DEPARTMENT OF PHYSICS

SYLLABI FOR M.Sc PHYSICS

CURRICULAM AND SCHEME OF EXAMINATIONS (CBCS)
(Applicable to students admitted during the academic year 2015-2016 and onwards)

KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
COIMBATORE -641029

2015- 2016

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 2015–2016 and onwards)

Semester	Subject code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam. Hrs.	Credit
				CIA	ESE	Total		
I	15PPH101	**C.P 1**- Classical Mechanics	5	25	75	100	3	5
	15PPH102	**C.P 2**- Mathematical Physics	5	25	75	100	3	5
	15PPH103	**C.P 3**- Modern Optics	5	25	75	100	3	5
	15PPH1N1	**IN1** – Non –Major Elective I **: Digital electronics and Microprocessors /** Applied Physics	5	25	75	100	3	5
	15PPH2CL	**C. Pr 1**- General Experiments	5	-	-	-	-	-
	15PPH2CM	**C. Pr 2**- Electronics Experiments	5	-	-	-	-	-
II	15PPH204	**C.P 4**- Quantum Mechanics –I	4	25	75	100	3	4
	15PPH205	**C.P 5**- Thermodynamics and statistical Mechanics	4	25	75	100	3	4
	15PPH206	**C.P 6**- Thin Film Physics, Plasma Physics and Crystal growth	4	25	75	100	3	4
	15PPH207	**C.P 7**- Nuclear and Particle Physics	4	25	75	100	3	4
	15PPH2N2	**2N2** – Non –Major Elective II: **Energy Physics /** Industrial Physics	4	25	75	100	3	5
	15PPH2CL	**C.Pr 1** - General Experiments	5	40	60	100	4	3
	15PPH2CM	**C.Pr 2** - Electronics Experiments	5	40	60	100	4	3
III	15PPH308	**C.P 8**- Quantum Mechanics-II	5	25	75	100	3	5
	15PPH309	**C.P 9**- Electromagnetic theory and Electrodynamics	5	25	75	100	3	5
	15PPH310	**C.P.10** Solid State Physics	5	25	75	100	3	5
	15PPH3E1	**Major Elective I: Nano Science /** Atmospheric Science	5	25	75	100	3	5
	15PPH4CN	**C. Pr 3**- Advanced Experiments	5	-	-	-	-	-
	15PPH4CO	**C. Pr 4** - Special Electronics Experiments	5	-	-	-	-	-

PPH2

IV	15PPH411	**C.P. 11** Communication Physics	5	25	75	100	3	4
	15PPH412	**C.P 12** - Atomic & Molecular Spectroscopy	5	25	75	100	3	4
	15PPH4N2	Major Elective II: **Problems in Physics /** Biomedical Instrumentation	5	25	75	100	3	5
	15PPH4CN	**C. Pr 3** - Advanced Experiments	5	40	60	100	6	3
	15PPH4CO	**C. Pr 4** - Special Electronics Experiments	5	40	60	100	6	3
	15PPH4Z1	**Project and Viva Voce**	5	40	160	200	-	4
		Total				2200		90

Major Elective Papers

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

1. **Nanoscience**
2. Atmospheric Science
3. **Problems in Physics**
4. Biomedical Instrumentation

Non - Major Elective papers

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

1. **Digital electronics and Microprocessors**
2. Applied Physics
3. **Energy Physics**
4. Industrial 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.)

SEMESTER – I **15PPH101**

CORE PAPER 1 - CLASSICAL 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

Mechanics of Single and System of Particles

Newton's laws of motion – Mechanics of a particle- Equation of motion of a particle – Motion of a particle under constant force and alternating force – Mechanics of systems of particles – Angular momentum of the system – Potential and kinetic energies of the system – Motion in a central force field – Motion of two particles equivalent to single particle – Equation o motion of centre of mass with respect centre of force – Motion in an inverse square law force field – Classification of orbits.

