ST. JOSEPH'S COLLEGE OF ARTS & SCIENCE

(AUTONOMOUS)

CUDDALORE-1

PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc (Physics)

SYLLABUS 2016-2017

P.G. and Research Department of Physics
B.Sc Physics
Curriculum Template
M.Sc., PHYSICS

Sem	Code	Title	Hours/Week	Credits
I	PPH701	Statistical Mechanics	5	4
	PPH702	Classical & wave mechanics	5	4
	PPH703	Mathematical Physics	5	4
	EPPH704	Electronic Devices & Applications	5	4
	PPHG01	General Practical-I	4	4
	PPHE02	Electronics Practical - I	4	4
		Seminar / Paper Presentation	2	1
	Total		**30**	**25**

Sem	Code	Title	Hours/Week	Credits
II	PPH805	Electromagnetic theory	5	4
	PPH806	Nuclear and Particle Physics	5	4
	PPH807	Quantum mechanics -I	5	4
	EPPH808	Molecular Physics	5	4
	PPHG03	General Practical – II	4	4
	PPHE04	Electronics Practical – II	4	4
		Seminar / Paper Presentation	2	1
	Total		**30**	**25**

Second Year

Sem	Code	Title	Hours/Week	Credits
III	PPH909	Quantum mechanics -II	5	4
	PPH910	Condensed Matter Physics	5	4
	EPH911	Elective I	5	4
	EPH912	Elective II	5	4
	PPHG05	General Practical – III	4	4
	PPHE06	Microprocessor Practical - III	4	4
		Human Rights	2	1
	Total		30	25

Elective I:

A. Microprocessor and Microcontroller
B. LASER Physics

Elective II:

A. Physics of Nano materials
B. Medical Physics

Sem	Code	Title	Hours/Week	Credits
IV	**PPH1013**	Research Methodology, Computation Methods & Programming	5	4
	EPPH1014	Elective III	5	4
	EPPH1015	Elective IV	5	4
	PPHPR01	Project	15	8
	PPHGP01	Guide Paper	-	4
	JPPH1018	Skill Based Subject (Scientific Analysis)	5	1
	Total		30	25

Elective III:
A. Communication Physics
B. Materials Science

Elective IV:
A. Electronic Instrumentation
B. Astronomy and Astrophysics

I – M.Sc (Physics)	STATISTICAL MECHANICS For the students admitted in the year 2012	PPH701
SEMESTER - I		HRS/WK - 5
CORE - 1		CREDIT - 4

Objectives

- To study the nature of statistical mechanics
- To understand the concepts of various ensembles
- To study statistics of systems of independent particles
- To understand the concepts quantum statistics.

UNIT-I: FOUNDATIONS OF STATISTICAL MECHANICS (15 Hours)

Phase space- States of a system- Micro canonical ensemble- Density of states-Liouville's theorem- Statistical equilibrium- Relation between statistical and thermo dynamical quantities- Boltzmann entropy relation- Classical ideal gas-Entropy of mixing- Gibb's paradox.

UNIT-II: PARTITION FUNCTION (15 Hours)

Canonical and grand canonical ensembles - Partition function - Relation between partition function and thermo dynamical quantities - Entropy – Helmholtz free energy – Total energy – Enthalpy - Gibb's potential – pressure - specific heat C_V .

UNIT-III: STATISTICS OF SYSTEMS OF INDEPENDENT PARTICLES (15 Hours)

Quantum picture – Maxwell Boltzmann, Bose Einstein and Fermi Dirac statistics - Limit of applicability of the three distribution laws - MB ideal gas - Equipartition law of energy - Classical real gas - Maxwell's law of distribution of velocities – most probable speed, mean speed, root mean square speed.

UNIT-IV: QUANTUM STATISTICS (15 Hours)

Ideal BE gas - Gas degeneracy - BE condensation - transition in He^4 – Theory of super fluidity (London, Tisza and Landau) – Photon gas - Plank's law of radiation - Phonon gas - Einstein and Debye's models for specific heat of solids. Ideal FD gas - Gas degeneracy - Electron gas - Thermionic emission – Pauli's theory of paramagnetism - White dwarfs.

UNIT-V: FLUCTUATIONS AND TRANSPORT PROPERTIES (15 Hours)

Fluctuations in Energy, pressure, volume & enthalpy - density fluctutation-Correlation of space-time dependent fluctuation- Fluctuation dissipation theorem - Transport properties – Boltzmann transport equation-Random walk-Brownian motion.

TEXT BOOKS:-

1. Agarwal B.K. and Melvin Eisner, *Statistical Mechanics,* New Age International Publishers.
2. Kerson Huang, *Statistical Mechanics*, Wiley Eastern Ltd.
3. Gupta and Kumar, *Elements of Statistical Mechanics*, Meerut, Pragathi Prakasham

REFERENCE BOOKS:-

1. Landau and Lifshitz, Statistical Physics
2. Ralph Baierlein, Thermal Physics, Cambridge University Press
3. Gupta M. C, Statistical Thermodynamics, New Age International Publishers
4. Gopal ESR, *Statistical Mechanics & Properties of Matter,* The Macmillan Co. of India Ltd.
5. Laud B.B, *Fundamentals of statistical Mechanics,* New Age International Publishers

I – M.Sc (Physics)	CLASSICAL & WAVE MECHANICS	PPH702
SEMESTER - I	For the students admitted in the year	HRS/WK - 5
CORE - 2	2014.	CREDIT - 4

Objectives

- ❖ To acquire knowledge of Lagrangian formulations.
- ❖ To understand the concepts of Hamiltonian formulations.
- ❖ To study dynamics of rigid bodies.
- ❖ To understand the concepts of relativistic & wave mechanics.

UNIT-I: PRINCIPLES AND LAGRANGIAN FORMULATION (15 Hours)

Mechanics of a particle and system of particles – conservation laws – constraints - generalised co-ordinates – D'Alembert's principle and Lagrange's equations and Hamilton's principle - Lagrangian equation of motion from Hamilton's principle – conservation theorems and symmetry properties-Invariance & Noether's theorem (without proof)-Applications.

UNIT-II: HAMILTONIAN FORMULATIONS (15 Hours)

Hamilton's canonical equation – proof of principle of least action – general equations of canonical transformations -Cyclic Co-ordinates- Hamilton - Jacobi differential equation – Legrange brackets and Poisson brackets – Action angle variables – the Kepler problem in action angle variable.

UNIT-III: RIGID BODY DYNAMICS (15 Hours)

Angular momentum – rotational kinetic energy and moment inertia of a rigid body – Euler's angle – moments and products of inertia – Eulers' equation – Motion of a symmetrical top under the action of gravity. Theory of small oscillations – frequencies of free vibration and normal - coordinates – Linear tri atomic molecules.

UNIT-IV: RELATIVISTIC MECHANICS (15 Hours)

Lorentz transformations – Lorentz transformations in real four dimensional spaces – covariant four dimensional formulations – force and energy equations in relativistic mechanics – Lagrangian and Hamiltonian formulation of relativistic mechanics.

UNIT-V: WAVE MECHANICS (15 Hours)

Inadequacy of Classical Mechanics - Evolution of quantum mechanics - Schrödinger equation for a free particle in one dimension - Equation of continuity – Ehrenfest's theorem - Uncertainity relation - General formalism of wave mechanics.

