DEPARTMENT OF PHYSICS

SYLLABI FOR M.Sc PHYSICS

CURRICULAM AND SCHEME OF EXAMINATIONS (CBCS)

(Applicable to students admitted during the academic year 2014-2015 and onwards)

KONGUNADU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

COIMBATORE -641029

2014- 2015

PPH1

KONGUNADU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

COIMBATORE-641 029

M. Sc., PHYSICS

Curriculum and Scheme of Examination under CBCS

(Applicable to students admitted during the Academic year 2014–2015and onwards)

Semester	Subject code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam. Hrs.	Credit
				CIA	ESE	Total		
I	12PPH101	**C.P 1**- Classical Mechanics and Statistical Mechanics	5	25	75	100	3	5
	12PPH102	**C.P 2**- Mathematical Physics	5	25	75	100	3	4
	12PPH103	**C.P 3**- Solid State Physics	5	25	75	100	3	4
	14PPH1N1	**IN1** – Non –Major Elective I **:** Energy Physics/ Industrial Physics	5	25	75	100	3	5
	12PPH2CL	**C. Pr 1**- General Experiments	5	-	-	-	-	-
	12PPH2CM	**C. Pr 2**- Electronics Experiments	5	-	-	-	-	-
II	14PPH204	**C.P 4**- Quantum Mechanics –I	4	25	75	100	3	4
	12PPH205	**C.P 5**- Electromagnetic theory and Electrodynamics	4	25	75	100	3	4
	14PPH206	**C.P 6**- Modern Optics	4	25	75	100	3	4
	12PPH207	**C.P 7**- Digital Electronics and Microprocessors	5	25	75	100	3	4
	14PPH2N2	**2N2** – Non –Major Elective II: Characterization of Materials / Applied Physics	4	25	75	100	3	5
	12PPH2CL	**C.Pr1** - General Experiments	5	40	60	100	4	4
	12PPH2CM	**C. Pr 2** - Electronics Experiments	5	40	60	100	4	4
III	12PPH308	**C.P 8**- Quantum Mechanics-II	5	25	75	100	3	4
	12PPH309	**C.P 9**-Atomic & Molecular Spectroscopy	5	25	75	100	3	4
	14PPH310	**C.P.10** Thin Film Physics, Plasma Physics and Crystal growth	5	25	75	100	3	4
	14PPH3E1	**Major Elective I:** Nano Science / Atmospheric Science	5	25	75	100	3	5
	12PPH4CN	**C. Pr 3**- Advanced Experiments	5	-	-	-	-	-
	12PPH4CO	**C. Pr 4**- Special Electronics Experiments	5	-	-	-	-	-
	12PPH411	**C.P. 11** Bio-Medical Instrumentation	5	25	75	100	3	4

PPH2

IV	12PPH412	**C.P 12**- Nuclear and Particle Physics	5	25	75	100	3	4
	12PPH4N2	Major Elective II: Microwave Communication Physics / Information Storage materials and Devices	5	25	75	100	3	5
	12PPH4CN	**C. Pr 3**- Advanced Experiments	5	40	60	100	6	4
	12PPH4CO	**C. Pr 4**- Special Electronics Experiments	5	40	60	100	6	4
	12PPH4Z1	**Project and Viva Voce**	5	40	160	200	-	5
		Total				2200		90

Major Elective Papers

(2 papers are to be chosen from the following 4 papers)

1. Nanoscience
2. Atmospheric Science
3. Microwave Communication Physics
4. Information Storage materials and Devices

Non - Major Elective papers

(2 papers are to be chosen from the following 4 papers)

1. Energy Sources
2. Industrial Physics
3. Characterization of Materials
4. Applied Physics

Tally Table:

Part	Subject	No. of Subjects	Marks	Credits
I	Core – Theory / Practical / Project	18	1800	70
	Major Elective Paper	2	200	10
	Non-Major Elective Paper	2	200	10
	Grand Total	22	2200	90

Note:

- CBCS– CHOICE BASED CREDIT SYSTEM
- CIA– CONTINOUS INTERNAL ASSESMENT
- ESE–END OF SEMESTER EXAMINATION

1. Break up Marks for CIA of Theory

CIA Exam	-	15
Assignment	-	5
Attendance	-	5
Total		25

2. Components of Practical :

Break up Marks for CIA of Practical

CIA Practical Exam	-	25
Observation Notebook	-	10
Attendance	-	5
Total		40

Break up Marks for ESE of Practical

Experiment	-	50
Record	-	10
Total		60

3. Component for Project:

CIA/ESE	Particulars	Project out of 200 marks (PG)
CIA	Project Review	30
	Regularity	10
	Total Internal Marks	**40**
*ESE	Project Report Presentation	120
	Viva Voce	40
	Total External Marks	**160**
Total Marks (CIA + ESE)		**200**

* Projects report and Viva voce will be evaluvated jointly by both the the project Supervisor (Faculty of the Department) and an External Examiner.

Question Paper Pattern for CIA and ESE

Theory **Maximum marks: 75**

Section A (10 x 1 =25 marks)

Q.No. 1 to 10 : Multiple choice type alone with four distracters each

Section B (5x 5 =25 marks)

Q.No. 11 to 15 : Either or / essay type question (one question 'a' or 'b' from each unit.)

Section C (5x 8 =40 marks)

Q. No. 16 to 20 : Either or / essay type question (one question 'a' or 'b' from each unit.)

PPH6

SEMESTER – I **12PPH101**

CORE PAPER 1 -CLASSICAL MECHANICS AND STATISTICAL MECHANICS

Total Hours of Teaching: 75 hrs **Total Credits: 5**

Objectives:

To study about the

i. Hamiltonian formulation of mechanics, rigid body dynamics and mechanics of small oscillations and continuous systems,
ii. Classical Statistics and Quantum Statistics.

UNIT I **15 hrs**

Hamiltonian formulation of Mechanics

Canonical or contact transformations-Advantage of canonical transformations- Hamilton-Jacobi method-H.J partial differential equation-Hamilton's principal function-Harmonic oscillator by H.J method-H.J equation for Hamilton's Characteristic function - Kepler's problem by H.J method- Action and angle variables-Harmonic oscillator by action angle variable method-Poisson brackets-Invariance- equations of motions in Poisson bracket form-Lagrange's brackets-Relation between Lagrange and Poisson brackets.

UNIT II **15 hrs**

Rigid body dynamics

Generalized coordinates for rigid body motion –Euler angles –Angular velocity of a rigid body - Angular momentum of a rigid body—Moments and products of inertia –Principal axes transformation—Rotational kinetic energy—Moment of inertia of a rigid body—Equation of motion of a rigid body—Euler's equations—The motion of a symmetric top under action of gravity.

UNIT III **15 hrs**

Mechanics of small oscillations and continuous systems

Stable and unstable equilibrium—Two coupled oscillators—formulations of the problem—properties of T,V and ω—Normal coordinates and Normal frequencies of vibration—System with few degrees of freedom—Parallel pendula—Double pendulum - Triple pendulum (a degenerate system)—Linear Triatomic molecule—Transition from discrete to a continuous system—**Formulation of the problem for the continuous system*.**

UNIT IV **15 hrs**

Classical Statistics

Maxwell Boltzmann distribution law (no derivation) - Evaluation of constants α and β – Partial function Z - Condition for applicability of the M.B Statistics –Non-degenerate and degenerate systems - M-B speed distribution law-Most probable, average and root mean square speeds-Maxwell velocity distribution in a given direction –Total internal energy of an ideal gas - Molar heat capacity of a gas at constant volume –Entropy -Helmholtz free energy - Pressure and equation of state of an ideal gas -Equation of state of an ideal gas from M-B velocity distribution law- Principle of equipartition of energy-Limitations of M.B method.

UNIT V **15 hrs**

Quantum Statistics

Bose- Einstein distribution law (no derivation) – B.E. Energy distribution for energies in the range E to E +dE – Condition for the B.E distribution to approach classical MB distribution – Limiting case of B-E statics-Derivation of Plank's law of radiation from B.E. distribution law – Fermi Dirac distribution law (no derivation) F.D energy distribution law for energies in the range E and E +dE – Fermi energy – Effect of Temperature on the Fermi energy- Energy distribution curve– Fermi energy E_{Fo} for free electrons in a metal-Mean internal energy of free electrons in a metal at T=0 - Fermi temperature T_F -Fermi velocity and mean velocity of a free electron in a metal at T=0 - Thermionic emission-**Comparison of M-B, B-E and F-D statistics***

* **Self study**

Books for study:

1.Classical Mechanics	S.L. Gupta, V. Kumar and H.V. Sharma, Pragati Prakashan Publications, Meerut (1998).
2.Classical Mechanics	Herbert Goldstein, Addison Wesley Publishing Company,Delhi, (1996).
3. Elements of Statistical Mechanics	Miss Kamal Singh and S. P. Singh, S. Chand & company Ltd New Delhi (1999).

Books for Reference:

1. Classical Mechanics of Particles and Rigid bodies	Kiran C.Gupta, New Age International Publishers, New Delhi (2008).
2. Fundamental of Statistical Mechanics and Thermal Physics	F Reif, Mc Graw Hill.(1965).
3. Elements of Statistical Mechanics	Gupta, Kumar, Pragati Prakasan, Meerut, Ist edition, (2009).