Unit – II 15 hrs

Lagrangian Formulation

Generalized coordinates and constraints – principle of virtual work and D'Alembert's principle – Lagrange's equation for a conservative system – velocity dependent potentials and dissipation function. Hamilton's principle – Lagrange's equations of motion from this principle – extension of the principle to non-conservative and non-holonomic systems – conservation theorems and symmetry properties. Applications for Lagrangian and Variational Principle: simple pendulum, compound pendulum, double pendulum, triple pendulum, simple harmonic oscillators

Unit - III 15 hrs

Mechanics of Rigid Body Motion

Generalized coordinates for rigid body motion – Euler's integrals – infinitesimal rotations – Coriollis force – application of a free fall of a body on earth's surface and Foucault's pendulum – moments and products of inertia – Euler's equation of motion – **force free motion of a symmetrical rigid body – heavy symmetrical top under gravity – fast top and sleeping top conditions*.**

Unit - IV 15 hrs

Hamiltonian Formulation

Hamilton's equation of motion – cyclic coordinates and Routh's procedure – conservation theorem – Hamilton's equation of motion from variational principle – principle of least action – canonical transformation – equations of canonical transformation and generating functions – examples of canonical transformations – integral invariance of Poincare-Lagrange and Poisson's brackets – equations of motion in Poisson bracket notation – Jacobi's identity-infinitesimal contact transformations – angular momentum – Poisson bracket relations – Liouville's theorem.

PPH7

UNIT – V **15 hrs**

Hamiolton-Jacobi Theory and Small Oscillations

Hamilton-Jacobi equations for Hamilton's principle and characteristic functions – harmonic oscillator problem – separation of variable method – action angle variables – applications – linear harmonic oscillator and Kepler problem – theory of small oscillations – Eigen value equations – normal modes and normal coordinates – application to triatomic molecule.

* **Self study**

Books for study:

1. Classical Mechanics. Goldstein, Pearson New International 3rd Edition (2014)
2. Classical Mechanics Gupta, S.L.Kumar and Sharma, Pragathi Edition (2012)

Books for Reference:

1. Classical Mechanics Gupta and Sathya Prakash, Kedar Nath Ram Nath & Co
2. Classical Mechanics Rana and Joag, Tata McGraw-Hill Education (2001)

PPH8

SEMESTER –I **15PPH102**

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.

PPH9

UNIT V **15 hrs**

Numerical Analysis

Bisection and Newton – Raphson's 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, 3 Ed (2006).
2. Mathematical Physics	B.S Rajput, Pragati Prakashan Meerut 17th Ed (2004).
3. Numerical Methods	A.Singaravelu, Meenakshi Publishing (2000).
4. Mathematical Physics with Classical mechanics	Sathyaprakash, Sultan Cand & Sons (2014)

PPH10

SEMESTER - I **15PPH103**

CORE PAPER- 3 : MODERN OPTICS

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.

UNIT II **12 hrs**

Magneto-optic and Electro-optic effects

Faraday rotation in Solids – Kerr electro optic effect – The Cotton-Mouton effect – The Pockels effect

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

Unit – III **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 IV **12 hrs**

Fibre Optic sensors

Fibre Optic sensors – Intensity modulated sensors – Micro band Strain intensity modulated sensor – liquid level type hybrid sensor – Internal effect intensity modulated sensor – Diffraction grating sensors – Sensors using single mode fiber – Interferometry sensors – Interferometry pressure sensor - Interferometry temperature sensor – Polarization problems in Interferometry sensor using single mode sensor – Medical applications of fiber sensor – Electric field and Voltage sensors – Chemical sensors – Magnetic field and current fibre sensors

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, Dower Publications 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.
6. Modern optics, A.B.Gupta, Books and allied publishers, Kolkata, 2nd edition (2010)
7. Lasers and non linear optics, B.B.Laud, New age international, 2nd edition (reprint 2008)