TEXT BOOKS:-

1. Rana.N.C & Joag, P.S, *Classical Mechanics*, Tata McGraw Hill
2. Herbert Goldstein, *Classical Mechanics*, Narosa Publications
3. Ghatak and Loganathan A.K, *Quantum Mechanics,* Macmillan
4. Mondal, *Classical Mechanic,* Prentice Hall of India.
5. Aruldhas, *Quantum Mechanics*, Prentice Hall of India.

REFERENCE BOOKS:-

1. Bhatia V.B, *Classical Mechanics*, Tamil Nadu Book House
2. Mathews P.M and Venkatesan, *Quantum Mechanics,* Tata Mc Graw Hill

I – M.Sc (Physics)	MATHEMATICAL PHYSICS For the students admitted in the year 2014	PPH703S
SEMESTER - I		HRS/WK - 5
CORE - 3		CREDIT - 4

Objectives

- To give the basic knowledge of vector spaces
- To acquire knowledge of matrices and tensors.
- To understand the concepts Fourier and Laplace Transforms.
- To study complex variables
- To understand the concepts of special functions.

UNIT-I: VECTOR SPACES (15 Hours)

Euclidean, space-Linear combination of vectors- Linearly dependent and independent sets- Basis and dimension- Inner product space- Orthogonal basis- Linear transformation.

UNIT-II: MATRICES AND TENSORS (15 Hours)

Matrices - Elementary matrices and a method for finding inverse orthogonal and unitary matrices - Independent elements of a matrix - Eigen values and eigen vectors – Diagonalisation - Complete orthonormal sets of functions. Tensors - Fundamentals of tensors - Operations with tensors – Addition – Subtraction - outer product – Contraction - inner product - quotient law.

UNIT-III: FOURIER AND LAPLACE TRANSFORMS (15 Hours)

Fourier series- Fourier series arbitrary period – Half-wave expansions - partial sums - Fourier integral and transforms - Fourier Transform of delta function - Laplace transform - first and second shifting theorems - Inverse Laplace transforms by partial functions - Laplace transforms of derivative and integral of a function.

UNIT-IV: COMPLEX VARIABLES (15 Hours)

Complex variable theory - Single and multi valued functions - The Cauchy-Reiman differential equations - Cauchy's integral theorem and integral formula - Residue and Cauchy's residue theorem - Lioville's theorem – Applications of the evaluation of definite integrals.

UNIT-V: SPECIAL FUNCTIONS (15 Hours)

Gamma and beta functions - Legendre, Bessel, Hermite and Laguerre equations - Generating functions - Series solutions and recurrence relations for Legendre, Bessel, Hermite and Laguerre equations - Physical applications.

TEXT BOOKS:-

1. Sathyapraksh. R, *Mathematical Physics*.
2. Arfken G, *Mathematical Methods for Physics*
3. Joshi A.W, *Matrices and Tensors for Physicists*.
4. Rainville E.D, *Special Functions*.
5. Bell W.W, *Special Functions*.
6. Spiegel, *Fourier Laplace Transforms*, Schaum's Outline Series.
7. Complex Variables - Spiegel, Schaum's Outline Series

REFERENCE BOOKS:-

1. Kreyszig E, *Advanced Engineering Mathematics.*
2. Reily K.F Hobson M.P. and Bence S.J, *Mathematical Methods for Physicists and Engineers.*
3. Howard Anton, *Elementary Linear Algebra,* John Wiley Sons
4. Engineering Mathematics-series, Dr. M. K. Venkataraman- The National publishing company-Madras.

I – M.Sc (Physics)	ELECTRONIC DEVICES & APPLICATIONS For the students admitted in the year 2014.	EPPH704S
SEMESTER - I		HRS/WK - 5
ELECTIVE - I		CREDIT - 4

Objectives

- To acquire knowledge of PN junction diode and special diodes
- To understand the concepts of various semiconductor transistors & devices
- To study microwave devices
- To understand the concepts Op-amps and its applications.

UNIT-I: PHYSICS OF DEMICONDUCTOR DEVICES (15 Hours)

P-N Junction diode: Basic Device technology (principles) – Depletion region and depletion capacitance - V-I characteristics - Junction Breakdown - Transient behaviour and Noise - Solar Cell.
Metal semiconductor contacts: Schottky Barriers – Ohmic Contacts **-** MIS diode **- special diodes:** Varactor diode – Tunnel diode – LED.

UNIT-II: TRANSISTOR & THYRISTORS (15 Hours)

Some fact about Bipolar transistors – Transistor as an amplifier – JFET - Pinch off voltage – VI characteristics - low frequency response and high frequency response FET amplifiers – applications of JFET – working principle of MOSFET & MESFET- UJT operation – characteristics - application - SCR – VI characteristics - applications – TRIAC – operation - characteristics – applications.

UNIT-III: NEGATIVE CONDUCTANCE MICROWAVE DEVICES (15 Hours)

Transit time devices: IMPATT diode – QWITT diode – TRAPATT diode - Gunn diode - The transferred electron mechanism – Formation and drift of space charge domains - modes of operation in resonance circuit - Fabrication and applications.

UNIT-IV: OP AMP- LINEAR AND NON LINEAR CIRCUITS (15 Hours)

Differential amplifiers – its transfer characteristics - Voltage amplifier- Current amplifier- Voltage follower- Frequency response of OP AMP. **Nonlinear application:** Log and antilog amplifiers - Half wave and full wave rectifiers - Clippers - Voltage comparator.

UNIT-V: Op-amp APPLICATIONS (15 Hours)

Sample and hold circuit - Schmitt trigger - Peak detector - active filters - low pass, high pass, band pass – band reject and all pass filters – **Oscillators:** Wien Bridge, phase-shift, square wave oscillators- phase locked loop amplifier.

TEXT BOOKS:-

1. SZE SM, 1985, *Semiconductor Devices – Physics and Technology*, Wiley.
2. Streetman B.G., *Solid State Electronic Devices,*(4th Edition), Prentice Hall of India
3. Milman and Halkins, 1993, *Integrated Electronics*, Tata McGraw hill.
4. Gayakwad R.A., *OP AMPS and Linear Integrated Circuits,* (3rd Edn), Prentice Hall of India.
5. Liano S.L., *Microwave Devices and Circuits*, Prentice Hall of India.

REFERENCE BOOKS:-

1. Tyagi M.S., *Introduction to Semiconductor devices*, John Wiley & Sons.
2. Joseph Lindemeyer and Charles Y. Wrigley, 1965, *Fundamentals of semiconductor Devices,* D.Van Nostrand Company.
3. Gutpa Y.C., *Microwave Electronics,* John Wiley.