Specific Topics for the problems

1. Determine the frequency of the Kepler problem for which Hamiltonian application of action angle variables
2. Show that the transformation is a Canonical
3. To show that the Hamiltonian- Jacobi equation for the system whose Hamiltonian is given
4. Angular momentum, rotational kinetic energy, equation of momentum of a rigid body
   i) Linear triatomic molecules
   ii) Double pendulum, triple pendulum

PPH8

SEMESTER –I **12PPH102**

CORE PAPER 2 - MATHEMATICAL PHYSICS

Total Hours of Teaching: 75 hrs **Total Credits: 4**

Objectives

i To enable the learners to
ii Understand complex variables, group theory & tensors
iii Know about different differential equations and partial differential equations in Physics
iv Study about some of the numerical methods

UNIT I **15 hrs**

Complex variables

Elements of complex analysis –**Taylor and Laurent series** *- Cauchy- Riemann differential equation-Complex line integrals-Cauchy's integral theorem – Cauchy's integral formula-derivatives of an analytic function–Singularities of an analytic function- Residues and their evaluation - Cauchy's residue theorem – Evaluation of definite integrals by contour integration – integration round the unit circle of the type $f(\cos\theta, \sin\theta)d\theta$ - evaluation of $f(x)dx$.

UNIT II **15 hrs**

Differential equations

Bessel differential equation: Series Solution –Bessel's function of a first kind- Half order Bessel function - Recurrence formula for $J_n(x)$ – Generating function for $J_n(x)$.

Legendre's differential equation: Series solution Legendre polynomials- Generating function-Recurrance relations – Rodrigue formula - Orthogonality of Legendre's polynomials.

Hermite's differential equation: Series solution – Hermite polynomials – Generating function – Recurrance formula – Rodrigue's formula for Hermite polynomials - Orthogonality of Hermite polynomials

UNIT III **15 hrs**

Group theory and Tensors

Group Theory

Definition of groups – groups of transformation – multiplication table (C_{4v})- conjugate elements and classses – sub groups - cyclic groups - cosets - Lagrange's theorem- normal subgroups - factor subgroups - reducible and irreducible representation of a group- Schur's lemma- orthogonality theorem – construction of character table for C_{2V}.

Tensors

Introduction – n-dimensional space – superscripts and subscripts – coordinate transformation – indicial and summation conventions – dummy and real indices – Kronecker delta symbol – scalars, contravariant and covariant vectors – tensors of higher ranks – algebraic operations of tensors.

UNIT IV **15 hrs**

Partial differential equations in physics

Introduction – solution of Laplace's equation in Cartesian co-ordinates – solution of Laplace's equation in two dimensional cylindrical co-ordinates(r, θ); circular harmonics- solution of Laplace equation in general cylindrical co-ordinates ; cylindrical harmonics- solution of Laplace's equation in spherical polar co-ordinates; spherical harmonics-diffusion equation or

Fourier equation of heat flow- solution of heat flow equation; (method of separation of variables)-two dimensional heat flow - three dimensional heat flow.

UNIT V **15 hrs**

Numerical Analysis

Bisection and Newton – Raphsons method of finding roots of the equation - Giraffe's root squaring method of solving algebraic equation- Gregory-Newton forward &backward interpolation formulae - solution of simultaneous linear equation by Gauss elimination and Gauss-Jordans method – solution of ordinary differential equation by Euler method and Runge-Kutta second and fourth order methods – Evaluation of integral by means of Trapezoidal and Simpson's one third rule.

* **Self study**

Books for study:

1. Mathematical Physics, Sathya Prakash, Sulthan Chand & Sons (2000).
2. Elements of group theory for Physicists A.W.Joshi, New age International Publications, New Delhi, (2009).
3. Numerical Methods in Science and Engineering Mathematics, M. K. Venkataraman, National Publishing Co Chennai (2001).

Books for Reference:

1. Mathematical Physics B.D Guptha, Vikas Publishing House (1996).
2. Mathematical Physics B.S Rajput, Pragati Prakashan Meerut (1996).
3. Numerical Methods A.Singaravelu, Meenakshi Publishing (2000).

Specific Topics for the problems

1. Proving the given set as a group under the given laws of composition
2. Showing the given group as an abelian group
3. Proving the given group as a cyclic group

PPH10
SEMESTER I **12PPH103**

CORE PAPER- 3 SOLID STATE PHYSICS

Total Hours of Teaching: 60 hrs **Total Credits: 4**

Objectives

To impart knowledge on

i) The different symmetry phases and structures that occur in native
ii) Different types of defects, dislocations in crystals
iii) Various physical properties of crystalline solids

UNIT I **12 hrs**

Crystal Structure and Reciprocal lattice

Symmetry elements – Space lattice: Three dimensional lattice types – Interplanar distance (spacing of lattice plains) – Separation between lattice plains in simple cubic, fcc and bcc lattices. Lattice constant and density – Hexagonal closed packed structure (qualitative)- Diamond structure – Sodium chloride – Cesium chloride structure – The reciprocal lattice- Graphical construction and vector development – Properties of the reciprocal lattice – Bragg condition in terms of the reciprocal lattice.

UNIT II **12 hrs**

Imperfections in crystal

Classification of imperfections – crystallographic imperfections: point defects – Frenkel defects – colour centers – F Centers – Other centres in alkali halides – Line defects: Definitions of dislocations – Plastic deformation – Shear strength of single crystals – Edge dislocations – Screw dislocations – Burger's vector – Stress fields around dislocations.

UNIT III **12 hrs**

Lattice vibrations; **semiconductors**, **dielectrics**

Lattice vibrations: The linear diatomic lattice – Excitation of optical branch in ionic crystals – The IR absorption – Localized vibrations – Quantization of Lattice vibrations – Phonon momentum.

Semiconductors: Intrinsic semiconductors – Band model- electron and hole concentrations – Law of mass action – Electrical conductivity – Extrinsic semiconductors – Impurity state and Band model – electron and hole concentrations – Impurity electrical conductivity.

Dielectrics: Ferroelectricity – Theories of Ferroelectricity – Applications of Ferroelectrics – Ferroelectricity versus Piezoelectricity – Anti ferroelectricity.

UNIT IV **12 hrs**

Superconductivity

Introduction – Thermal properties – The Energy gap – Isotope effect – Type I and Type II superconductors – London equations (electrodynamics) – Superconductors in AC fields – Thermodynamics of superconductors – BCS theory – BCS Ground state – Quantum tunneling – Josephson's tunneling – Theory of D.C.Josephson Effect – AC Josephson effect

Practical Applications of superconductivity: Low temperature superconductors – High temperature superconductors – SQUIDS

UNIT V **12 hrs**

Magnetism

Diamagnetism – Classical theory – Quantum theory – Paramagnetism – Classical theory – Quantum theory – Ferromagnetism – Spontaneous magnetization. Weiss theory of spontaneous magnetization – Hysteresis – Weiss theory of Hysteresis – Ferromagnetic domains – Antiferromagnetism – Molecular field theory – Susceptibility above and below Neel temperature – Ferrimagnetism – Molecular field theory of Ferrimagnetism.

Books for study:

Solid state physics	S.L Gupta and Kumar, V.K. Nath and Co., Meerut (2005)
Solid State Physics	R.L.Singhal ,Kedar Nath Ram Nath and Co., Meerut (2005)

Books for reference:

Solid State Physics, III edition	S.O.Pillai, IV Edition, New Age International Publishers, (2001)
Solid State Physics	R.K.Puri, V.K.Babbar, S.Chand & Co., New Delhi (2001)

Specific Topics for the problems

1. Inter planar spacing for SC, FCC, BCC lattices
2. Lattice constant and density
3. X - ray diffraction

PPH12
SEMESTER I **14PPH1N1**

NON MAJOR ELECTIVE - I
1. ENERGY PHYSICS

Total Hours of Teaching: 75 hrs **Total Credits: 5**

Objectives

1. To know about solar radiation & solar pond
2. To know about photovoltaic energy conversion
3. Students to know hydrogen energy, wind energy & OTEC

UNIT I **15 hrs**

Solar thermal energy

Introduction on solar radiation - solar constant - solar radiation at the earth surface - physical principles of the conversion of solar radiation into heat solar energy collectors - flat plate collectors - advantages of flat plate collectors - concentrating collector parabolic through reflectors and mirror - strip reflector - advantages and disadvantages of concentrating collectors over flat plate type collectors - solar energy storage - solar pond - principle of operation and description of non-convective solar pond - applications of solar ponds.

UNIT II **15 hrs**

Solar photovoltaic energy

Solar photovoltaic: Introduction - Fundamentals of photovoltaic conversion - semiconductor materials - photon energy - electron - hole concentration and Fermi level –A p-n junction – light absorption in a semi conductor- solar cell materials - efficiency of solar cells - silicon solar cell - polycrystalline & amorphous silion cells - photovoltaic applications.

UNIT III **15 hrs**

Wind and Ocean thermal energy

Introduction - Basic principles of wind energy conversion – nature of wind - the power and the wind - forces on the blades and thrust on turbines - wind energy conversions - site selection conservations - basic components of the wind energy conversion system - classification of WEC systems - advantages and disadvantages of WECs - energy storage - applications of wind energy.

Ocean thermal energy

Introduction: Ocean thermal energy conversion (OTEC) – methods of ocean thermal electric power generation - open cycle OTEC system - heat exchangers - bio-fouling – site selection – energy utilization - hybrid Cycle.

UNIT IV **15 hrs**

Hydrogen energy and Fuel cells

Hydrogen energy

Introduction - hydrogen production - electrolysis or the electrolytic production of hydrogen - solar energy methods - bio-photolysis and photo-electrolysis - hydrogen storage – hydrogen transformation - utilization of hydrogen gas - electric power generation - hydrogen in fuel cells - **Hydrogen as an alternative fuel for motor vehicles *** - safety and management.

PPH13

Fuel Cells:

Introduction – Principle of operation of a fuel cells - classification of fuel cell -hydrogen fuel cells - Advantages and disadvantages of fuel cells - applications of fuel cells.