PPH12

SEMESTER I **15PPH1N1**

NON MAJOR ELECTIVE I : DIGITAL ELECTRONICS AND MICROPROCESSORS

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

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 – V to I converter – I to V 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, 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 Integrated circuits	P.Mathur,C.Kulshreshta and R.Chada, Umesh Publications, New Delhi (2005).
6. Linear integrated circuits	D Roy Choudhary, Shail B.Jain , New age International pub. IV edition, (2014)
7. Introduction to Integrated electronics, digital and analog	V.Vijayendaran, S.Vishwanathan Printers and Publishers Pvt.Ltd (reprint 2011).

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).

PPH14

SEMESTER I **15PPH1N1**

NON MAJOR ELECTIVE – I : 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**

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)

PPH15

SEMESTER II **15PPH204**

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 formalism of quantum mechanics, energy eigen value problems and approximation methods.

UNIT I **12 hrs**

General formalism of quantum mechanics

Linear vector space – linear operator – **Eigen values and Eigen functions*** – the Hermitian operator – Postulates of Quantum Mechanics – simultaneous measurability of observables – General Uncertainty relation - Dirac's notation – Equations of motion – Momentum representation – related solved problems

UNIT II **12 hrs**

One and three dimensional energy Eigen value problems

Square-well potential with rigid walls – square-well potential with finite walls – square potential barrier – alpha emission – Bloch waves in a periodic potential – Kronig-Penney square-well periodic potential – Linear harmonic oscillator: Schroedinger method

Particle moving in a spherically symmetric potential – spherical harmonics – radial equation – system of two interacting particles – rigid rotator – hydrogen atom – radial equation and its solution – energy eigen values – radial wave functions – wave function of hydrogen like atoms – radial probability density

UNIT III **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 IV **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 V **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***

* **Self study**

PPH16

Books for study:

1. UNIT 1&2 : Quantum Mechanics II edition	G Aruldhas, PHI learning Pvt Ltd, New Delhi, (2009)
2. UNIT 3 : Quantum Mechanics	Sathyaprakash and Swathi Saluja Kedarnath Ram nath & Co.,(2002)
3. UNIT 4 : Quantum Mechanics	Kakhani & Chandalia, Sultan Chand & Sons, third edition, (1996).
4. UNIT 5 : Quantum Mechanics	Gupta, Kumar and Sharma. Jai Prakashnath & Co., Meerut (2010)

Books for Reference:

1. A text book of Quantum Mechanics	P.M. Mathews and K.Venkatesan Tata Mc GrawHill education Pvt. Ltd(2004)
2. Quantum mechanics	Leonard. I. Schiff, McGraw Hill Co., third Edition, (2002)
3. Modern quantum mechanics	J J Sakurai, Jim J Napolitino, II edition, Pearson new international edition (2014)
4. Quantum Mechanics: Theory and applications	Ajoy Ghatak and Lokanathan 5th edition Macmillan India Ltd. (2002)

PPH17

SEMESTER II **15PPH205**

CORE PAPER 5 – THERMODYNAMICS AND STATISTICAL PHYSICS

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

Objective:

To know about

(i) Basic laws in Thermodynamics
(ii) Classical law and distributions
(iii) Basic concepts in quantum Statistics

UNIT I: Thermodynamics and Radiation:

Second law of thermodynamics- Entropy and Second law of thermodynamics- Entropy and Disorder- Thermodynamic Potential and Reciprocity relation- Thermodynamic Equilibria - Chemical Potential. Blackbody radiation - Planck‟s Radiation law.

UNIT II: Basic Concepts:

Phase space- Volume in phase space-Number of phase cells in given energy range of harmonic oscillator- Number of phase cell in the given energy range of 3-dimensional free particle- Concept of ensemble- Micro canonical ensemble-Canonical ensemble- Grand Canonical ensemble- Density distribution in phase space- Liouvilles theorem- Postulate of equal a priori probability- Statistical equilibrium- Thermal equilibrium- Mechanical equilibrium-Particle equilibrium-Connection between Statistical and thermodynamic quantities.