I – M.Sc (Physics)	GENERAL PRACTICAL – I For the students admitted in the year 2011	PPHG101
SEMESTER - I		HRS/WK - 4
CORE		CREDIT - 4

(Any ten out of the given 12 experiments)

1. Determination of Stephan's constant
2. Young's Modulus by elliptical fringes.
3. Young's Modulus by hyperbolic fringes
4. Determination of band gap in semiconductor.
5. Hydrogen spectrum – Rydberg's constant
6. Viscosity of liquid – Meyer's disc
7. Solar spectrum – Hartmanns interpolation formula
8. Absorption spectrum of Iodine
9. Specific charge of an electron.
10. Biprism – Wave length and thickness
11. Fiber Optics Experiment
12. Ultrasonic diffraction

I – M.Sc (Physics)	ELECTRONICS PRACTICAL – I For the students admitted in the year 2011	PPHE101
SEMESTER - I		HRS/WK - 4
CORE		CREDIT - 4

(Any ten out of the given 12 experiments**)**

1. FET Characteristics and amplifier design
2. UJT characteristics and applications
3. SCR characteristics and applications
4. Op-amp – Inverting, non-inverting amplifier – Voltage follower- summing, difference, average amplifier – differentiator and integrator.
5. Op-amp solving simultaneous equations
6. Diac and Triac Characteristics and Applications.
7. Up-down counters – Design of modulus counters
8. IC 555 – Astable multivibrator and voltage controlled oscillator
9. IC 555 – Monostable multivibrator, frequency divider
10. Op-amp I to V and V to I converters
11. Clock Oscillator using digital ICs
12. Power amplifier – Transistor.

I – M.Sc (Physics)	ELECTORMAGNETIC THEORY For the students admitted in the year 2008	PPH805
SEMESTER - II		HRS/WK - 5
CORE – PAPER - 5		CREDIT - 4

Objectives

- To study electromagnetic waves
- To understand the concepts of reflection and transmission of EM waves.
- To acquire knowledge of wave guides and waves
- To study about antenna and wave propagation
- To understand the concepts relativistic electrodynamics.

UNIT-I ELECTROMAGNETIC WAVES (15 Hours)

Maxwell's equations and their physical significance-Equation of continuity – Displacement current – Poynting theorem and Poynting vector- electromagnetic waves in free space, conducting and non-conducting medium.

UNIT-II REFLECTION AND TRANSMISSION OF E.M. WAVES (15 Hours)

Boundary conditions at the surface of discontinuity – reflection and refraction of electromagnetic waves at the interface of non conducting media – Fresnel's equations – electric field vector E parallel and perpendicular to the plane of incidence – reflection and transmission coefficient at the interface between two non conducting media-

UNIT-III WAVE GUIDES AND GUIDED WAVES (15 Hours)

Transverse electric waves – Transverse magnetic waves- Characteristics of TE and TM waves- Transverse electromagnetic waves- attenuation in parallel plane guides- attenuation of TE waves, TM waves and TEM waves- Rectangular wave guides- TE waves and TM waves- Q factor of waveguides.

UNIT-IV ANTENNA AND WAVE PROPAGATION (15 Hours)

Radiation field due to Hertzian dipole antenna- Radiation resistance of short dipole antenna- quarter wave monopole and half wave dipole- effective length of a half wave dipole- Radiation pattern of a dipole antenna. Space wave propagation - characteristics of Radio waves, VHF, UHF and microwaves.

UNIT-V RELATIVISTIC ELECTRODYNAMICS (15 Hours)

Lorentz transformation- consequences- transformation of differential operators- invariance of D'Alembert's operator- four vector-Lorentz transformation of space and time in four vector form.- Transformation of electromagnetic potentials A & - Maxwell's equation in covariant tensor form

TEXT BOOKS:-

1. Narayana Rao, *Basic electromagnetics with applications,* Prentice Hall
2. Kraus, *Introduction to electrodynamics*, Prentice Hall of India.
3. Chakraborty B, *Principles of Electrodynamics*, Books and allied Kolkata.
4. Landah & Lifschitz, *Electrodynamics of continuous media.*

REFERENCE BOOKS:-

1. Sengupta P, *Classical Electrodynamics*, New Age International publishers
2. David. I. Griffiths, *Introduction to electrodynamics*, Prentice Hall of India

I – M.Sc (Physics)	NUCLEAR AND PARTICLE PHYSICS For the students admitted in the year 2014	PPH806T
SEMESTER - II		HRS/WK - 5
CORE – PAPER -6		CREDIT - 4

Objectives

- To understand the concepts of nuclear models.
- To study central force and tensor force
- To understand the concepts of nuclear reaction.
- To study the theory of beta decay.
- To acquire knowledge of particle physics.

UNIT-I NUCLEAR MODELS (15 Hours)

Liquid drop model- Bohr Wheeler theory fission- Experimental evidence for shell effects- Shell model-Spin orbit coupling- Magic numbers- Angular Momenta and parities of nuclear ground states- Qualitative discussion and estimates of transition rates- magnetic moments and Schmidt lines- Collective model of Bohr and Mottelson- oblate and prolate deformation of Nucleus.

UNIT-II NUCLEAR FORCE (15 Hours)

Central force and tensor forces- Ground state of deuteron- Magnetic and quadrupole moments- Charge independence and spin dependence of nuclear forces-n-p scattering and p-p scattering at low energies-effective range theory-High energy nucleon- nucleon scattering-Exchange forces- Meson theory of nuclear forces.

UNIT-III NUCLEAR REACTIONS (15 Hours)

Types of reactions and conservation laws- energetics of nuclear reactions-reaction dynamics- Q – value equation- scattering and reaction cross section-compound nucleus- scattering matrix- fission and controlled fission reactions, fission reactors – fission explosives - fusion, solar fusion – thermonuclear reactions and weapons.

UNIT-IV NUCLEAR DECAY (15 Hours)

Beta decay- Fermi theory of beta decay- Shape of the beta spectrum- Total decay rate- Angular momentum and parity selection rules- Comparative half-lives-allowed and forbidden transitions- Selection rules- Parity violations- Two component theory of neutrino decay- Detection and properties of neutrino-Gamma decay.

UNIT-V PARTICLE PHYSICS (15 Hours)

Baryons and Mesons- their properties, decay models- Strong, weak and electromagnetic interactions- Hadrons and Leptons, Tau-Theta puzzle-Strangeness- Gellman- Nishijima-relations-SU(3) classifications of Hadrons-Octets and decouplets-elementary ideas of Quarks – New particles.

TEXT BOOKS:-

1. Srivastava B.N, *Basic Nuclear Physics,* Pragathi Prakasan.
2. Tayal D.C, *Nuclear Physics,* Himalaya Publications.
3. Pandya M.L, *Elementary Nuclear Physics,* Kedar Nath Ram Nath.
4. Enge H.A, *Introduction to Nuclear Physics,* Addison-Wesley.
5. Concepts of Nuclear Physics – B.L. Cohen (Wiley-Eastern)
6. Griffiths D, *Introduction to Elementay Particles,* Harper and Row.

REFERENCE BOOKS:-

1. Elton, *Introductory Nuclear Theory,* Pitman.
2. Waghmare Y.R, *Introductory Nuclear Physics,* Oxford-IBH.
3. Kaplan I, *Nuclear Physics,* Narosa.
4. Kenneth S. Krane, I*ntroductory Nuclear Physics, Wiley-Eastern*

I – M.Sc (Physics)	QUANTUM MECHANICS – I For the students admitted in the year 2014.	PPH807S
SEMESTER - II		HRS/WK - 5
CORE – PAPER - 7		CREDIT - 4

Objectives

- ❖ To study the postulates of quantum mechanics.
- ❖ To understand the concepts one dimensional problems.
- ❖ To understand the concepts of angular momentum operators & eigen values.
- ❖ To understand the approximation methods.
- ❖ To acquire knowledge of relativistic quantum mechanics.

