors (SNAs), Lorenz Equations: Period Doubling Bifurcations and Chaos - Necessary Conditions for Occurrence of Chaos: Continuous Time Dynamical Systems (Differential Equations), Discrete Time Systems(Maps)

Unit- V: Chaos in Nonlinear Electronic Circuits

Linear and Nonlinear Circuit Elements - Linear Circuits: The Resonant RLC Circuit - Nonlinear Circuits –Chua's Diode - A Simple Practical Implementation of Chua's Diode -Chua's Oscillator - Bifurcations and Chaos in Chua's Oscillator –Murali-Lakshmanan-Chua (MLC) Circuit: Experimental Realization, Stability Analysis, Explicit Analytical Solutions, Experimental and Numerical Studies - Analog Circuit Simulation of a Duffing Oscillator- Nonlinear Circuits as Dynamical Systems.

Books for Study and Reference

- Nonlinear Dynamics: Integrability, Chaos, and Patterns -M. Lakshmanan S. Rajasekar, Springer Verlag, 2002

Units	Page Numbers
I	1, 5, 7, 11, 17, 21, 27
II	31,34,38,50,52,55,58
III	75, 89, 91, 94, 96, 98, 101, 111, 116
IV	124, 135, 147
V	159, 161, 165, 167, 171, 178

SEMESTER – IV

SEMESTER IV: CORE – XIII
SOLID STATE PHYSICS

Course Code : 17PPH4C13 | **Max.Marks : 100**
Hours / Week : 6 | **Internal Marks : 25**
Credit : 5 | **External Marks : 75**

Objectives:

- To study the structure of crystalline solids
- To study the carrier movement, lattice vibration and thermal property in solids
- To understand the concepts of Free Electron and Band Theory of Solids
- To study the dielectric and super conductivity materials

Unit-I: Crystal Physics (18 Hours)

Crystals-Crystal lattice and translation vectors -Types of lattices (2D & 3D)-Point group - Space groups- Lattice direction and planes- Simple crystal structures-Close packed and loose packed structures- Structure of Diamond, Zinc Blende and Sodium chloride- X-ray diffraction - Powder crystal method -Reciprocal lattice- Properties-Imperfections in crystals- Point defects - line defects.

Unit-II: Semiconductors, Lattice Vibrations and Thermal Property (18 Hours)

Intrinsic and Extrinsic semiconductors- Fermi level and conductivity – Lattice vibrations - One dimensional Monotomic lattice - One dimensional diatomic lattice – Phonons - Phonon momentum- Lattice heat capacity- Classical theory (Dulong and Petit Law) - Einstein theory- Debye's model- Density modes.

Unit-III: Free Electron Theory and Band Theory of Solids (18 Hours)

Drude - Lorentz's classical theory of free electron gas – Expression for thermal and electrical conductivity - Wiedemann-Franz Law – Free electron Gas in a 3-D-Application of free electron gas model – Bloch theorem –Kronig-Penny model – velocity and effective mass of electron.

Unit-IV: Dielectrics and Magnetism in Solids (18 Hours)

Polarization and Susceptibility – Local field-Dielectric constant and Polarizability (Clausius-Mosotti Equation) - Sources of Polarizability - Ferro electricity - Piezo electricity.

Classical and Quantum theory of Dia and Para magnetism - Weiss theory of ferromagnetism- Hund rules-Concepts of Domains –Antiferromagnetism - ferrimagnetism

Unit-V: Superconductivity (18 Hours)

Introduction –The Meissner effect – Soft and hard superconductors –Thermo dynamical and optical properties – Type -I and Type-II superconductors- London equations – BCS theory- Quantum tunneling-Josephson tunneling- Theory of DC Josephson effect– Theory of AC Josephson effect- High T_c super conductors – SQUIDS – critical fields – critical currents –Magnetic levitations.

Books for Study:

1. Solid State Physics – S. O. Pillai, New Age International (P) Ltd, Revised 6th Edition, 2008.
   Page Nos:
   87 – 109, 123 – 146, 164 – 169, 179 – 189, 334 – 361, 373 – 428, 441 – 507, 523 – 567,625 – 663.

Books for Reference:

1. Introduction to Solid State Physics - C.Kittel, Wiley Publication.
2. Solid State Physics - Gupta, Kumar, Sharma, S. Chand & Company Ltd.
3. Solid State Physics – R.K. Puri and V.K. Babbar, S. Chand & Company Ltd.
4. Solid State Physics - Gupta Saxena, Prakathi Prakasan Publications.