UNIT III: Classical Distribution Law:

Microstates and Macro states-Classical Maxwell-Boltzmann distribution law- Evaluation of constants, α and β- Maxwell‟s law of Distribution of velocities- Principle of equi-partition of energy- Gibbs paradox- Partition function and its correlation with thermodynamics quantities- Partition functions and its properties- Comparison of ensembles- Equipartition theorem- Applications

UNIT IV: Quantum Statistics:

Indistinguishability and quantum statistics- Statistical weight and apriori probability- Identical particle‟s and symmetry requirements- Bose Einstein‟s Statistics- Fermi Dirac Statistics – **Comparison of M-B, B-E, and F-D statistics*-** Thermodynamic interpretation of parameter‟s α and β- Blackbody radiation and Planck radiation- Specific heat of solids: Dulong and Pettit‟s law- Einstein‟s Theory- Debye theory.

UNIT V: Application of Quantum Statistics:

Energy and pressure of ideal Bose Einstein gas- Bose Einstein condensation- Liquid helium Energy and pressure of ideal Fermi Dirac gas – Fermi energy – Effect of temperature on the Fermi energy - Free electron model and electronic emission- Onsager relations- Fluctuation; Energy, Pressure, Enthalpy- Bragg William Approximation One dimensional Ising model

*** Self study**

Books for Study:

1. Statistical Mechanics, Gupta & Kumar, 20th edition, Pragati Prakashan Meerut, 2003.
2. Elements of Statistical Mechanics, Miss kamal Singh and S.P.Singh.

Books for Reference:

1. Fundamentals Of Statistical Mechanics, Keiser Huang, Revised edition
2. Fundamentals of Statistical Mechanics and Thermal Physics, F Reif, McGraw Hill, Revised edition.

PPH18

SEMESTER- II **15PPH206**

CORE PAPER - 6

THIN FILM PHYSICS, 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**

PPH19

Books for study:

1. Thin film fundamentals	A Goswami, New age international (P) Lt., New Delhi, (2006).
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

PPH20
SEMESTER- II **15PPH207**

CORE PAPER 7 – NUCLEAR AND PARTICLE PHYSICS

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)

PPH22

SEMESTER II **15PPH2N2**

NON MAJOR ELECTIVE - II : 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
4. Students to understand the importance of energy auditing and carbon credits.

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.

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

An Economic concept of Energy – Principles of Energy conservation and Energy Audit - types of energy Audits – **Global Climate change - Greenhouse effect*** – Emissions from Combustion of Natural gas.

Emission trading: The definition and concept – carbon credits – carbon currency – carbon credits under Kyoto Protocol.

Trading of Carbon Credits and India's perspectives – Implementing of CDM projects in India – Potential CDM projects in India.

***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, Fifth Edition, Khanna Publishers, New Delhi, (12th reprint 2014).
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)

PPH24

SEMESTER II **15PPH2N2**

NON MAJOR ELECTIVE – II : 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)

PPH26
SEMESTER II **15PPH2CL**

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/m 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
23. Study of thermolumnescence of F-centres
24. Determination of electron Spin - Stern Gerlac Experiments
25. Fizeau's Method – Liner expansion

PPH27
SEMESTER II **15PPH2CM**

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

PPH28

SEMESTER III **15PPH308**

CORE PAPER 8 – QUANTUM MECHANICS - II

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, quantum optics and quantization of fields and scattering

UNIT I 12 hrs

Many electron atoms:

Indistinguishable particles – Pauli principle – Inclusion of Spin – Spin functions for two electrons - Spin functions for three electrons – The Helium atom – Central Field approximation – Thomas-Fermi model of the atom – Hartree Equation

UNIT II 12 hrs

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

UNIT III 12 hrs

Relativistic Quantum mechanics:

Klein Gordan equation – Interpretation of the Klein Gordan equation – Particle in a coulomb field – Dirac's equation for a free particle – Dirac Matrices – Covariant form of Dirac's equation - Probability density – plane wave solution - Negative energy states – spin of the Dirac particle – Magnetic moment of the electron – Spin- Orbit Interaction.