UNIT-I: BASIC FORMALISM (15 Hours)

Postulates of quantum mechanics - Equation of continuity – Ehrenfest's theorem- Operator formalism - Linear operators, self adjoint operators - expectation value - stationary state - Hermitian operators for dynamical variables - eigen values and functions- orthonormality - commutation relations.

UNIT-II: APPLICATIONS (15 Hours)

One dimensional problems – Wells; Infinite square well and finite square well and barriers; Rectangular barrier - Harmonic Oscillator by Schrödinger equation and operator method (I&III D) - Rigid rotator - Hydrogen Atom.

UNIT-III: ANGULAR MOMENTUM (15 Hours)

Angular momentum operator - commutation rules - Eigen value spectrum - Ladder Operators - Momentum Eigen values and Eigen function - L2 Operators Eigen values and Eigen function - Spin matrices and wave function- combination of two angular momentum - Clebesh Gordon coefficients.

UNIT-IV: APPROXIMATION METHODS (15 Hours)

Perturbation theory - Non degenerate and degenerate cases- removal of degeneracy - application to ground state of anharmonic oscillator - Variation method - Hydrogen Molecule - Zeeman and Stark effects - WKB approximation.

UNIT-V: RELATIVISTIC QUANTUM MECHANICS (15 Hours)

The Klein-Gordon equation- probability density and current density- The Dirac's equation and Dirac's matrices- Plane wave solutions of the Dirac's equation- Spin as an inherent property of an electron- Covariant form of Dirac's equation- Gamma matrices and their properties- Positive and negative energy states and Dirac's explanation.

Text books:-

1. Ghatak and Loganathan A.K, *Quantum Mechanics,* Macmillan.
2. Mathews P.M and Venkatesan, *Quantum Mechanics,* Tata Mc Graw Hill.
3. Satya Prakash and Singh C.K, *Quantum Mechanics*.
4. Gupta S.L, Kumar V, Sharma R.C and Sharma H.V, *Quantum Mechanics,* Jai Nath & Co.
5. Chatwal and Anand, *Quantum Mechanics,* Himalaya & Co.

REFERENCE:-

1. Feynmann Lectures, *Quantum Mechanics,* Vol.- III.
2. Powel and Craseman, *Quantum Mechanics,* Addison-Wesley.
3. Gupta S.L. and Gupta I.D, *Advanced Quantum Mechanics and Field,* S. Chand & Co.
4. V. K. Thangappan, *Quantum Mechanics, New Age International Pvt. Ltd.*
5. *V. Devanadhan, Quantum Mechanics, Alpha Science.*

I – M.Sc (Physics)	MOLECULAR PHYSICS For the students admitted in the year 2011	EPPH808S
SEMESTER - II		HRS/WK - 5
ELECTIVE - 2		CREDIT - 4

Objectives

- To understand the concepts microwave and IR spectroscopy.
- To study Raman spectroscopy.
- To understand the concepts molecular quantum.
- To study the electronic spectra of molecules.
- To acquire knowledge of nuclear spectroscopy.

UNIT-I: MICROWAVE (MW) AND INFRARED (IR) SPECTROSCOPY (15Hours)

Classification of rotating molecules – rotational spectra of linear and symmetric top molecules - Stark modulation MW spectrometer - IR spectrometer – diatomic molecules as harmonic and anharmonic oscillators- rotation –vibration spectra diatomic molecules – P,O and R branches- analysis of symmetric top molecules – Basic principles of FTIR.

UNIT-II: RAMAN SPECTROSCOPY (15 Hours)

Raman Effect - Molecular polarisability – Quantum theory – Pure rotational Raman spectra of diatomic and poly atomic molecules – Vibration - rotation Raman spectra of diatomic and polyatomic molecules - Application of Raman spectroscopy for the structure determination of H_2O molecule. Laser Raman spectroscopy – Basics.

UNIT-III: UV-VISIBLE SPECTROSCOPY (15 Hours)

Molecular quantum number – coupling of angular momenta - classification of states- electronic spectra of diatomic molecules - Frank condon principle - Vibrational structure of electronic bands - Rotational fine structure - Fortrat parabola and band head formation- Intensity distribution in an electronic band - dissociation energy.

UNIT-IV: NMR SPECTROSCOPY (15 Hours)

Concepts of NMR spectroscopy- Chemical shift- spin-spin coupling between two and more nuclei - application to structural determination of molecules- spin - spin and spin lattice relaxation processes - FTNMR – measurement of relaxation times by pulse sequence technique.

UNIT-V: ESR, NQR and MOSSBAUER SPECTROSCOPY (15 Hours)

Concept of ESR spectroscopy - effect of L-S coupling - Lande splitting factor 'g" – Hyperfine and fine structure.General principles of NQR spectroscopy and its applications. Mossbauer spectroscopy - recoilless emission and absorption - Mossbauer spectrometer- Isomer shift – Nuclear quadrupole splitting - Zeeman splitting.

TEXT BOOKS:-

1. Banwell CN and McCash E.M, 1994, *Fundamentals of Molecular Spectroscopy*, 4th Edition, Tata McGraw-Hill Publications, New Delhi.
2. Aruldas G, 2001, *Molecular structure and spectroscopy*, Prentice,-Hall of India Pvt.Ltd., New Delhi.
3. Satyanarayana D.N, 2004, *Vibrational spectroscopy and applications*, New age international Publications, New delhi.
4. Atta U Rahman, 1986, *Nuclear Magnetic Resonance*, Spingerr Verlag, Newyork.
5. Towne and Schawlow, 1995, *Microwave Spectroscopy*, McGraw- Hill,
6. D.A.Lang, *Raman Spcetroscopy*, McGraw- Hill international, N.Y.
7. Jenkens and white, Basics of Spectroscopy.

REFERENCE:-

1. Raymond Chang, 1980, *Basic Principles of spectroscopy*, McGraw- Hill, Kogakusha,Tokyo.
2. Straughan B.P. and Walker, *Spectroscopy-Vol* 1, Chapman and Hall, Londan, 1996.
3. Straughan B.P. and Walker, *Spectroscopy-Vo*l 2, Chapman and Hall, Londan, 1996.
4. Straughan B.P. and Walker, *Spectroscopy-Vol 3*, Chapman and Hall, Londan, 1996.
5. Hore P.J, *Nuclear Magnetic Resonance* – Oxford Science Publications 1995.

I – M.Sc (Physics)	GENERAL PRACTICAL -II	PPHG202
SEMESTER - II	For the students admitted in the	HRS/WK - 4
CORE – PRACTICAL-II	year 2008	CREDIT - 3

(Any ten out of the given 12 experiments**)**

1. Brass alloy arc spectra.
2. Laser – study of laser beam parameter.
3. Laser – Thickness of the enamel coating on a wire by diffraction
4. Electrical resistance of a metal / alloy by four probe's method.
5. F.P etalon using spectrometer.
6. Permittivity of a liquid using – RFO
7. Spectrum photo – Cu, Fe – Arc spectra
8. Determination of Plank's constant.
9. Cauchy's Dispersion constant
10. Dielectric constant – Wavemeter
11. Microwaves – Gunn diode
12. Ultrasonic interferometer.