SEMESTER IV: CORE-XIV
ELECTRONIC COMMUNICATIONS

Course Code : 17PPH4C14 **Max. Marks: 100**
Hours/Weak : 6 **Internal Marks : 25**
Credit : 5 **External Marks : 75**

Objective:

- To understand the fundamental concepts of digital modulation.
- To know the basic concepts of digital transmission and multiplexing
- To understand the optical fiber communication system, structure, different types and losses of optical fiber.
- To study the satellite orbits, synchronization and communication with satellite and antennas.

Unit – I : Digital Modulation (18 Hours)

Bit rate, M-ary encoding, Baud and Minimum band width - Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) – FSK transmitter and receiver – Binary Phase Shift Keying (BPSK) – BPSK receiver – Quaternary Phase Shift Keying (QPSK) – QPSK band width - QPSK transmitter and receiver – Differential PSK (DPSK) transmitter and receiver

Unit – II : Digital transmission (18 Hours)

Pulse modulation – PCM – PCM sampling – Block diagram - sampling rate – Signal to quantization noise ratio – companding – analog and digital – Delta modulation transmitter and receiver – Adaptive delta modulation - Differential PCM - Time Division Multiplexing (TDM)

Unit – III: Optical Fiber Communications (18 Hours)

Block diagram of an optical fiber communication system – optical fiber types – construction – cable configuration – Snell's law - critical angle – acceptance angle, acceptance cone, and numerical aperture – optical fiber configuration – mode of propagation – index profile – single mode and multimode step index - graded index – optical fiber comparison – losses in optical fiber cables – power, absorption, scattering, radiation and coupling

Unit – IV: Satellite Communications (18 Hours)

Kepler's laws – satellite orbits – satellite elevation categories – satellite orbital patterns – geosynchronous satellites – round trip time delay of geosynchronous satellites – Clarke orbit – advantages and disadvantages of geosynchronous satellites – angle of elevation – azimuth angle – satellite system link models – uplink and downlink model – transponder

Unit – V: Antennas (18 Hours)

Power gain of an antenna - Hertzian dipole – Half wave dipole – vertical antennas – Loop antenna – Ferrite rod antenna – Driven arrays – broadside array – End fire array – VHF-UHF antennas - Discone Omini – Helical antenna – Microwave antennas – Horns - Paraboloidal reflector antenna.

Book for study:

1. Unit – I, II, III & IV: Wayne Tomasi, *Electronic Communications Systems Fundamentals Through Advanced*, Pearson Education, Fifth Edition.
Unit – I : 9.2 - 9..5.2 & 9.1.0
Unit – II : 10.2 – 10.4.1, 10.5, 10.9 – 10.9.2, 10.12 – 10.14 & 11.2
Unit – III : 13.5 – 13.10 & 13.10.6
Unit – IV : 25.3 – 25.6.2, & 25.9 – 25.9.3
2. Dennis Roddy – Jhon Coolen, *Electronic Communications*, Estern Economy Edition, Fourth Edition.
Unit – V : 16.7, 16.10 – 16.14, 16.16 – 16.19

Reference :

1. Louis E.Frenzel, *Communication Electronics Principles and applications*, Tata McGraw-Hill Publishing Company Limited, Third edition,2002.

SEMESTER IV: CORE – XV

MICROPROCESSOR AND MICROCONTROLLER - PRACTICALS

Course Code	**: 17PPH4C15P1**	**Max.Marks**	**: 50**
Hours / Week	**: 3**	**Internal Marks**	**: 10**
Credit	**: 3**	**External Marks**	**: 40**

Objectives:

- To practice Intel 8085 and Intel 8051 assembly language programs with interfacing circuits

List of Experiments:

Microprocessor Experiments using Intel 8085

1. Conversion from Decimal to Hexadecimal and vice versa.
2. Interfacing of ADC
3. Wave form generation using DAC 0800
4. Interfacing of Hex key board

Microcontroller Experiments using Intel 8051

5. Basic Arithmetic Operations
6. Interfacing of seven segment display
7. Stepper Motor control
8. Traffic light control

SEMESTER IV: CORE – XV

NUMERICAL SIMULATIONS IN PHYSICS - PRACTICALS

Course Code	**: 17PPH4C15P2**	**Max.Marks**	**: 50**
Hours / Week	**: 3**	**Internal Marks**	**: 10**
Credit	**: 2**	**External Marks**	**: 40**

Objectives:

- To practice numerical simulations of Physics principles by scientific programming using C language.

List of Experiments:

1. Plotting of Linear Harmonic Oscillator wave functions.
2. Numerical simulation of Beats phenomenon.
3. Lagrange's Interpolation: Determination of nuclear scattering energies.
4. Simulation of Brownian motion in a fluid
5. Simulation of Radioactive decay.
6. Trapezoidal Rule: Simulation of free falling motion of a body.
7. Simpson's 1/3 Rule: Motion of a body in a central potential.
8. RK-IV method: Electromagnetic Oscillations in an LCR circuit.