UNIT IV 12 hrs

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***

UNIT V 12 hrs

Quantum theory of scattering

Scattering cross-section – scattering amplitude – Partial waves – Scattering by a central potential: Partial wave analysis – Significant number of partial waves - The Born approximation – scattering by a screened coulomb potential – Validity of Born approximation.

*** Self study**

Books for study:

1. UNIT 1 & 5 : Quantum Mechanics II edition — G Aruldhas, PHI learning Pvt Ltd, (2009)
2. UNIT 2 : Introductory Quantum Chemistry — A.K.Chandra TataMcGrawHill (2010) 4 Ed
3. UNIT 3 & 4 : Quantum Mechanics — Gupta. Kumar.Sharma, 29 Ed 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)
5. Quantum Mechanics	Leonard I Schiff III Edition, Tata Mc Graw Hill, (2002) New Delhi.

PPH30

SEMESTER III **15PPH309**

CORE PAPER 9 – ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS

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

Objective:

To know about (i) Theoretical study on electrostatics and magneto statics
(ii) Applications of Maxwell's equations
(iii) Antenna Arrays

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., 5th edition (2010),
2. Electromagnetics	Gupta Kumar& Singh, Pragathi Prakashan, Meerut. (2005).

Book for Reference:

1. Electromagnetic theory and Electrodynamics	Sathya Prakash, 10th edition, Kedar Nath, Ram Nath & Co, Meerut (2008).

PPH32

SEMESTER III **15PPH310**

CORE PAPER 10 : 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.

***Self study**

Books for study:

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

Books for reference:

1. Solid State Physics, III edition	S.O.Pillai, 4th Ed, New Age International Pub (2006)
2. Solid State Physics	R.K.Puri, V.K.Babbar, S.Chand & Co., (2001)

PPH34

SEMESTER – III **15PPH3E1**

MAJOR ELECTIVE I: NANOSCIENCE

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

Objectives

i) To understand the nanomaterial and nanotechnology
ii) To know the different synthesis processes for making nanomaterials
iii) To know the characterization techniques available for nanomaterials
iv) To explore the nanodevices and various applications

UNIT I **12 hr**

Physical concepts in Nanomaterials

Classification of nanomaterials – Quantum confinement in semiconductor nanostructures: quantum well, quantum wires and quantum dots : Electronic density of states, Surface to volume ratio versus shape, Magic Numbers, The quantum Hall effect - Resonant tunneling - 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

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**

Characterization of Nanomaterials

Scanning Electron Microscope – Transmission Electron Microscope – Atomic Force Microscope – Scanning Tunneling Microscope – Near Field and Confocal Scanning Light Microscope – X-ray Diffraction - UV-Vis Spectrophotometer – FTIR – Laser Raman Spectrometer – X-ray Photoelectron Spectroscopy – Energy dispersive mass analyser

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

PPH35

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

*** 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)	Charles P. Poole, Jr. Frank J. Owens, John Wiley & Sons, Inc. (2007)
4. Nanostructures and Nanomaterials:Synthesis, Properties and Applications (Unit 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)

PPH36

SEMESTER – III **15PPH3E1**

MAJOR ELECTIVE I: ATMOSPHERIC SCIENCE

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.

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.