I – M.Sc (Physics)	ELECTRONICS PRACTICAL – II For the students admitted in the year 2008	PPHE202
SEMESTER - II		HRS/WK - 4
CORE – PRACTICAL -II		CREDIT - 3

(Any ten out of the given 12 experiments)

1. A / D converter using comparator LM 336
2. D/A convertor using comparator LM 336
3. JFET and MOSFET applications
4. Shift registers
5. Schmitt trigger
6. Phase shift oscillator
7. Wein bridge oscillator
8. Multiplexer and Demultiplexer
9. Half adder, full adder, Half subtractor and full subtractor using IC 7400
10. Power amplifier – Using IC.
11. Study of Transducers.
12. Study of Modulation and Demodulation.

II – M.Sc (Physics)	QUANTUM MECHANICS – II	PPH909
SEMESTER - III	For the students admitted in the	HRS/WK - 5
CORE – PAPER- 9	year 2014.	CREDIT - 4

Objectives

- To study transition under constant perturbation and transition probability.
- To understand the concepts of scattering theory.
- To study the identical particles.
- To understand the semi classical treatment of radiation.
- To acquire knowledge of quantization of fields.

UNIT-I EVOLUTION WITH TIME (15 Hours)

Transition under constant perturbation - Transition probability - Fermi Golden Rule- Harmonic perturbation - Adiabatic and sudden approximations - Schrödinger picture - Heisenberg's picture - Interaction picture.

UNIT-II SCATTETING THEORY (15 Hours)

Collision in three dimension and scattering- laboratory and CM reference frames- Scattering Amplitude- Differential scattering cross section- Total scattering cross section- Scattering by spherically symmetrical potentials- partial waves and phase shifts- Born's approximation and its validity- square well, Yukawa potential and Rutherford's formula.

UNIT-III IDENTICAL PARTICLES (15 Hours)

Symmetric and antisymmetric wave functions – collision of identical particles – spin angular momentum – spin functions for a many – electron system – Slaters determinant – Hartree Fock Method.

UNIT-IV SEMICLASSICAL TREATMENT OF RADIATION (15 Hours)

Spontaneous and induced emission of radiation from semi - classical theory - Einstein's coefficients for induced and spontaneous emission and the relation between them - Electric di-pole and forbidden transition- selection rules.

UNIT-V QUANTISATION OF FIELDS (15 Hours)

Relativistic Lagrangian and Hamiltonian of a charged particle in an electromagnetic field – Lagrangian and Hamiltonian formulations of fields- Second quantization of Klein Gordon field – creation and annihilation operators – commutation rules – Quantization of electromagnetic and Schrodinger's field.

TEXT AND REFERENCE BOOKS:-

1. Ghatak A.K and Loganathan, *Quantum Mechanics*, Macmillan
2. Mathews P.M and Venkatesan, *Quantum Mechanics,* Tata Mc Graw Hill
3. Satya Prakash and Singh C.K, *Quantum Mechanics*.
4. Gupta S.L, Kumar V, Sharma R.C, and H.V Sharma, *Quantum Mechanics*, Jai Nath & Co
5. Chatwal and Anand, *Quantum Mechanics*, Himalaya & Co
6. Messiah A.P, *Quantum Mechanics*.

REFERENCE BOOKS:-

1. Feynmann Lectures, *Quantum Mechanics,* Vol.- III
2. Powel and Craseman, *Quantum Mechanics,*(Addison-Wesley
3. Schiff L.I, *Quantum Mechanics,* Mc Graw Hill
4. Gupta S.L, Gupta I.D, *Advanced Quantum Mechanics and Field,* S. Chand & Co.
5. *V. Devanadhan, Quantum Mechanics, Alpha Science.*

II – M.Sc (Physics)	CONDENSED MATTER PHYSICS For the students admitted in the year 2008	PPH910
SEMESTER - III		HRS/WK - 5
CORE – PAPER- 10		CREDIT - 4

Objectives

- To acquire knowledge crystals and to study crystal structure by x-ray diffraction pattern
- To explore the various defects in crystals.
- To understand the band theory of solids.
- To have knowledge of superconductors.
- To study the ferro electric and magnetic systems

UNIT-I CRYSTAL PHYSICS (15 Hours)

Unit cell - two and three dimensional Bravais lattices - Miller indices – reciprocal lattices - interaction of X-rays with matter - absorption of X-rays- elastic scattering from a perfect lattice - X-ray intensity and atomic configuration of unit cell - Diffraction of X-rays by crystals - application of reciprocal lattice in diffraction techniques - The Laue's powder and rotating crystal methods - crystal structure factor and diffraction of neutrons by crystals- temperature dependence of reflection lines – Debye - Waller factor.

UNIT-II CRYSTAL DEFECTS (15 Hours)

Crystal imperfections - point defects and phonon defects - ionic conductivity and lattice defects - Colour centres- F-centres - dislocations-dislocation densities - elementary ideas of crystal growth - grain boundaries - dislocations in plastic deformation and crystal growth - X-rays and electron microscope techniques in crystal imperfection studies.

UNIT-III ELECTRONS IN SOLIDS (15 Hours)

Electrons in a periodic lattice - Bloch theorem - band theory - Effective mass- Classification of solids – metals - semiconductors and insulators – Phonons - Fermi surface- Brillouin Zones - construction of Fermi surfaces - Experimental methods in Fermi surface studies- Cyclotron resonance – magnetoresistance - De Haas Van Alphen effect.

UNIT-IV SUPERCONDUCTIVITY (15 Hours)

Phenomena of superconductivity - Meissner effect - Type I and II superconductors- Thermodynamics of superconducting transitions - London's equation - Cooper pairing - BCS theory of superconductivity- Ginzbung - London theory- Josephson theory - D.C and A.C. Josephson effect - Quantum interference - vortices and Type II superconductors – Introduction to High temperature superconductors.

UNIT-V MULTIFERROIC SYSTEMS (15 Hours)

Polarization – dielectric constants – interval field – electric polarizability – ferroelectric crystals – displacive transitions – antiferroelectricy – ferroelectric domain – piezo electricity – interaction between magnetic ions – Curie Weiss law – exchange interaction – internal field – spin waves – ferromagnetic domains – anti ferromagnetism – behavior of antiferromagnets above and below Neel temperature.

TEXT BOOKS:-

1. Kittel. C, 1995, *Introduction to Solid State Physics, 7th Edition,* John Wiley & Sons
2. Pillai S.O, 1997, *Solid State Physics,* New Delhi, New Age International
3. Dekker, *Solid State Physics*
4. Kachava. C.M, 1990, *Solid State Physics,* New Delhi, Tata McGrawHill
5. Verma and Srivastava, *Crystallography for Solid State Physics*
6. Chaikin and Lubensky, *Principles of Condensed Matter Physics*
7. Cullity, *Elements of X-ray Diffraction*

REFERENCE:-

1. Omar, *Elementary Solid State Physics*
2. Azaroff, *Introduction to Solids*
3. Aschroft and Mermin, *Solid State Physics*
4. Blakemore.J.S, 1974, *Solid State Physics*, 2nd Edition, Philadelphia, W.B Saunders & Co.