Unit V **15 hrs**

Energy Auditing and Carbon Credit

Energy situation – energy consumption world wide – world energy outlook – types of energy audits – energy use profiles – energy uses – the energy survey – measuring electrical system performance – temperature measurements measuring combustion systems – HVAC system performance – calculating energy content of the process.

Carbon credits – carbon currency – Kyoto protocol – trend of global carbon market – a frame work for carbon accounting and emissions reductions.

***Selfstudy**

Books for study:

1. Solar energy fundamentals and applications — H.P. Garg and J. Prakash, McGraw Hill, New Delhi, (2002).
2. Solar Cell Device Physics — Stephen J.Fonash, IInd Edition, Elsevier Publishers, USA (2010).
3. Non ConventionalEnergy Sources, — G.D.Rai, Fourth Edition, Khanna Publishers, New Delhi, (2004).
4. Fundamentals of energy engineering — Albert Thumann, The Fairmont Press INC., USA, (1984).
5. Emissions trading and carbon management — A.N. Sarkar, Pentagon Press, New Delhi, First Edition, (2010)

Books for Reference:

1. Fundamentals of solar cells, photovoltaic solar energy — Fahrebruch & Bube Academic Press, (1983)
2. Hydrogen as an energy carrier technology system — Winter & Nitch, Springer, New Delhi (1988)

Specific topics for the problem:

1. Computation of Fill factor and Efficiency of a solar cell
2. Computation of

i) Voltage output
ii) Reversible voltage
iii) Efficiency
iv) Electrical work output per mole of H_2 consumed of chemical energy sources**.**

PPH14

SEMESTER I **12PPH1N1**

NON-MAJOR ELECTIVE I : 2. INDUSTRIAL PHYSICS

Total Hours of Teaching: 75 hrs **Total Credits: 5**

Objectives

To enable the learners to

i understand the working of SCR,UJT , Jones circuit and Triac circuits.
ii understand the construction and working of flip-flops, registers converter and microprocessors.
iii understand the working of the production of vacuum and construction of pumps and gauges
iv understand the working of heating system, photodiode, gauges etc.,

UNIT I **15 hrs**

Time-delay action – RC time constant. Direct coupling of transistor- Darlington circuit – Differential Amplifier. Uni junction transistor – silicon controlled rectifiers – SCR in simple AC circuits – phase control of the SCR – firing by UJT- phase control by pedestal and ramp – turn off of SCR. Jones circuit - Triac circuits – **Zero voltage switching circuit*.**

UNIT II **15 hrs**

Regulators of voltage and motor speed – voltage compensator – DC voltage regulated DC regulated Power supplies. Inverters – multivibrator inverter – two SCR inverter. Closer loop systems – Servomechanisms – basic part of a serve – complete serve diagram – loop gain – PID controllers.

UNIT III **15 hrs**

Switching and counting circuits – flip-flops – shift register – serial to parallel converter. MOS gates – complementary MOS – digital to analog converter – sample and hold information conversion – parallel to serial converter – multiplexer – addressing – BCD and octal binary codes – numeric displays - microprocessor and its operation (elementary ideas).

UNIT IV **15 hrs**

Industrial heating systems – electron beam heating – microwave heating – induction heating. Measurement of light , PMT – photodiode – IR detectors – Temperature – Thermocouple amplifiers - optical pyrometer – strain – strain gauges – electrochemical transducers – pH.

UNIT V **15 hrs**

Production of vacuum – rotary pumps – diffusion pumps – ion getter pumps – design of high vacuum units – Ultra high vacuum units. Measurement of pressure – Pirani gauge – Penning gauge – Hot cathode ionization gauges – **UHV gauges***.

*** Self study**

Books for study:

1. Electronics in Industry — G.M. Chute and R.D. Chute, McGraw Hill International, New Delhi (1995)
2. Electronic Systems and Instrumentation — R.W.Henry, Wiley & Sons Publising, New York (1978)

3. Digital Computer Electronics — Malvino, McGraw Hill, New Delhi (1992)

Book for Reference:

1. Instrumentation: Transducer Experimentation and Application — R.W.Perbwitt & S.W.Farads, Wiley, New York, (1962).
2. Scientific foundation of Vacuum technology — S.Dushman & J.M.Lafferty, John Wiley, New York, (1962)
3. Handbook of Semiconductor Electronics — Lloyd.P.Hunter, McGraw Hill, (1956)

PPH16

SEMESTER II 14PPH204

CORE PAPER 4 – QUANTUM MECHANICS – I

Total Hours of Teaching: 60 hrs **Total Credits: 4**

Objectives

1) To impart knowledge on topics of advanced quantum mechanics
2) To understand and to develop problem solving ability on matrix mechanics, approximation methods and scattering theory

UNIT I **12 hrs**

Operator formalism in quantum mechanics

Linear vector space – operators and linear operators – **Eigen values and Eigen functions*** – the operator formalism in quantum mechanics – the Hermitian operator – properties of Hermitian operators

Matrix formulation of quantum mechanics

Hilbert space – operators as matrices – matrix form of wave function – The state vector representation in Schrödinger and Heisenberg picture- Equation of motion representation in Schrödinger and Heisenberg picture – Dirac's bra and ket vectors: Dual space – matrix theory of harmonic oscillator

UNIT II **12 hrs**

Angular momenta and their properties

Angular momentum operator in position representation – spin angular momentum – the total angular momentum operators – commutation relations of total angular momentum with components – eigen values of J^2 and J_Z – eigen values of J_+ and J_- - eigen values of J_X and J_Y – explicit form of the angular momentum matrices – addition of angular momenta: Clebsch Gordan coefficients – properties of Clebsch Gordan coefficients

UNIT III **12 hrs**

Time independent quantum approximation methods

Stationary perturbation theory (non degenerate case) – evaluation of first order energy and evaluation of first order correction to wave function – normal helium atom – stationary perturbation theory : degenerate case – first order Stark effect in hydrogen atom – The variation method – The WKB method – application of WKB method: probability of penetration of a barrier

UNIT IV **12 hrs**

Time dependent perturbation theory

Time development of states – transition probability: Fermi – Golden rule – adiabatic approximation

The semi-classical treatment of radiation

The Einstein coefficients – The atom – field interaction – spontaneous emission rate – the quantum theory of radiation and its interaction with matter: **quantization of radiation field***

UNIT V **12 hrs**

Quantum theory of scattering

Introduction – condition for validity of classical theory of scattering – definition of cross-sections – stationary scattering wave: scattering amplitude – general formulation of the

scattering theory – Born approximation – condition for the validity of Born approximation – scattering by a screened coulomb potential: Rutherford's scattering formula from Born approximation – scattering by square well potential in Born approximation – partial wave analysis

* **Self study**

Books for study:

1. Quantum Mechanics	Sathyaprakash and Swathi Saluja Kedarnath Ram nath & Co.,(2002)
2. Quantum Mechanics: Theory and applications	Ajoy Ghatak and Lokanathan 5th edition Macmillan India Ltd. (2002)

Books for Reference:

1. Quantum Mechanics	Gupta, Kumar and Sharma Jai Prakash nath & Co., Meerut (2010)
2. A text book of Quantum Mechanics	P.M. Mathews and K.Venkatesan Tata Mc Graw Hill education Pvt. Ltd(2004)
3. Quantum mechanics	Leonard. I. Schiff, McGraw Hill Co., third edition, (2002)
4. Quantum Mechanics	Kakhani & Chandalia, Sultan Chand & Sons, third edition, (1996).

Specific Topics for problems:

i) Ground state energy calculation in perturbation theory
ii) Stark effect
iii) Matrix representation of angular momentum operators

PPH18

SEMESTER II **12PPH205**

CORE PAPER 5 – ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS

Total Hours of Teaching: 60 hrs **Total Credits: 4**

UNIT I 12 hrs

Electrostatics

Dielectric polarization – external field of a dielectric medium – the electric displacement vector, D- linear dielectrics – relation connecting electric susceptibility – P, D and dielectric constant – Molecular field and Clasius – Mosotti relation for non polar molecules – Langevin – Debye formula for polar molecules - **Electrostatic energy and energy density*.**

Magnetostatics

Biot - Savart law statement – Lorentz force law and definition of B – general proof of Ampere's Circuital law – divergence and curl of B – magnetic scalar potential (derivation of expression only) – equivalence of a small current loop and a magnetic vector potential (derivation of expression only).

UNIT II 12 hrs

Field equation and conservation laws:

Equation of continuity – displacement currents – The Maxwell's equations derivation – Physical significance – Poynting vector – momentum in electro magnetic field- electro magnetic potentials- Maxwell's equation in electro magnetic potentials- concept of gauge – Lorenz gauge-Coulomb gauge radiation produced by a low velocity accelerated charged particle (Larmour formula)- oscillating electric diode- radiation due to small current – linear half wave antenna **- antenna array***

UNIT III 12 hrs

Propagation of electromagnetic waves:

Electromagnetic waves in free space – poynting vector of free space (energy flow) plane electromagnetic waves in matter – isotropic dielectric,–in conducting media – poynting vector in conducting media- propagation in ionized gases.

Interaction of EMW with matter on microscopic scale:

Scattering and scattering parameters- scattering by a free election (Thomson scattering) – scattering by a bound electron (Rayleigh scattering) – dispersion in gases – normal and anamolous dispersion in liquids and solids.

UNIT IV 12 hrs

Interaction of EMW with mater on macroscopic scale:

Boundary conditions at interfaces – reflection and refraction- Frenel's law-Brewster;s law and degree of polarization – total internal reflection and critical angle-reflection from a metal surface- Wave guide(Rectangular) – TE waves – TM waves.

UNIT V 12 hrs

Relativistic Electrodynamics:

Four vectors – Transformation relation for charge and current densities-for electromagnetic potentials – covariant form of inhomogenous wave equations-covariance of field equation in terms of four vectors –covariant form of electric and magnetic field equations – covariance of

electromagnetic field tensor –transformation relation or field vector E and B – covariance form of Lorentz force law.