PPH38

SEMESTER – IV **15PPH411**

CORE PAPER 11 : COMMUNICATION PHYSICS

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

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 VSB 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 - Dipole arrays – Broad side and End fire array

Wide band and special purpose antennas

Folded dipoles, helical antenna, discose antenna and phased arrays – Ground wave propagation - Sky wave propagation **- 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**

Books for study:

1. Electronics Communication systems George Kennedy Davis, Tata McGraw Hill 4th Edition, New Delhi (2008).
2. Microwave Engineering Sanjeev Gupta, Khanna Publishers, Delhi (2001).
3. Principles of Communication engineering Anokh Singh & A.K.Chhabra, S.Chand and

Co.,(1999)

Books for Reference:

1. Electronics and Radio Engineering — F.E. Terman - McGraw Hill, (1957) 4th Edition
2. Communication systems — Simon Haykin, John Wiley and Son Inc. (2010). 5th Edition

PPH40

SEMESTER – IV **15PPH412**

CORE PAPER 12 : ATOMIC AND MOLECULAR SPECTROSCOPY

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, 4th 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).

PPH42

SEMESTER – IV **15PPH4N2**

MAJOR ELECTIVE - II : PROBLEMS IN PHYSICS

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

Objectives

1) To impart knowledge and skills to solve problem through the concept behind physics
2) To Apply multitude of creative thinking techniques towards the realistic problem
3) To define a plane for implementing lessons from the course once back on the job.

UNIT I **12 hrs**

Classical & Quantum Physics

Newton's laws - Phase space dynamics, stability analysis - Central force motions - Two body Collisions , Scattering in laboratory and Centre of mass frames - Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudo forces - Variational principle, Lagrangian and Hamiltonian formalism and equations of motion - Poisson brackets and canonical transformations - Symmetry, invariance and conservation laws and cyclic coordinates - Periodic motion: small oscillations, normal modes - Special theory of relativity, Lorentz transformations, relativistic kinematics and mass–energy equivalence.

Wave-particle duality - Wave-function in coordinate and momentum representations - Commutators and Heisenberg's uncertainty principle.Schrödinger equation (time-dependent and time-independent)- Hydrogen atom ,spin-orbit coupling, fine structure - Time-independent perturbation theory and applications - Variational method WKB approximation - Time dependent perturbation theory and Fermi's golden rule - Selection rules –Semi-classical theory of radiation – Elementary theory of scattering, phase shift, partial waves, Born approximation - Identical particles – Pauli's exclusion principle.

UNIT II **12 hrs**

Atomic & Molecular Physics

Quantum states of an electron in an atom- Electron spin-Stern and Gerlach experiment - Spectrum of helium and alkali atom-Relativistic corrections for energy levels of hydrogen atom- Hyperfine structure and isotopic shift- Width of spectrum lines- L-S & J-J couplings- Zeeman, Paschen-Bach and Stark effects – X-ray spectroscopy - Electron spin resonance, NMR, chemical shift – Rotational, Vibration, Electronic and Raman spectra of diatomic molecules- Frank Condon principle and selection rules

UNIT III **12 hrs**

Condensed Matter Physics

Bravais Lattice, Bonding of solids, elastic properties, phonon, Lattice specific heat. Drude model of electrical and thermal conductivity. Hall effect and thermo electric power-Electron motion in a periodic potential, Band Theory of matter-translational and orientational order, Defects and dislocation. Kinds of liquid crystalline order. Quasi crystal

UNIT IV **12 hrs**

Electromagnetic Theory & Nuclear Physics

Electrostatics: Gauss's law and its applications-Laplace and Poisson equations, boundary value problems- Magnetostatics: Ampere's circuital law – Force on current carrying conductor and charges. Magnetic vector potential – Propagation of electromagnetic waves in free space, dielectric, conductivity and ionized gases – Brewster's angle – critical angle – Dispersion in

gases, liquids and solids – Radiation from an accelerated charged particle – Radiation from an Oscillating dipole – Poynting vector and radiated power

Basic Nuclear properties- size, shape and charge distribution – Binding energy – Semi empirical mass formula, liqid drop model. Deutron Problem. Rotational spectra, Elementary ideas of Alpha, Beta and Gamma decays and their selection rules. Classification of fundamental forces, Elementary particles and their quantum numbers – Quartz model – Baryon and Measons