II – M.Sc (Physics)	MICROPROCESSOR AND MICROCONTROLLER For the students admitted in the year 2008	EPPH911
SEMESTER - III		HRS/WK - 5
ELECTIVE – 3		CREDIT - 4

Objectives:

- ❖ An in depth understanding of the architecture and working of microprocessors and micro controllers.
- ❖ To explore to the popular microprocessor Intel 8086 and the micro controller Intel 8051.

UNIT-1: INTEL 8086 ARCHITECTURE AND INSTRUCTION SET (15 Hours)

CPU architecture – addressing modes – instruction formats – instruction set – executing timing.

UNIT-11 INTRODUCTION TO MACRO ASSEMBLER (MASM) (15 Hours)

Assembler directives – assembler operators – assembly process – translation of assembler instructions – simple basic programs with reference to specific topics.

UNIT-111: MODULAR PROGRAMMING AND MULTIPROGRAMMING (15 Hours)

Linking and relocation – access to external identifiers – procedures – interrupts and their routines – macros – process management and IRMX86 – semaphore operations – common procedure sharing.

UNIT-1V: I/O CONSIDERATION, INTERRUPTS AND SYSTEM BUS STRUCTURE (15 Hours)

Programmed I/O – Interrupt I/O – block transfer and DMA – basic 8086 bus configuration – minimum and maximum modes – system bus timings – interrupt priority management – single and multiple 8259.

UNIT-V INTEL 8051 MICRO CONTROLLER (15 Hours)

Introduction to micro controllers – internal architecture of 8051 – addressing modes – instruction set – Applications-Summer,ADC/DAC.Waveform generator-Squure,triangular,- Hexkey board, Interface, Display interface.

TEXT BOOKS:-

1. Yu-cheng Liu, Glen A. Gibson, 2006, *Microcomputer System 8086/8088 Family*, Prentice – Hall of India.
2. Douqlas V. Hall, 2005, *Microprocessor interfacing, Programming and Hardware*, Tata McGraw-Hill
3. Vijayendran V, 2005, *Fundamentals of Microprocessor – 8086*, 3rd Edition Visvanathan Pvt. Ltd.
4. Muhammad Ali Mazidi, 2006, *The 5051 Microcontroller and Embedded Systems*, First Impression, Pearson Prentice Hall.

REFERENCE BOOKS:-

1. Barry B Brey, 1995, *The Intel Microprocessor 8086/8088, 80186, 80286, 80386 and 80486*, 3rd Edition, New Delhi, Prentice Hall of India.
2. Uffrenbeck J, *The 8086/8088 Family – Design*, Programming and Interfacing, Software, Hardware and Applications, New Delhi, Prentice Hall of India.
3. Tribel W.A and Avtar Singh, *The 8086/8088 Microprocessors Programming*, Interfacing, Software, Hardware and Applications, New Delhi, Prentice Hall of India.

II – M.Sc (Physics)	LASER PHYSICS	EPH911
SEMESTER - III	For the students admitted in the year 2012	HRS/WK - 5
ELECTIVE – 3A		CREDIT - 4

Objectives

- To understand the basic operations of lasers.
- To study laser characteristics.
- To explore the various laser systems.
- To study the spectroscopic applications of lasers
- To understand the quantum interpretation.

UNIT-I PRINCEPLES OF LASER ACTION (15 Hours)

Einstein's theory - Interaction of radiation with matter - Theory of some simple processes.

UNIT-II LASER CHARACTERISTICS (15 Hours)

Gaussian beam and its properties - Stable two Minor optical resonators, Longitudinal and Transverse Modes of Laser cavity- Mode selection-gain in a Regenerative Laser cavity-Threshold for 3 and 4 level laser systems- Mode locking pulse shortening-Pico second & femto second operation- Spectral narrowing and stabilization.

UNIT-III LASER SYSTEMS (15 Hours)

Laser systems involving low density gain media- Nitrogen Laser, Carbondioxide Laser and Excimer Laser. Laser systems involving high density gain media- Ruby Laser, Nd-YAG laser, Semiconductor laser, Diode Pumped solid state laser, Dye laser, High power semiconductor diode laser systems.

UNIT-IV LASER SPECTROSCOPIC TECHNIQUES AND OTHER APPLICATIONS (15 Hours)

Laser fluorescence and Raman scattering and their use in Pollution studies, Nonlinear interaction of light with matter, laser induced multi photon processes and their applications, Ultra high resolution spectroscopy with laser and its applications, Porpagationof light in a medium with variable refractive index, optical Fibres. Light wave communication. Qualitative treatment of medical and Engineering applications of Lasers.

UNIT-V QUANTUM TREATMENT (15 Hours)

Einstein coefficients-Momentum transfer- life time- Possibility of amplification. Quantization of the field- Zero point energy, Coherence and monochromaticity, Kinetics of Optical absorption- Quantum mechanical treatment of line broadening mechanism- Doppler broadening.

TEXT BOOKS:-

1. Orazio Svelto, *Principles of Lasers*
2. William t. Silfvast, *Laser Fundamentals*
3. B.B. Laud, *Lasers and Non-linear Optics*

REFERENCE BOOKS:-

1. Yariv, Optical Electronics
2. Demtroder, Laser and Spectroscopy
3. Latekhor, Non-linear Laser Spectroscopy

II – M.Sc (Physics)	PHYSICS OF NANOMATERIALS For the students admitted in the year 2014.	EPPH912
SEMESTER - III		HRS/WK - 5
ELECTIVE - 4		CREDIT - 4

Objectives

- To explore the basics of nano physics.
- To study the synthesis of nano crystals.
- To understand the various characterization techniques.
- To have knowledge of nanotutbes
- To understand the applications of nano materials.

Unit – I INTRODUCTION TO NANOPARTICLES (15 Hours)

Introduction – Historical perspective of nano particle – Classification of nanomaterials – Zero Dimension, 1D, 2D & 3D nano particle – Nano material preparation – Plasma arching – Chemical Vapour Deposition – Solgel electro deposition – Ballmilling technique.

Unit – II NANO CRYSTALS (15 Hours)

Synthesis of metal nanoparticles and structures – Background on quantum semiconductors - Background on reverse Miceller solution - Synthesis of semiconductors - Cadmium telluride nano crystals - Cadmium sulfide nano crystals - Silver sulfide nano crystals - Nano Manipulator - Nano tweezes – quantum dots.

Unit - III SIZE DEPENDENT PROPERTIES (15 Hours)

Magnetism in particle of reduced size dimension – Variation of magnetism with size-Magnetic behaviour of small particle-Diluted magnetic semiconductors (DMS) - their applications - Nanomaterials in catalysis-Nanostructure adsorpents - Nanoparticle as chemical reagents - Specific heat of nanoparticles crystals - Melting point of nanoparticle material – Nanolithograpy -Estimation of nanoparticle size using XRD, TEM, AFM & MFM.

Unit - IV NANOTUBES (15 Hours)

New form of carbon-Types of nanotubes-Formation of nanotubes-Various techniques-Preparation and properties of nanotubes-Uses of nanotubes and applications-Nanomaterial processingfor nanotube-Light and nanotechnology-Nanoholes and photons-Quantum electronic devices-Quantum information and quantum computers.