SEMESTER IV: ELECTIVE - IV
ADVANCED TOPICS IN PHYSICS

Corecode : 14PPH4CE4A **Max.Mark : 100**
Hours/Weak : 6 **Internal Mark : 25**
Credit : 4 **External Mark: 75**

Objectives:

- Providing a platform for acquainting the students to the advanced area in physics
- Motivating them to learn and apply the learned concepts to understand the insight of the subject.

Unit I: Quantum theory of scattering **(18 Hours)**

Scattering: scattering cross section, scattering amplitude-scattering by a central potential: partial wave analysis, asymptotic solution, scattering amplitude, scattering cross section, optical theorem - scattering by an attractive square-well potential–Born approximation –scattering by screened Coulomb potential – #validity of Born approximation#.

Unit II: Molecular Orbital theory **(18 Hours)**

MO treatment of Hydrogen molecule –Hydrogen molecule: Heitler London theory –VB method of Hydrogen molecule ion – sp,sp^2,sp^3 and #other Hybridizations#.

Thomas-Fermi model of the atom –Hartree equation –Hartree-fock equation.

Unit III: Non- linear waves and solitons **(18 Hours)**

Linear dispersive and non-dispersive wave propagation-Non-liner dispersive system- John Scot Russel's water tank experiment- cnoidal and solitary wave solution of Korteweg-de vries (K-dV)equation- Fermi-Pasta Ulum(FPU) numerical experiments and recurrence phenomenon- numerical experiments of Zabusky and Kruskal – #birth of soliton# – one soliton solution of the K-dV equation using the Hirota method.

Unit IV: Optical electronics **(18 Hours)**

The electro-optic effect: the electro-optic effect in KDP crystal: longitudinal mode -transverse mode.

Acousto optic effect: Raman-Nath and Bragg regimes of diffractions –experimental set up to observe Raman-Nath diffraction – Raman-Nath acousto-optic modulator- Bragg modulator –acousto- # optic spectrum analyser #

Unit V: Astronomical instruments **(18 Hours)**

Optical telescope: main parts –general properties –special purpose telescope: Astrograph-Schmidt telescope –Infrared telescope –solar telescope –Photography techniques- standard spectrograph/Scanner – #characteristics of spectrograph# –High resolution spectrograph: Echelle Spectrograph – Fabry-Perot etalon.

#---------- # Self study portion

Text Books

1. Molecular Structure and Spectroscopy by G.Aruldhas (unit 1)
2. Quantum mechanics (2^{nd} edition) by G.Aruldhas (unit1 and unit2)
3. Nonlinear dynamics: integrability chaos and patterns by, M. Lakshmanan and S. Rajasekar (unit 3)
4. Optical electronics by AjoyGhatak,K.Thyagarajan (unit 4)
5. Astrophysics, stars and Galaxies by K.D.Abhyankar (unit 5)

Unit I	Chapter 14	Section :14.1-14.14
Unit II	Chapter 4(1^{nd}TB) Chapter 13(2^{nd}TB)	Section: 4.3,4.7,4.8,4.10 Section: 13.8,13.10
Unit III	Chapter 11 &12	Section :11.2,11.3,11.6,11.7,12.2,12.4,12.5
Unit IV	Chapter 15,17 &19	Section:15.1-15.3,17.1-17.4,19.2-19.5
Unit V	Chapter 19	Section :19.2(a,b,d),19.3(a),19.4(a,b,c)

Books for reference

1. Quantum Mechanics (2nd edition) by B. H. Bransden and Joachain
2. Quantum mechanics and field theory by AjoyGhatak, K.Thyagarajan
3. Waves called solitons, Concepts and experiments by Michel Remosissenet
4. Contemporary Optics by AjoyGhatak, K.Thyagarajan
5. Optical electronics by A. Yariv
6. An introduction to Cosmology by Jayant Vishnu Narlikar

SEMESTER IV: ELECTIVE -IV
PHYSICS OF LIQUID CRYSTALS

Course code : 14PPH4CE4B **Max.Marks :100**
Hours/week : 6 **Internal Marks : 25**
Credit : 4 **External Marks :75**

Objectives:

- To Know the advanced concepts in liquid crystals
- To learn the classifications, theories and optical properties of Liquid Crystals

Unit I : Classification of Liquid Crystals (18 Hour)

Symmetry, Structure and classification of liquid Crystals, Polymorphism in thermotropics,Reentrant phenomena in liquid crystals, Blue phases, Polymer liquid crystals, Distribution functions and order parameters, macroscopic and microscopic order parameters. #Measurement of order parameters #.