* **Self study**

Books for study:

1. Electromagnetic theory	Chopra & Agarwal, K.Nath & Co., (2002),
2. Electromagnetics	Gupta Kumar& Singh, Pragathi Prakashan, Meerut. (2005).

Book for Reference:

1. Electromagnetic theory and Electrodynamics	Sathya Prakash, First Edition, Kedar Nath, Ram Nath & Co, Meerut (2008).

Specific problems for the problems:

i) Calculation of angular distribution of energy
ii) Calculation of angular distribution of field in the case of antenna arrays
iii) Calculation of Poynting vector

PPH20
SEMESTER II

CORE PAPER 6 – MODERN OPTICS 14PPH206

Total Hours of Teaching: 60 hrs **Total Credits: 4**

Objectives
To explore
i) Necessary and sufficient condition for laser
ii) Basic principles involved in Non-linear optical effects
iii) Different types of optical fibers and its applications

UNIT I **12 hrs**
Polarization and Optics of Solids
Scattering and Polarization – circular and Elliptical Polarization – Quarter wave plate – Matrix representation of Polarization – The Jones calculus – Orthogonal polarization – propagation of light in crystals – Phase-velocity surface – pointing vector and the Ray velocity – The ray velocity surface double refraction at a boundary – polarizing prisms – Optical activity – Susceptibility tensor of an optically active medium – Faraday rotation in solids.

UNIT II **12 hrs**
LASERS
Stimulated Emission and Thermal Radiation – Amplification in a medium – The Gain constant – The Gain curve - Methods of producing a population inversion - Three level pumping scheme - Four level pumping scheme - Comparison of four level laser with the three level laser - Laser oscillations - Threshold condition for oscillation.
Types of Lasers
He-Ne laser - Nd: YAG laser – CO_2 laser - Ruby laser – Q-switching- Mode locking.

UNIT III **12 hrs**
Non-linear optical effects
Wave propagation in an anisotropic crystal – Polarization response of materials to light - Second order Non linear optical processes: Second harmonic generation - Sum and Difference Frequency generation – Optical Parametric Oscillation - Third order Non linear optical processes: Third harmonic generation – Intensity dependent Refractive index – Self focusing – nonlinear optical materials – Phase matching – Description of phase matching – Achieving phase matching – Angle tuning – Temperature tuning – Types of Phase matching
Holography
Principle and Theory

Unit – IV **12 hrs**
Optical fibers
Fabrication techniques of fibers (External chemical vapor deposition - External chemical vapor deposition of glasses - Internal chemical vapor deposition, Multi element glasses, Phasil system) - Optical fiber as cylindrical wave guide – Wave guide equation – flow of power in SI fibers – Multiplexers and demultiplexers
Plastics fibers - Latest developed types of optical fibers (HPSUV, HPSIR, Halide, Chalcogenide Tapered fibers) – Mechanism of refractive index variation – Fiber strength – Mechanical Strength measurement of fibers.

Unit – V **12 hrs**

Special applications of optical fibers

Fiber optic switches – Integrated optical fiber and its applications – long haul communication - Angular Division of the critical angle for multiplexing (ADM) - Frequency Division multiplexing (FDM) for a multichannel AM - Video link – Satellite link – Computer link - Nuclear reaction link – Community Antenna Television (CATV) – Switched star CATV - Fibers in computer network – Computer Network types (LAN, MAN, WAN) – Physical Topology (Bus, Star and Mesh)

Books of study:

1. Introduction to Modern optics, G.R.Fowles, Holt, Rincharf and Winstron Inc. N.Y.(1975)
2. Optical fibres and fibres optics, Subir Kumar Sarkar, S.Chand Publisher, (2004)
3. Optical fibres and fibres optic communication systems, Subir Kumar Sarkar, S.Chand Publisher, (2010)

Books for reference:

1. Principles of optics Born and Wolf, Pergman press (1975)
2. Fibre optics technology and applications Stewart D.Perstinick, Khanna Publishers, Delhi
3. Lasers: Theory and Applications K.Thyagarajan and A.K.Ghatak, Springer, (1981)
4. Laser fundamentals, William T. Silfvast. Cambridge University press IInd Edition (2004)
5. A Text book of Optics, N.Subrahmanyam Brijlal and M.N. Avadhanulu, S.Chand Publishers, 2006.

Specific Topics for the problems:

1. Optical activity
2. Computation of Numerical aperture, Acceptance angle, Critical angle, Refractive index

PPH22
SEMESTER II **12PPH207**

CORE PAPER 7 – DIGITAL ELECTRONICS AND MICROPROCESSORS

Total Hours of Teaching: 75 hrs **Total Credits: 4**

Objectives

To study about the

i) IC Voltage Regulators, operational amplifiers and its applications and non linear IC circuits,

ii) Architecture, instruction set, interfacing and programming of 8085 microprocessors.

UNIT I **15 hrs**

IC Voltage Regulators

Positive and negative voltage regulators – adjustable voltage regulators – high current short circuit protected regulators - dual tracking regulators – programmable supply – current regulators –switching regulators –feedback current limited and shutdown circuits.

UNIT II **15 hrs**

Amplifiers

Inverting amplifiers, non-inverting amplifiers-differential amplifier – integrator and differentiator* – logarithmic amplifiers and multipliers – filters - voltage to frequency converters – sample and hold circuits- high input impedance amplifiers –instrumentation amplifiers- sensing amplifiers and comparators.

UNIT III **15 hrs**

Nonlinear integrated circuits : sequential circuits

Asynchronous counters – Four stage Binary ripple counter; Decade ripple counter; up-down counter – synchronous counters – up-down synchronous counters with parallel carry; shift Register counter – Memory data register(MDA); Content addressable memories (CAM)

UNIT IV **15 hrs**

Microprocessors – Basic Concepts

Fundamentals – Microprocessor architecture - 8085 –pin diagram of 8085- instruction format- Instruction set – Machine code – mnemonics –addressing modes- programming .

UNIT V **15 hrs**

Microprocessors Interfacing

Basic concept of interfacing- Stepper Motor Interfacing – Key board Interfacing – LED Interfacing – Traffic light Controller Interfacing – Digital to Analog Interfacing – Analog to Digital Interfacing – Music Tone Generator Interfacing

*** Self study**

Books for study:

1. Introduction to Microprocessors — Aditya P Mathur, Tata McGraw Hill Co., (2002).

2. Pulse Digital and Switching waveforms — Jacob Milliman and Herbert Taub, Tata McGraw Hill, Publications, New Delhi

(1995).

3.	Integrated Electronics	Millman and Hilkais, Tata McGraw Hill Publications (1983).
4.	Pulse and Digital electronics	G.K.Mithal & A.KVanwani, Khanna Publishers New Delhi, (1981).
5.	Electronic devices Applications and	P.Mathur,C.Kulshreshta and R.Chada,
6.	Integrated circuits	Umesh Publications, New Delhi (2005).

Books for Reference:

1. Digital Principles and Applications	Albert Paul, Malvino, McGraw Hill Publications (1997).
2. Digital Fundamentals	Thomas L. Floyd, Merrill Publisher and Co Toronto (1990).
3. Digital Fundamentals	Floyd, Tata McGraw Hill, New Delhi (1995).

Specific Topics for the problems:

i) Design a current source that will deliver a optimum current
ii) Design an adjustable voltage regulator using lm317 to satisfy the given specifications
iii) Fixed regulator used as adjustable regulator- calculation of suitable components.
iv) Positive and negative voltage regulators adjustable voltage regulators

PPH24
SEMESTER –II

NON MAJOR ELECTIVE II **14PPH2N2**
1. CHARACTERIZATON OF MATERIALS

Total Hours of Teaching: 60 hrs **Total Credits: 5**
Objective:
To enable the learners to

i. Know the characterization techniques for the study of materials.
ii. Understand the principles and working of characterizing tools.

UNIT I **12 hrs**
Thermal analysis
Introduction – Thermogravimetric analysis (TGA) – Instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves - differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermomechanical parameters .

UNIT II **12 hrs**
Microscopic methods
Optical Microscopy: optical microscopy techniques – Bright field optical microscopy - Dark field optical microscopy – Dispersion staining microscopy - phase contrast microscopy - differential interference contrast microscopy - fluorescence microscopy - confocal microscopy - scanning probe microscopy (STM, AFM) - scanning new field optical microscopy - digital holographic microscopy - **oil immersion Objectives - quantitative metallography - image analyzer*.**

UNIT III **12 hrs**
Electron microscopy and optical characterization
SEM, EDAX, EPMA, TEM: working principle and Instrumentation – sample preparation – data collection, processing and analysis- Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.

UNIT IV **12 hrs**
Electrical methods
Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations.

UNIT V **12 hrs**
X-ray and spectroscopic methods
Principles and instrumentation for UV-Vis-IR - XPS - AES and SIMS - Proton induced X-ray Emission spectroscopy (PIXE) – Rutherford Back Scattering (RBS) analysis-application
X-ray diffraction - Diffractometer - Interpretation of diffraction patterns - indexing - phase identification - residual stress analysis - Particle size- texture studies - **X-ray fluorescence spectroscopy – uses***.