Unit – V APPLICATIONS (15Hours)

Micromechanical system – Robots - Ageless material – Nanomechanics – Nanoelectronics - Optoeletronic devices – Micro Electro Mechanical System (MEMS) and Nano Electro Mechanical System (NEMS), Applications - Colourants and Pigments - Nano bio technology - DNA chips - DNA array devices - Drug delivery systems.

TEXT BOOKS:-

1. Kenneth J.Klabunde, 2001; *Nanoscale Materials in chemistry*,A john Wiley &Sons, Inc., Publication.
2. De Jongh.J, 1994; *Physics and chemistry of metal cluster compounds*. Kulwer Academic publisher, Dordrecht.
3. Henrich. V, Cox P.A, 1994; *Metal oxides, Cambridge university press*, New york.
4. Ed. George C.Hadji panyis and Gary A. Prinz, 1991; NATO ASI Series, *Science and technology of Nanostructured Magnetic Materials*, Plenum press, New York.
5. T. Pradeep, 2007; Nano: The Essentials: Understanding Nanoscience and Nanotechnology, *Tata McGraw-Hill Education.*

REFERENCE BOOKS:-

1. Jiles.D, 1991; *Inrodution to Magnetism and Magnetic and Magnetic Materials*, Chapman and Hall, London
2. Christof M. Niemeyer & Chad A. Mirkin 2004; *Nano Bio*
3. Charles Poole, *Introduction to nanotechnology.*
4. *Introduction to Nanotechnology, Charles B. Poole, Jr and Frank J. Owens, Wiley International, 2003.*
5. *Guozhong Cao and Ying Wang, Nano Structures and Nano Materials, Second Edition, World Scientific Publishers, 2004.*

II – M.Sc (Physics)	MEDICAL PHYSICS	EPPH1015
SEMESTER - III		HRS/WK - 5
ELECTIVE – 4A		CREDIT - 4

Objectives:

- ❖ To explain the physical principles underlying the five areas of the application of physics to medicine covered in the module.
- ❖ To discuss the advantages and drawbacks of each of these therapeutic or investigative techniques and have some understanding of the current research into ways in which they might be improved.

UNIT I X-RAY IMAGING (15 Hours)

Production of X-ray images, attenuation coefficients, choice of suitble energy, contrast, hardware; digital imaging X-ray computed tomography, five generations of scanners, reconstruction methods, CT number, contrast stretching-Optical Chromatography.

UNIT II NUCLEAR MEDICINE (15 Hours)

In vitro and in vivo testing, gamma rays for imaging, radiopharmaceuticals, the gamma camera, SPECT, PET, examples of clinical use.

UNIT III ULTRASOUND IN MEDICINE (15 Hours)

Ultrasound imaging, generation and detection of ultrasound, ultrasound propagation, choice of frequency, A-scan, B-scan, M-mode imaging and echo cardiography. Use of Doppler techniques for blood flow etc. Use of ultrasound in therapy

UNIT IV RADIOTHERAPY (15 Hours)

Effect of radiation on normal and malignant tissue, cell survival Types of radiotherapy unit: low voltage, orthovoltage, megavoltage, electron beam, brachytherapy Dosimetry: calculation and measurement of dose, % depth dose, isodose lines, scattering effects Treatment planning, fractionation, conformal radiotherapy- Photodynamic Therapy.

UNIT V NEUROELECTRICS AND NEUROMAGNETICS (15 Hours)

Basic electrophysiology, genesis of electric and magnetic signals Techniques for measurement and imaging of EEG, ECG, MEG and MCG.

TEXT BOOKS:-

1. Webb. S (Ed), The Physics of Medical Imaging, Hilger
2. Dendy. P.P and B Heaton, Physics of Diagnostic Radiology, IOPP
3. Brown. B.H et. al., Medical Physics and Biomedical Engineering IOPP
4. Duck. F, Ultrasound in Medicine, IOPP
5. Krestel. E, Imaging Systems for Medical Diagnostics, Siemens

REFERENCE BOOKS:-

1. Maisey, Britton and Gilday (Eds), Clinical Nuclear Medicine, Chapman and Hall
2. Hendee. W.R, Radiation Therapy Physics, Mosby
3. HedrickW.R, DL Hykes, and DE Starchmann, Ultrasound Physics and Instrumentation, Mosby
4. Steele. G, *Basic Clinical Radiobiology*, Arnold
5. Carlton. R and A. Adler, Principles of Radiographic Imaging, Delmar
6. Cameron.J.R and J.G. Skofonick, *Medical Physics*, Wiley
7. Delchar. T.A, *Physics in Medical Diagnosis*, Chapman and Hall

II – M.Sc (Physics)	**GENERAL PRACTICAL -I**	**PPHG303**
SEMESTER - III	**For the students admitted in the**	**HRS/WK - 4**
CORE – PPRACTICAL-III	**year 2008**	**CREDIT - 3**

(Any ten out of the given 13 experiments**)**

1. Curie temperature – Ferroelectric and Ferromagnetic materials
2. Hall Effect
3. Molecular Spectra CN Band
4. Polarisibility of Liquids using hollow prism
5. Susceptibility of a liquid by Quincke's method
6. Dipole moment of liquids – RF Oscillator
7. Radio wave propagation
8. Michelson's Interferometer
9. e – Millikan's oil drop method
10. Microwaves Klystron
11. Dielectric constant Lecher Wires
12. Resistivity of semiconductor
13. Susceptability of liquids

II – M.Sc (Physics)	MIROPROCESSOR PRACTICAL – I For the students admitted in the year 2008	PPHE303
SEMESTER - III		HRS/WK - 4
CORE – PRACTICAL - III		CREDIT - 3

(Any ten out of the given 12 experiments**)**

1. 8085 – Addition, subtraction, multiplication and division
2. 8085 – Factorial, root, cube root
3. 8085 – Equation solving using subroutines (Eg $a^2 + b^2 + c! + d!$)
4. 8085 - Staircase – D/A converter
6. 8085 – Display the result, factorial root, a! + b!
7. 8085 - Time delay subroutine and a clock programme
8. 8086 – Steper Motor
9. 8085 – Number conversion – 8 bit and 16 bit: BCD to Binary, Binary to BCD, HEX to ASCII
10. 8086 - Addition, subtraction, multiplication and division
11. ADC and interfacing 0809 with MPU
12. Curve fitting – Least Square fitting with algorithm, flowchart – C Programme
13. Solutional of a Polynomial equation and determination of roots by Newton Raphson Method with algorithm, flowchart – C Programme

<table>
<tr><td>II – M.Sc (Physics)</td><td rowspan="3">RESEARCH METHODOLOGY,
COMPUTATION METHODS & PROGRAMMING
For the students admitted in the year 2014.</td><td>PPH1013</td></tr>
<tr><td>SEMESTER - IV</td><td>HRS/WK - 5</td></tr>
<tr><td>CORE – PAPER- 13</td><td>CREDIT - 4</td></tr>
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Objectives

- To explore basics of research techniques.
- To study numerical and differentiation and integration techniques.
- To solve simultaneous equations.
- To have knowledge of errors and approximations
- To learn the programming in C.