UNIT V **12 hrs**

Electronics

Semiconductor device physics including diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices, device structure, device characteristics, frequency dependence and applications-

Opto-electronic devices including solar cells, photo-detectors, LEDs –High frequency devices including generators and detectors - Operational amplifiers and their applications- Digital techniques and applications (registers, counters, comparators and similar circuits)- A/D and D/A converters

* **Self study**

Books for study:

CSIR-UGC NET/JRF/SET Physical Science Dr.SurekhaTomar, Upkar Prakahan, Agra

Unit I - Page 139-209 & 314-424
Unit II - Page 760-853
Unit III - Page 854-945
Unit IV - Page 210-313 & 946-1033
Unit V – Page 535-700

(NOTE: Problems only from Book for Study)

Books for Reference:

Numerical Problems in Physics: Jain K.C. Arora, S.Chand & Company (2012)
Problems in Elementary Physics: Bukhovtsev.B.Krivchenkov, CBS Publishers and distributors Pvt Ltd, New Delhi (2012)

PPH44

SEMESTER – IV 15PPH4N2

MAJOR ELECTIVE II: 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.

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 2nd Edition (2014).
2. Biomedical instrumentation — Dr.M.Arumugam, Anuradha Agencies publishers, Kumbhakonam, (2010).

Book for reference:

1. Biomedical instrumentation and measurements — Leslie Crombwell, Fred.J.Weibell & Trich.A.Pfeiffer, Prentice Hall of India, (2011).
2. Electronic Instrumentation — H.S.Kalsi II edition Tata Mc GrawHill Co.(2013)

PPH46

SEMESTER- IV **15PPH4CN**

CORE PRACTICAL –III : ADVANCED EXPERIMENTS

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

List of Experiments
(Any Fifteen)

1. Development of Copper/Brass/Iron Arc spectra – Constant Deviation Spectrograph
2. Magnetic field Strength determination – Search Coil method
3. Determination of Magnetic Susceptibility of the given solutions – Quincke's method
4. Determination of Magnetic Susceptibility of the given solutions – Guoy's method
5. Compressibility of a liquid – Ultrasonic diffraction
6. Hall Effect- Measurement of Hall parameters.
7. e/m – Zeeman effect
8. e/m – Magnetron method.
9. e/m – Helical method
10. B-H curve - Anchor ring
11. B-H curve - Solenoid
12. I-H curve - Solenoid
13. Kelvin's double Bridge – Determination of very low resistance and specific resistance of different metals.
14. Determination of Planck's constant - Photo Cell.
15. To determine the resistivity of a Semiconductor material - Four Probe method.
16. 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
24. Optical bench – Biprism

PPH47
SEMESTER- IV **15PPH4CO**

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
8. Op amp -Analog Computations - First order differential Equations
9. Op-amp-Instrumentation amplifier-Temperature measurement
10. Op-amp- Instrumentation amplifier-Light intensity-Inverse square law
11. 555 Timer -Schmitt trigger & Voltage controlled oscillators
12. 555 Timer - Monostable & Astable multivibrators
13. Study of Flip Flops
14. Study of Shift Registers
15. Study of Johnson and Ring Counters
16. Study of Synchronous Counters
17. Study of Asynchronous Counters
18. Study of Semiconductor Memory - ROM
19. Microprocessor - LED interfacing (Rolling display)
20. Microprocessor - Stepper motor interfacing
21. Microprocessor - Traffic control simulation
22. Microprocessor - ADC interface
23. Microprocessor – DAC - Wave form generator
24. Microprocessor - Hex key board interfacing
25. Microprocessor - Musical tone generator
26. Microprocessor - Temperature controller

PPH48
SEMESTER – 1V

PROJECT WORK AND VIVA-VOCE (15PPH4Z1)

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.