*** Self study**

PPH25

Books for study:

1. Characterization of Materials	Elton N. Kaufmann, Wiley-International Publications, (2003) Vol : 1& 2
2. Growth and Characterization of semiconductors	Stradling, R.A; Klipstain, P.C;Adam Hilger, Bristol, (1990).
3. Materials Characterization Techniques	Sam Zhang, Lin Li and Ashok kumar,CRC Press (2008)

Books for reference:

1. Elements of X-Ray Diffraction B.D. Cullity, Addison-Wesley Publishing Company, Inc, Nevada, USA (1956).
2. Fundamentals of surface and Thin Film Analysis Leonard . C. Feldman, James W. Mayer, North Holland, New York, (1986).
3. Electron microscopy and microanalysis of crystalline materials Belk, J.A; Applied Science Publishers, London, (1979).
4. Electron and Ion microscopy and Microanalysis principles and Applications Lawrence E.Murr, Marcel Dekker Inc, New York, (1991).
5. Analytical Chemistry D.Kealey & P.J.Haines, Viva Books Private Limited, New Delhi, (2002).

Specific topics for the problem:

Computation of

1) Resistivity and conductivity by TWO probe method
2) Resistivity and conductivity by FOUR probe method
3) Resistivity by van der Pauw method
4) Carrier concentration and Hall mobility from Hall measurements.

PPH26
SEMESTER II **12PPH2N2**

NON MAJOR ELECTIVE - II
2. APPLIED PHYSICS

Total Hours of Teaching: 60 hrs **Total Credits: 5**

Objectives

i. To know about crystalline and amorphous semiconductors.
ii. To know Thin film deposition techniques.
iii. To know LED & production of laser diodes.

UNIT I **12 hrs**

Crystalline and amorphous semiconductors–general introduction–band structure of crystalline and amorphous semiconductors (qualitative). Carrier transport phenomena–mobility lifetime. Optical properties of solids-Optical constants-fundamental absorption in semiconductors-direct and indirect transmission, Photoconductivity, Radiative transmissions-**Photoluminescence***- Methods of excitation- efficiency.

UNIT II **12 hrs**

Device physics: p-n junction-depletion region and depletion capacitance (abrupt junction)-current-voltage characterization-heterojunction-depletion layer photodiodes-avalanche photodiodes. Solar cell basic characteristics-spectral response recombination - current and series resistance, semi conductor lasers-transition process-population inversion-gain junction lasers-threshold current density.

UNIT III **12 hrs**

Important elemental and compound semiconductors-Ge, Si, Se, Te, II-VI,III-V, IV-VI and amorphous Si. single crystal growth techniques-float zone-Czochralski-hydrothermal growth - growth of GaAs-production of Si and GaAs**. Wafers-growth of quartz.***

UNIT IV **12 hrs**

Thin film deposition techniques-thermal and electron gun evaporation - DC and RF sputtering. Epitaxial film deposition techniques-CVD, VPE, LPE and MBE – general ideas.

UNIT V **12 hrs**

Production of difused p-n junction-transistor, planar epitaxial technology-photo-lithography, production of integrated circuits-production of LED-production of laser diodes, both homo and hetero junctions.

*** Self study**

PPH27

Books for study:

1. An Introduction to Solid State Physics Physics and its applications — R.J.Elliot and A.P.Gibson Macmillan, (1974)
2. Physics of Semiconductor devices — S. M. Sze , Willey online Library (2006)
3. Handbook of Thin Film Technology — L.Maissel and R. Glang, Mcgraw-Hill,(1970)
4. Optical Electronics — A.Yariv, Saunders College Publishing. (1991)

Books for Reference:

1. Semiconductors — R.A.Smith,Cambridge University Press, (1959)
2. Crystal Growth — B.R.Pamplin, Pergamon Press, (1975)
3. Crystal Growth: A Tutorial approach — W.Bardsley, D.T.O.Hurle and J.B.Mulin, J.Appli.Cyst., (1981)

Specific Topics for the problems:

1. Calculation of life time
2. Calculation of optical constant

PPH28

SEMESTER II **12PPH2CL**

CORE PRACTICAL I – GENERAL EXPERIMENTS
(Examination at the end of II semester)

Total Hours of Teaching: 150 hrs **Total Credits: 4**

List of Experiments
(Any Twelve)

1. Young's modulus-Elliptical fringes (Cornu's method)
2. Young's modulus-Hyperbolic fringes- (Cornu's method)
3. Viscosity of a liquid-Mayer's oscillating disc
4. Stefan's constant
5. Rydberg's constant- solar spectrum
6. Thickness of insulation using laser source
7. Determination of audio frequencies -Wien Bridge method
8. Coefficient of Self-inductance of a coil by Anderson's bridge method.
9. Forbes method-Thermal conductivity
10. 'e' by Millikan's method
11. e/m by Thomson's method
12. TCR and band gap energy of thermistor- Carey Foster's Bridge
13. Ferguson's method-specific heat of liquid
14. Biprism of optical bench-Determination of wavelength
15. Planck's Constant – Photoelectric emission
16. Hysteresis loss by CRO
17. Diffraction at a prism table- determination of wavelength
18. Determination of Dielectric constant of a liquid
19. Determination of wavelength of laser source- transmission grating
20. Determination of refractive index of a liquid by Air Wedge method
21. Determination of refractive index of a liquid by Newtons ring method
22. Laser – Determination of refractive index of given liquids

PPH29

SEMESTER II **12PPH2CM**

CORE PRACTICAL II – ELECTRONICS EXPERIMENTS

(Examination at the end of II semester)

Total Hours of Teaching: 150 hrs **Total Credits: 4**

List of Experiments
(Any Twelve)

1. Construction of dual regulated power supply
2. Parameters of Op-Amp
3. Triangular wave generator
4. Square wave generator
5. Wien's Bridge Oscillator
6. Active filters using Op-Amp
7. Schmitt Trigger using Op-Amp
8. Astable Multivibrator using Op-Amp
9. Phase- Shift Oscillator using Op-Amp
10. Clipping circuits
11. Clamping circuits
12. Differentiating and integrating circuits
13. Characteristics of Photo diode and Photo Transistor
14. Characteristics of Tunnel Diode
15. Characteristics of SCR
16. Characteristics of UJT
17. UJT relaxation oscillator
18. FET - common source amplifier
19. FET - common drain amplifier
20. Direct Coupled Amplifier
21. Characteristics of MOSFET
22. Characteristics of DIAC & TRIAC
23. Study of Pulse width modulation

PPH30
SEMESTER III

CORE PAPER 8 – QUANTUM MECHANICS - II 12PPH308

Total Hours of Teaching: 60 hrs **Total Credits: 4**

OBJECTIVES

To enable the learners to

i. Understand the basic approximate methods in molecular Quantum Mechanics
ii. Understand relativistic quantum theory and quantization of fields

UNIT I

Atomic Structure of many electron atoms:

Central field approximation – Thomas Fermi statistical model – Hartree's self consistent field method – corrections to the central field approximation – LS coupling scheme – selection rules – jj coupling scheme – The alkali atoms – Doublet separation –Doublet intensity.

UNIT II

Molecular structure:

The Born Oppenheimer Approximation – Molecular orbital theory (LCAO approximation) - Hydrogen molecule Ion – Hydrogen molecule (The MO method)-The valence bond (VB method) - Comparison of MO and VB theories – Restricted and unrestricted Hartree fock treatment of molecules .

UNIT III

Chemical Bonding in Polyatomic molecules:

Directed valence – Hybridisation - hybridization and geometry – Simple Huckel theory of linear conjugated systems – Examples of Simple Huckel calculations : Ethylene and **Butadiene*** - Self consistent field method – valence state ionization potentials - The Pariser – Parr – Pople (ppp) Approximation.

UNIT IV

Relativistic Quantum mechanics:

Schroedinger's relativistic equation – Probability and current densities - Klein Gordan equation in the presence of electromagnetic field – Application of Klein Gordan equation to hydrogen atom - Dirac's relativistic equation for a free electron – Free particle solutions -Negative energy states - Probability and current densities - Dirac's equation in a central field (The electron spin).

UNIT V

Quantum field theory:

Concept of Field and Second Quantization - Quantization of wave field –Lagrangian & Hamiltonian density – Lagrangian & Hamiltonian field equations – Quantum Canonical equations - Quantum equations for the non relativistic Schrödinger equation - Creation, destruction and number operators – anti commutation relations (basic concepts) – **Quantization of electro magnetic field***

*** Self study**

PPH31

Books for study:

1. Quantum Mechanics	Leonard I Schiff III Edition, Tata Mc Graw Hill, (2002) New Delhi.
2. Introductory Quantum Chemistry	A.K.Chandra Tata Mc Graw Hill (2010) IV Edition
3. Quantum Mechanics	Gupta . kumar . Sharma XXIX Edition Jai Prakash Nath & Co. (2010)

Books for reference:

1. Physics of atoms and molecules	B.H.Bransden and C.J.Joachain, Longman Publication, (1983)
2. Quantum Mechanics,	A.K.Ghatak and Loganathan, McMillan & Co., IV Edition, (2002).
3. A text book of Quantum Mechanics	P. M. Mathews and K.Venkatesan, TATA Mc Graw Hill, (2004).
4. Quantum Chemistry	Ira N.Levine, Prentice Hall, International Inc (1999).

PPH32

SEMESTER- III

CORE PAPER- 9 ATOMIC AND MOLECULAR SPECTROSCOPY

12PPH309

Total Hours of Teaching: 60 hrs **Total Credits: 4**

Objectives:

To study about the

i. Atomic Spectroscopy, Microwave Spectroscopy, IR Spectroscopy and Raman Spectroscopy
ii. Electronic Spectra of diatomic molecules
iii. NMR and AQR Spectroscopy

UNIT I **12 hrs**

Atomic spectroscopy

Spectra of the alkali metal vapours– Elements with more than one outer valence electron – magnetic moment and space quantization of angular momentum– The magnetic moment of the atom – Normal Zeeman effect – anamalous Zeeman effect– Emitted transitions in anomalous Zeeman transitions – The Lande's 'g' formula – The Paschen Back effect – hyperfine structure of spectral line – Zeeman effect of hyperfine structure – the Back-Goudsmit effect.