Unit II : Theories of Liquid Crystalline Phase Transitions (18 Hours)

Nature of phase transitions and critical phenomena in liquid crystals, hard particle, Maier - Saupe and Van der Waals theories for nematic - isotropic and nematic smetic A transitions; Landau theory : Essential ingradients, application to nematic isotropic, nematic-smetic A transitions and transitions involving smectic phases.

Unit III : Continuum theory (18 Hours)

Curvature elasticity in nematic and smectic A phases, distortions due to magnetic and electric Fields, magnetic Coherence length, Freedericksz transition, field - induced cholesteric-nematic transition. Dynamical Properties of Nematics :The equations of nematodynamics, Laminar flow, #molecular mortions#**.**

Unit IV : Optical porperties of Cholesterics (18 Hours)

Optical properties of an ideal helix, agents influencing the pitch, liquid crystal displays. Ferroelectic Liquid Crystals : The properties of smectic C, continuum description, smectic C smectic A transition**,** #applications#

Unit V : Discotic Liquid Crystals (18 Hours)

Symmetry and structure, mean-field description of discotic liquid crystals, continuum description Lyotropic liquid crystals and biological membrane.
Applications of liquid crystals #**.**
#---------- # **Self study portion**

Text Books:

1. Physics and Chemistry of liquid crystals by Collyer (1998)

Unit I	Chapter 2	Section :2.1,2.3,2.5-2.14
Unit II	Chapter 3	Section: 3.3,3.5,3.6-3.18
Unit III	Chapter 5	Section :5.2,5.4,5.8-5.23
Unit IV	Chapter 6	Section:6.5,6.8,6.11,6.13-6.21
Unit V	Chapter 8	Section :8.2,8.5-8.9,8.12-8.17

Books for Reference

1. Chandrashekhar : Liquid Crystals
2. Vertogen & de Jeu : Thermotropic Liquid Crystals: Fundamental
3. De Gennes & Prost : The Physics of Liquid Crystals Elston & Sambles : The Optics of Thermotropic Liquid Crystal

SEMESTER IV: EXTRA CREDIT – II
NON – CONVENTIONAL ENERGY SOURCES

Course Code : 17PPH4EC2 **Max. Marks : 100**
Hours / Week : -- **Internal Marks: --**
Credit : 5 **External Marks: 100**

Objectives:

- To understand the concepts of nonconventional energies resources and their applications

Unit – I Solar Energy

Introduction – Solar constant – Solar radiation at the earth's surface – Solar radiation measurements – Flat-Plate collectors – solar Air heaters – Concentrating collectors – Selective coatings – solar water heater – Solar Electric power generation – Solar cooker.

Unit – II Wind Energy & Biomass

Introduction – Principles of wind energy conversion – Power in the Wind – Basic component of a Wind Energy (WECS) Conversion systems – Classification of WECS – Advantages and Disadvantages of WECS.

Bio-Mass – Photosynthesis – Bio-gas generation – Types of Bio-gas plants – Bio-gas from plant wastes Fuel properties of Bio-gas – Advantages and disadvantages.

Unit – III Geothermal & Ocean Energies

Introduction – Geothermal sources – Hydrothermal resources – Hot dry Rock resources – Magma resources – Applications of geothermal energy.

OTEC – Open cycle OTEC system – Heat exchangers – Basic principle of Tidal power – merits and demerits of wave energy.

Unit – IV Chemical Energy Sources

Fuel cells – Classification – Design and principle of operation – application of fuel cells – Hydrogen fuel cells – Types – Batteries – Different types of Battery arrangement – Lead-Acid, Nickol-Iron, Nickel-Cadmium batteries – High temperature batteries – Advantages of Batteries for Bulk energy storage.

Unit – V Hydrogen and Nuclear energy source

Hydrogen energy – Production of hydrogen – Hydrogen storage – advantages of hydrogen fuel engines.

Nuclear fission, fusion – Basic Nuclear fusion reaction – Thermo nuclear function reactors.

Book for Study:

- Non – Conventional energy Sources – G.D. RAI, Fourth Edition, Khanna Publishers, (Thirteenth reprint), 2004.

Units	Page Numbers
I	47 – 49, 60, 76, 81, 112, 121, 147, 178, 202
II	227, 230, 231, 256, 260, 262, 311, 324, 337, 341
III	439, 443, 445, 477, 497, 501, 513, 534
IV	561 – 566, 589, 591, 597, 604, 608
V	609, 613, 637, 645, 744, 754