UNIT II **12 hrs**

Microwave Spectroscopy

The rotation of molecules – rotational spectra of rigid diatomic molecules – the intensities of spectral lines – the non rigid rotator – the spectrum of a non-rigid rotator – symmetric top molecules

IR Spectroscopy

The vibrating diatomic molecules – The simple harmonic oscillator – The anharmonic oscillator – The diatomic vibrating rotator – fundamental vibrations and their symmetry – The influence of rotation on the vibrational spectra of polyatomic molecules – linear molecules – symmetric top molecules.

Unit III **12 hrs**

Raman spectroscopy

Quantum theory – Classical theory – pure rotational Raman spectra – linear molecules – symmetric top molecules – Raman activity of vibrations – Rule of mutual exclusion – Vibrational Raman spectra – Rotational fine structure

Electronic spectra of diatomic molecules

Vibrational coarse structure – Deslandres tables – Frank-Condon principle – rotational fine structure of electronic – vibrational transition

UNIT IV **12 hrs**

NMR spectroscopy:

Quantum mechanical and classical description – The Bloch equations - Relaxation processes- spin lattice and spin relaxation – Fourier transformation - Experimental technique- principles and working of Fourier transform NMR spectrometer- chemical shift.

NQR spectroscopy:

Fundamental requirements - general principles – Half integral spins – Integral spins experimental detection of NQR frequencies.

UNIT V **12 hrs**

ESR Spectroscopy:

Basic principles of ESR – experiments - ESR Spectrometer - Reflection cavity and microwave bridge – ESR spectrum- **Hyperfine structure – Study of free radicals*.**

Mossbauer Spectroscopy:

The Mossbauer effect – The recoilless emission and adsorption – The Mossbauer spectrum-experimental methods.

*** Self study**

Books for study:

1. Fundamentals of Molecular Spectroscopy C.N. Banwell and E.M.McCash, IV Edition Tata McGraw Hill Pub.Co. (1994).
2. Spectroscopy B.P.Straughan and S.Walker, John Wiley & Sons Inc., Newyork (1976).

Books for Reference:

1. Elements of spectroscopy Gupta Kumar, Pragathi Prakasan pub.Co., Meerut (2007).
2. Molecular structure and spectroscopy G.Aruldhas, Prentice Hall of India, (2002).

Specific Topics for the problems:

Evaluation of

i) Equilibrium vibration frequency and anharmonicity of diatomic molecule
ii) The exact zero point energy
iii) The force constant

PPH34

SEMESTER- III **14PPH310**

CORE PAPER - 10 THIN FILMS, PLASMA PHYSICS AND CRYSTAL GROWTH

Total Hours of Teaching: 60 hrs **Total Credits: 4**

Objectives

To understand the

i. Preparation and characterization of thin films
ii. Fundamentals of plasma physics
iii. Techniques of crystal growth

UNIT I **12 hrs**

Methods of preparation of thin films

Nature of thin film- emission conditions- distribution of deposits from point, surface and cylindrical sources – deposition technology- resistive heating- electron beam method- cathodic glow discharge sputtering – chemical vapour deposition-chemical deposition-substrate cleaning.

UNIT II **12 hrs**

Nucleation, Growth and Thickness measurements

Nucleation and growth

Thermodynamis of nucleation – nucleation theories- film growth –incorporation of defects, impurities etc., in thin film –deposition parameters and grain size.

Thickness measurements

Interferometry – Fringes of equal thickness (FET) – Fringes of equal chromatic order (FECO) – Step gauges - Ellipsometry – Stylus profilometry - Vibrating quartz crystal method - Gravimetric balance method

UNIT III **12 hrs**

Plasma state - Characterization

Occurrence of plasma in nature- definition of plasma –concept of temperature-Debye shielding –plasma parameters- criteria for plasma – single particle motion: uniform B field –uniform E and B fields- Gravitational field –**non uniform B field*** –curved B –magnetic mirrors

UNIT IV **12 hrs**

Fluid theory and Application of Plasma

Derivation of fluid equation of motion - fluid drifts perpendicular to B- fluid drifts parallel to B

Application of Plasma Physics: Production of nano particles by plasma-Plasma nitriding – Plasma sources for hospital waste-Plasma treatment of textiles.

UNIT V **12 hrs**

Crystal growth

Growth from liquid solution: Aqueous solution growth – Holden's rotary crystallizer- Mason jar method - temperature differential methods- chemical reactions – sol gel growth – liquid crystal (preliminary ideas only).

Hydrothermal growth: Modified Bridgemann hydrothermal autoclave- Morley hydrothermal autoclave – phase equilibria and solubility- kinetic quartz.

*** Self-study**

PPH35

Books for study:

1. Thin film fundamentals	A Goswami, New age international (P) Lt., New Delhi, (1996).
2. Introduction to plasma physics and controlled fusion	Francis F.Chen ,Plenum Press, New York and London (1984).
3. Materials Science of Thin Films	Milton Ohring, IInd Edition, Academic Press, 2001
4. Plasma Sciences and the creation of wealth	P.I. John , Tata McGraw Hill Publishing Company Limited, New Delhi (2005).
5. Growth of Crystal from liquids	J.C.Brice, Blackie & Sons Pub., London (1986).

Books for Reference:

1. Hand book of thin film Technology	L.T. Meisssel and R.Glang , McGraw Hill (1978).
2. Principles of Plasma physics Nicholas	A. Krall and Alvin W.Trivelpiece, McGraw Hill Publications, (1982).
3. Thin Film Phenomena	K.L.Chopra, Malabar : Robert E. Krieger Publishing Company, 1979

Specific Topics for the problems:

i) Calculation of Debye length

ii) Calculation of plasma density

iii) Calculation of inter-planar spacing of the crystal using DeBroglie concept of matter waves.

PPH36

SEMESTER – III

MAJOR ELECTIVE I: 1.NANOSCIENCE 14PPH 3E1

Objectives

i) To understand the nanomaterial and nanotechnology
ii) To know the different synthesis processes for making nanomaterials
iii) To understand in-depth of nanomaterial properties
iv) To explore the nanodevices and various applications
v)

UNIT I **12 hr**

Overview of Nanomaterials

Classification of nanomaterials - Quantum confinement in semiconductor nanostructures: quantum well, quantum wires and quantum dots – Electronic density of states.

Size effects: Surface to volume ratio versus shape – Surface curvature – Strain Confinement

Metal clusters: Magic Numbers – Geometric Structure – Electronic Structure - Reactivity

UNIT II **12 hr**

Synthesis of Nanoscale materials and structures

Methods of making 0-D Nanomaterials:

Inert gas condensation, Inert gas expansion, Sonochemical processing, Spray pyrolysis - Sol-gel deposition and molecular self-assembly

Methods of making 1-D and 2-D Nanomaterials:

Foil beating – Electrodeposition – Electrospinning - Physical Vapor Deposition (PVD) – Chemical Vapor Deposition (CVD) – Template based Synthesis

Methods of making 3-D Nanomaterials:

Top down processes: milling and mechanical alloying

Methods of nanoprofiling:

Micromachining – Photolithography*

UNIT III **12 hr**

Physical Processes in Semiconductor Nanostructures

Modulation doping - The quantum Hall effect - Resonant tunneling - Charging effects - Ballistic carrier transport - Interband absorption in semiconductor nanostructures - Intraband absorption in semiconductor nanostructures - Light emission processes in nanostructures - The phonon bottleneck in quantum dots - The quantum confined Stark effect - Non-linear effects - Coherence and dephasing processes – Super lattices – Photofragmentation - Coulombic explosion

UNIT IV **12 hr**

Properties of Nanomaterials

Mechanical properties of nanostructured materials: nanodispersions, nanocrystalline solids - Thermal properties: melting point, thermal transport - Electrical properties – Magnetic properties – GMR - Superparamagnetism - Optical properties - Surface plasmon resonance - Acoustic Properties – Catalytic properties

UNIT V **12 hr**

Nanodevices and their various applications

Nanomagnetic materials – Particulate nanomagnets and geometrical nanomagnets – Probing nanomagnetic materials – Nanomagnetism in technology – carbon nanotubes: properties and applications in hydrogen storage, supercapacitor and fuel cells– Organic FET: Principle and

operation - Organic LED: basics, bipolar carrier injection, exciton formation – Organic photovoltaics: basic characteristics – Injection lasers - quantum cascade lasers - optical memories

*** Self Study**

Specific topics for Problems:

Calculation of surface to volume ratio
Magic Numbers
The quantum Hall Effect

Books for Study:

1. Nanomaterials, Nanotechnologies and Design: An Introduction for engineers and Architects (Unit I, II, III & IV)	Micheal F. Ashby, Paulo J. Ferreira,Daniel L. Schodek, Elsevier Science (2009)
2. Nanoscale Science and Technology (Unit I, II, V)	Robert Kelsall, Ian hamley, MarkGeoghegan, John Wiley & Sons, Ltd.(2005)
3. Introduction to Nanotechnology (Unit I, II)	Charles P. Poole, Jr. Frank J. Owens, John Wiley & Sons, Inc. (2007)
4. Nanostructures and Nanomaterials:Synthesis, Properties and Applications (Unit III, IV)	Guozhong Cao, Imperial College Press (2004)

Books for Reference:

1. Nanoparticle Technology Handbook	Masuo Hosokawa, Kiyoshi Nogi, Makio Naito, Toyokazu Yokoyama, Elsevier Science (2007)
2. Handbook of Nanostructured materials and nanotechnology	Hari Singh Nalwa, Academic Press (2000) Vol (1-5)

PPH38
SEMESTER -III
MAJOR ELECTIVE - I: 2. ATMOSPHERIC SCIENCE 12PPH3E1

Total Hours of Teaching: 45 hrs **Total Credits: 5**

Objectives:
To study about the
i. Atmospheric thermodynamics and radiation
ii. Clouds and precipitation and Air pollution.
iii.Meteorological systems and global energy balance and

Unit I **12 hrs**
Atmosphere
Origin and composition of the atmosphere, distribution of pressure and density, ionosphere, atmospheric electric field and magneto sphere, distribution of temperature and winds, measurement of temperature and humidity, measurement of wind and masses, measurement of precipitation, modern metrological instruments.

Unit II **12 hrs**
Atmospheric Thermodynamics and Radiations
Gas laws and equation of state for a mixture of ideal gases, work, heat and First Law of thermodynamics, adiabatic processes, moist thermodynamics and latent heats, thermodynamic diagram, saturated adiabatic and pseudoadiabatic processes, stability criteria using parcel method, stability criteria using slice method, entrophy and second law of thermodynamics, Carnot cycle and Clausius Clapeyron equation, Black body radiation, absorption and emission of radiation by molecules, indirect estimate of solar irradiation at the top of the atmosphere, scattering of solar radiation.

Unit III **12 hrs**
Clouds and Precipitation
Atmospheric Aerosols, Aerosol size and concentration, sources and sinks of atmospheric aerosol, Nucleation theory of water vapour condensation, cloud condensation nuclei, growth of cloud droplets in warm clouds by condensation, Grouth of cloud droplets by collision and coalescence, mechanism of cloud formation, types of clouds, cloud seeding, role of clouds and precipitation products in charge separation, mechanism of charge separation, circulation and vorticity, Kelvin's circulation theorem.

Unit IV **12 hrs**
Meteorological Systems and Global energy balance
Air masses, warm front, cold front, stationary front, occluded fronts, monsoons, differential heating of Land and Sea, compressibility, rotation and moisture effects, tropical and oceanic convergent zones, monsoon disturbances, semi permanent monsoon systems over India, factors responsible for the formation of tropical cyclone, climatology of tropical cyclones, movement of tropical cyclones, life cycle of a tropical cyclones, tropical cyclone structures, thunderstorms, life cycle of thunderstorms, tornadoes, global energy balance requirement for the earth's atmosphere, energy processes in the upper atmosphere, weather forecasting and climate forecasting.

PPH39

Unit V **12 hrs**

Air pollution

Air pollution in perspective - The LOS Angeles Smog-Global and regional pollutants- The principal atmospheric pollutants, effects of air pollution - health effect-effects on plants and animals, effects on materials and services, source of air pollution-identifying air pollution-Natural sources-Domestic sources-Commercial sources-Industrial sources-Agricultural sources-Transformation related sources, control of air pollution-Natural cleaning of the atmosphere-Air quality control, particle emission control, gas emission control, Nitrogen oxide emission control, Ambient air quality control by Dilution, Predictor air pollution concentration-Airpollutionmeteorology.

Books for study:

1. Basics of Atmospheric science — A.Chandrasekar, PHI Learning Private Limited, New Delhi-110001, 2010.
2. Environment Science and Engineering — J.GLYNN HENRY,GARY, W.HEINKE, PHI Learning private Limit, New delhi, 2009.

PPH40

SEMESTER –IV **12PPH411**

CORE PAPER 11 - BIOMEDICAL INSTRUMENTATION

Total Hours of Teaching: 75 hrs **Total Credits: 4**

Objectives

i. To impart knowledge on various biomedical instruments
ii. To understand the working of biomedical instruments

UNIT I 15 hrs

Bioelectric potential and transducers

Origin of bioelectric signals – Electrocardiogram – Electroencephalogram – Electromyogram – Physiological transducers – classifications – characteristics – variable resistance, capacitance, inductance transducers – LVDT – Piezoelectric transducers – pressure transducers – LVDT and strain gauge transducers – electrical resistance thermometer – Photoelectric transducers – Photovoltaic and Photoemissive cells – **Silicon diode detectors and diode arrays***

UNIT II 15 hrs

Pulmonary function Analyzers

Ventilation, distribution and diffusion –Respiratory volumes and capacities– Basic Spirometer and Ultrasonic Spirometer.

Blood Gas Analyzers

Acid – Base balance, Blood pH measurements – electrodes for blood pH measurements – Effect of blood on electrodes – Buffer solutions. Measurement of blood pCO_2 - blood pO_2 measurements – A complete blood gas analyzer.

Oximeters

Principle of oximetry – invitro-oximetry and invivo-oximetry. Ear oximeter and pulse oximeter.

UNIT III 15 hrs

Blood Cell Counters and Audiometer

Types of blood cells - Methods of cell counting- Automatic optical method - Electrical conductivity method - Coulter counter – Mechanism of hearing – Measurement of Sound – Basic audiometer – Hearing Aids – conventional and digital hearing aids.

Bio-medical Recorders

Electrocardiograph (ECG) – block diagram description of an ECG – ECG leads (basic concepts) – Microprocessor based ECG machines - Electroencephalograph (EEG) – block diagram description of an EEG – Computerized analysis of EEG.

Telemedicine

Telemedicine applications – Telemedicine concepts – essential parameters for telemedicine – block diagram explanation of a typical telemedicine system – **Concepts of Telemedicine technology***

UNIT IV 15 hrs

Modern Imaging Systems

X-Rays: Nature of X-rays, properties and units of X-rays- X-ray machine – Visualization of X-rays: - X-ray Image Intensifier System – Basic Principle of X-ray Computed Tomography.

PPH41

Magnetic Resonance Imaging

Principles of NMR imaging systems – Fourier transformation of the FID - Basic NMR components – block diagram explanation – biological effects of NMR imaging - Advantages of NMR imaging System.

Ultrasonic Imaging Systems

Principle of Ultrasonic waves – Generation and detection of Ultrasound – Medical ultrasound – ultrasonic imaging instrumentation.

UNIT V **15 hrs**

Electrical safety of medical instruments

Introduction – radiation safety instrumentation - physiological effects due to 50 Hz current passage – micro shock – macro shock – electrical accidents in hospitals – devices to protect against electrical hazards – hospital architecture.

*** Self study**

Books for study:

1. Hand book of Biomedical instrumentation	R.S Kandpur, Tata McGraw Hill publishing Co, New Delhi (1999).
2. Biomedical instrumentation	Dr.M.Arumugam, Anuradha Agencies publishers, Kumbhakonam, (2003).

Book for reference:

1. Biomedical instrumentation and measurements	Leslie Crombwell, Fred.J.Weibell & Trich.A.Pfeiffer, Prentice Hall of India, (1997).
2. Electronic Instrumentation	H.S.Kalsi II edition Tata Mc GrawHill Co.(2002)

Specific Topics for the problems:

Determination of

1) Mean Cell Volume (MCV)
2) Mean Cell Haemoglobin (MCH)
3) Mean Cell Haemoglobin Concentration (MCHC)

PPH42

SEMESTER- IV

CORE PAPER 12 – NUCLEAR AND PARTICLE PHYSICS

12PPH412

Total Hours of Teaching: 75 hrs **Total Credits: 4**

Objectives

To study about the

i. Basic nuclear structure

ii. Radio - Alpha decay, Beta decay and Gamma decay

iii.Nuclear Models: Liquid Drop Model, Shell Model

UNIT I **15 hrs**

Basic Nuclear Structure

Distribution of nuclear charge – Nuclear mass – Mass spectroscopy – Bain bridge and Jordan, Nier Mass spectrometer* – Theories of nuclear compositions (proton-electron, proton-neutron) – Bound states of two nucleons – spin states – Paulis's exclusion principle — Tensor force – Static force – Exchange force – Low energy nucleon- nucleon scattering

UNIT II **15 hrs**

Radioactivity

Alpha decay: Properties of α particles – Velocity and energy of α particles – Gamow's theory of α decay – α – ray energies and fine structure of α rays - long range α particles.

Beta Decay: Properties of β particles – General features of β rays Spectrum – Pauli's hypothesis – Fermi's theory of β decay – Forms of interaction and selection rules – Fermi and Gamow Teller transitions.

Gamma decay: Interaction of γ rays with matter - measurement of γ rays energies – DuMond bent Crystal spectrometer method – internal conversion.

UNIT III **15 hrs**

Nuclear Models

Liquid drop model: Bohr Wheeler theory of fission – condition for spontaneous fission – activation energy - Seaborg's Expression.

Shell Model: Explanation of magic numbers – prediction of shell model – prediction of nuclear spin and parity – Nuclear statistics – Magnetic moment of nuclei - Schmidt lines – nuclear isomerism.

Collective model: Explanation of quadrupole moments – prediction of sign of electric quadrupole moments.

Optical Model: Nelson Model – Elementary ideas.

UNIT IV **15hrs**

Nuclear Reaction

Kinds of reactions and conservation laws – Energies of Nuclear reaction – reaction cross section – continum theory of Nuclear reaction – resonance – Briet Wigner Dispersion formula – Stages of a Nuclear reaction – statistical theory of nuclear reaction – Evaporation probability and Cross reaction – **kinematics of stripping and pickup reaction*.**

UNIT V **15 hrs**

Particle Physics

Hadrons – Hyperons – Pion – Meson resonances – strange mesons and Baryons – Gellmann Okuba mass formula for Baryons – CP violation in K decay – Quark model – Reaction and decays – quark structure of Hadrons.

***Self study**

Books for study:

1. Nuclear Physics	R.C. Sharma, K. Nath &Co., Meerut (2004)
2. Nuclear Physics	D.C.Tayal, Himalayan Publishing House, Bombay (2002).
3. Elements of Nuclear Physics	Yadav and Pandya., K.Nath Ram Nath Co., Meerut(2000).

Books for Reference:

1. Concept of Nuclear Physics	Bernard L. Cohen, Tata Mc Graw Hill Publishing Company, New Delhi (2004).
2. Introduction of Modern Physics	Kenneth S. Karne John Hile and Sons, New York (1998).
3. Nuclear Physics	R.Murugesan, S. Chand and Co, New Delhi(1999)

Specific Topics for the problems:

1. Calculation of atomic mass

PPH44
SEMESTER -IV

MAJOR ELECTIVE - II

3. MICROWAVE COMMUNICATION PHYSICS 12PPH4N2

Total Hours of Teaching: 75 hrs **Total Credits: 5**

Objectives

To enable the learners to understand

i. Various modulation and detection techniques
ii. Generation and propagation of microwaves
iii. Radar and communication electronics

UNIT I **15 hrs**

Modulation and Detection

Need for modulation – Principles of AM and FM with circuit diagrams – Comparison of DSB, SSB and vestigial side band transmission – Multichannel communications, FDM, TDM – AM detection – Frequency discriminator and ratio detector.

UNIT II **15 hrs**

Microwaves

Microwave generation – Multicavity Klystron -Reflex Klystron – Magnetron, TWT and other microwave tubes - Microwave transistors – Microwave integrated circuits – Parametric Amplifiers – MASER –Tunnel Diode – Gunn Diode.

UNIT III **15 hrs**

Antennas and Wave Propagation

The elementary doublet - Wire radiators in space – Terms and definitions in connection with antennas and their radiation patterns – Effect of ground on antennas – Effect of antenna height - Antenna coupling at medium frequencies - Directional high frequency antennas – Dipole arrays – Broad side and end side arrays - Wide band and special purpose antennas (folded dipoles, helical antenna, discose antenna and phased arrays) – Ground wave propagation - Sky wave propagation **- Ionosphere - Ecles and Larmor Theory - Magneto - ionic Theory ***

UNIT IV **15 hrs**

Radar and Television

Elements of a RADAR system – The RADAR equation – Radar performance factors – Radar Transmitting systems – Radar Antennas -Duplexers -Radar Receivers and Indicators – Pulsed systems – Other Radar systems – Black and White TV Transmission – Black and White TV Reception – Colour TV Transmission and Reception.

UNIT V **15 hrs**

Communication Electronics

Fundamentals of Data Communication systems – Data Sets and interconnection requirements – Network and control considerations – Multiplexing – Short and Medium Haul systems – Long Haul systems – Elements of Long distance Telephony – Satellite communication – **Features of a communication network –TYMNET, ARPANET, ISDN, LAN***

* **Self study**

PPH45

Books for study:

1. Electronics Communication systems,	George Kennedy, Tata McGraw Hill (1998). New Delhi (2004).
2. Microwave Engineering,	Sanjeev Gupta, Khanna Publishers, Delhi (2001).
3. Communication systems	Simon Haykin , John Wiley and Son Inc. (1994).

Books for Reference:

1. Electronics,	Gupta and Kumar Pragathi Publishers (1989).
2. Electronics and Radio Engineering,	F.E. Terman – McGraw Hill, (1955)
2. Principles of Communication engineering	Anokh Singh & A.K.Chhabra, S.Chand and Co.,(1999)

Specific Topics for the problems:

1. To calculate the percentage of modulation in amplitude modulation
2. To calculate the frequency and the amplitude of upper and lower side bands
3. To calculate the range of radar

PPH46
SEMESTER – IV

MAJOR ELECTIVE - II
4. INFORMATION STORAGE MATERIALS AND DEVICES **12PPH4N2**

Total Hours of Teaching: 75 hrs **Total Credits: 5**

Objectives
To enable the learners to

i know about the information storage and some of the techniques to store the data
ii know about the role of the optical devices to store data
iii know the role of the magnetic properties to store the data

Unit I **15 hrs**
Overview of Information Storage and Nanotechnology
Different types of information storage materials and devices: solid state memory – optical memory – magnetic recording- emerging technologies – role of nanotechnology in data storage.

Unit II **15 hrs**
Optical Data Storage
Write and read techniques (signal modulation, disk format, data reproduction) – read and write principles (read-only, write-once, phase-change, magneto-optic disks) – optical pickup heads (key components, diffraction–limited laser spot, focusing and tracking error signals, servo-loop design, actuator) – optical media – near field optical recording – **holographic data storage*.**

Unit III **15 hrs**
Basics of Magnetism for Magnetic Data Storage
Magnetic field – magnetism of matter – spin-exchanges coupling– ferromagnetic and anti-**ferromagnetic materials***– magnetic anisotropy – demagnetization field – magnetic domain – magnetic hysteresis – superparamagnetism.

Unit IV **15 hrs**
Magnetic Media
Inductive read and write head – AMR head – GMR effect – spin-valve sensor – magnetic tunneling junction – GMR head – ultra-small head design.

Unit V **15 hrs**
Introduction to Composites (Fibre Reinforced Plastics):
Types of fibre reinforced plastics – Mechanics of short/long fibre reinforcements – Law of mixture – Weibull statistics– Fracture behavior of fibre reinforced composites – Technique in the manufacture of composites

* **Self Study**

PPH47

Books for study:

1.Fracture Behavior of Polymers	A.J.Kinlock and R.J.Young, Applied Science Publishers, New York, (1983).
2.Thermoplastics: Materials Engineering	L.Mascia, Applied Science Publishers, New York, (1983).
3.Stress Analysis of Ploymers	J.G.Williams, II Edition, John Wiley & Sons Ltd., (1980)

Books for References:

1. Handbook of Plastics and Elastomers	C.A.Harper, McGraw Hill Book.Co., (1975).
2. Introduction to Composite Materials	S.W.Tsai and H.T.Hahn, Technomic Pub.Co., (1980).

Specific Topics for the problems:

1. Magnetic field
2. Magnetism of matter
3. Magnetic hysteresis.

PPH48

SEMESTER- IV **12PPH4CN**

CORE PRACTICAL –III ADVANCED EXPERIMENTS

Total Hours of Teaching: 150 hrs **Total Credits: 4**

List of Experiments
(Any Fifteen)

1. Development of Copper Arc spectra – Constant Deviation Spectrograph
2. Development of Brass Arc spectra – Constant Deviation Spectrograph
3. Development of Iron Arc spectra – Constant Deviation Spectrograph
4. Magnetic field Strength determination – Search Coil method
5. Magnetic Susceptibility determination of a given salt – Quincke's method
6. Magnetic Susceptibility determination of a given salt – Guoy's method
7. Compressibility of a liquid – Ultrasonic diffraction
8. Hall Effect- Measurement of Hall parameters.
9. e/m – Zeeman effect
10. e/m – Magnetron method.
11. e/m – Helical method
12. B-H curve – Anchor ring
13. B-H curve Solenoid
14. Kelvin's double Bridge – Determination of very low resistance and temp co-efficient of resistance.
15. Determination of Planck's constant using a Photo Cell.
16. To determine the resistivity of a Semiconductor material using Four Probe method.
17. Determination of Dielectric Constant of a liquid and Dipole moment of an Organic molecule using Capacitance Measurement Circuit.
17. Crystal growth – Growing crystals by different methods.
18. Michelson interferometer – determination of λ, $d\lambda$ and thickness of mica sheet.
19. G.M Counter
20. Fiber optic Experiments - Determination of Numerical aperture, acceptance angle and Fibre Loss of an optical fibre
21. Determination of Dielectric constant (for solid)
22. X ray Diffraction – Structural analysis (Quantitative)
23. Thin Film – Material coating by Sol Gel method / Co-precipitation method

PPH49

SEMESTER- IV **12PPH4CO**

CORE PRACTICAL –IV SPECIAL ELECTRONICS EXPERIMENTS

Total Hours of Teaching: 150 hrs **Total Credits: 4**

List of Experiments
(Any Fifteen)

1. Op. amp - V to I & I to V converters.
2. Op. amp - D/A converter-Binary weighted, Ladder methods
3. Op. amp - Log and Antilog amplifiers.
4. Op. amp - Half wave, Full wave & Peak value Clippers and Clampers
5. Op. amp - Comparator-Zero crossing detectors, Window detector, Time marker.
6. Op-amp- Simultaneous Addition and Subtraction
7. Op amp -Analog Computations- Simultaneous equations - First and second Order Differential Equation.
8. Op-amp -Instrumentation amplifier-Temperature measurement
9. Op-amp- Instrumentation amplifier-Light intensity-Inverse square law
10. 555 Timer -Schmitt trigger & Voltage controlled oscillators
11. 555 Timer - Monostable & Astable multivibrators
12. Study of Flip Flops
13. Study of Shift Registers
14. Study of Johnson and Ring Counters
15. Study of Synchronous Counters
16. Study of Asynchronous Counters
17. Study of Semiconductor Memory - ROM
18. Microprocessor - LED interfacing
19. Microprocessor - Stepper motor interfacing
20. Microprocessor - Traffic control simulation
21. Microprocessor - ADC interface-wave form generation
22. Microprocessor – DAC-Wave form generator
23. Microprocessor - Hex key board interfacing
24. Microprocessor - Musical tone generator interface
25. Microcontroller - Stepper motor interfacing
26. Microcontroller - Traffic Control Simulation
27. Microprocessor - Temperature controller

PPH50

SEMESTER – 1V

PROJECT WORK AND VIVA-VOCE (12PPH4Z1)

Total Hours of Teaching: 150 hrs **Total Credits: 5**

Mark Distribution:

CIA	:	40 Marks
ESE*	:	160 Marks (Project Evaluation – 120 marks & Project Viva-voce – 40 marks)
Total	:	200 Marks

* Project & Viva –Voce shall be evaluated by both Internal & External Examiners Jointly.