UNIT-I: PRINCIPLES OF SCIENTIFIC RESEARCH (15 Hours)

Identification of the problem- Literature survey – Reference collection – Familiarity with ideas and concept of investigation –Internet Browsing –Drawing inference from data –Qualitative and Quantitative analysis – Result –Seminar _Synopsis writing –Art of writing a research paper and Thesis -Power point presentation –OHP Presentation.

UNIT-II: DIFFERENTIATION AND INTEGRATION (15 Hours)

Numerical differentiation and integration - Newton Cotes formulae – Gauss method - Newton Raphson method – Simpson's 3/8 rule – Euler and Runge Kutta method – Random variate – Montecarlo evaluation of integrals – Random walk and Metropolis method.

UNIT-III: SOLVING SIMULTANEOUS EQUATIONS (15 Hours)

Solutions of simultaneous linear equations - Gaussian elimination – pivoting - iterative method and matrix inversion. Eigen values and eigen vector of matrices - Power and Jacobi method.

UNIT-IV: ERRORS AND APPROXIMATIONS (15 Hours)

Finite differences - interpolation with equally and unevenly spaced points - Curve fitting, Polynomial least squares and cubic spline fitting – error estimates – gauss method

UNIT-V: PROGRAMMING IN C (15 Hours)

Introduction –Basic structure of C programming –Character set –constants – Kerywords –Identifiers –Variables –Assigning values to variables –Defining symbolic constants - Operators – Arithmetic, Relational. Logical, Assignment, increment, decrement conditional and special type conversion in Expressions – Arrays –one, two and multi dimensional arrays –Initializing two dimensional arrays –Declaring and Initializing string variables –Reading and Writing String on the screen –Arithmetic operation on strings – basic programme only.

TEXT BOOKS:-

1. Sastry, Introductory Methods of Numerical Analysis
2. Rajaraman, Numerical Analysis
3. Balagurusamy, Programming in C.

REFERENCE BOOKS:-

1. Vetterming, Teukolsky, Press and Flannery, Numerical recipes
2. V. Rajaraman, Computer Oriented Numerical Methods
3. M. K. Venkataraman ,Engineering Mathematics.
4. Singaravelu, Numerical Methods

II – M.Sc (Physics)	COMMUNICATION PHYSICS For the students admitted in the year 2008	EPPH1014
SEMESTER - IV		HRS/WK - 5
ELECTIVE - 5		CREDIT - 4

Objectives

- To learn FM, SSB & ISB transmission methods.
- To know the digital modulation and satellite communication.
- To understand the transmission and reception of TV.
- To have knowledge modern communication systems
- To study the basics of fiber optic communication.

UNIT-I FM TRANSMISSION (15 Hours)

Frequency modulation – FM radio frequency band – Direct frequency modulation – modulation index – FM wave equation – Bandwidth – deviation ratio – voltage distribution – power – reactance modulation – FM radio receiver (Block diagram) - SSB Transmission – Advantages and disadvantages –Balanced Modulators – Separation of sidebands – Filter method – the phase shift method – ISB – ISB receiver.

UNIT-II DIGITAL MODULATION, MULTIPLEXING AND SATELLITE COMMUNICATION (15 Hours)

Digital Modulation – codes – Data forms – Transmission modes between stations – Modems – Pulse amplitude modulation – Time division multiplexing – pulse width modulation – pulse position modulation – frequency division multiplexing – satellite communication – Geostationary satellites – Communication satellites – satellite subsystems – Earth stations – domestic satellites.

UNIT-III TELEVISION (15 Hours)

Television transmission – television pictures and cameras – Interlaced scanning and picture resolution – Tonal and colour characteristics of pictures – composite B & W and colour video signals – colour TV transmitter – Television reception – colour receiver plan – Electronic tuner – IF subsystem – receiver sound system – Y signal channel – chroma decoder – Raster circuits – EHT generation – receiver picture tubes – remote control of receiver functions.

UNIT-IV TELEPHONE SYSTEM AND MODERN COMMUNICATION SYSTEM (15 Hours)

Telephony – Telephone Instruments – Telephone transmitter and receiver – Electronic telephone – Dialler – Ringer – Transmission bridges – Telephone relays – Local Battery exchanges and central battery exchange – Automatic telephony – crowbar exchange – cross bar switch and exchange – electronic telephone exchanges – SLIC – advantages and disadvantages of digital transmission – FACSIMILE and cellular radio systems.

UNIT-V FIBER OPTIC COMMUNICATION (15Hours)

Fiber materials – glass fibers – plastic clad glass fiber – plastic fibers – fiber optic communications – propagation theory – numerical aperture – classification of optical fibers – scalar wave equation and solution to step index fiber – loss mechanism in optical fibers – signal distortion due to dispersion – amount of dispersion in a step index fiber.

TEXT BOOKS:-

1. Robert. J Schoenbeck, 1999, *Electronic communications*, Prentice Hall of India (P) Ltd, New Delhi.
2. Gulati R.R, 2000, *Composite Satellite and Cable Television*, New Age international.
3. Anokh Singh, 1999, *Principle of Communication Engineering*, Chand & Co, New Delhi.
4. Louis E. Frenzel, 1994, *Communication Electronic*, Mc Graw Hill.

REFERENCE BOOKS:-

1. Cerin, *Introduction to Optical Fibers,* McGraw Hill
2. B.B. Laud, *Laser and Nonlinear Optics,* Wiley Eastern Limited

II – M.Sc (Physics)	MATERIALS SCIENCE	EPH912
SEMESTER - IV	For the students admitted in the	HRS/WK - 5
ELECTIVE – 5A	year 2014.	CREDIT - 4

Objectives

- To understand the classification of materials.
- To study various phase diagrams.
- To know the phase transformation and nucleation.
- To learn the electron theory of metals
- To study the electric and magnetic properties of materials.

Unit I CLASSIFICATION OF MATERIALS (15 Hours)

Engineering materials- Material structure- Types of Bonds and their energies – Bond formation mechanism- Ionic bond-covalent bond examples-ceramics-thermal and electrical properties – uses-Metallic bond- comparison of bond (dispersion bonds, dipole bonds and hydrogen bonds)-Crystal imperfection – Types of imperfections- Thermal vibrations – point, line and surface imperfections- Frank –Read source.

Unit II PHASE DIAGRAMS (15 Hours)

Basic terms- solid solutions- Hume – Rothery's rules- intermediate phase- Gibb's Phase rules- Time – temperatures cooling curves- construction of phase diagrams- the Lever rule- eutectic systems- eutecoid - Systems- peritectic and peritectoid system-Ternary equilibrium diagrams.

Unit-III PHASE TRANSFORMATION (15 Hours)

Rate of transformation- nucleation (homogeneous and heterogeneous)- nucleation and growth –applications of phase transformations – micro constituent of iron – carbon system –the allotropy of iron – Iron-Carbon equilibrium diagram- formation of Austenite- TTT diagram- transformation Austenite upon continuous cooling.

Unit IV ELECTRON THEORY OF METALS (15 Hours)

Fundamental theories of electrons (Drude and Lorentz theory and Sommerfield free electron theory) –electron energies in a metal- Zone theory of solids- energy gaps – density of states – Zones in conductors, insulators and semiconductors - factors affecting electrical resistance of materials.

Unit V ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS (15 Hours)
Resistivity- conductivity- semiconductors –classsification of semiconductors on the basis of Fermi energy and Fermi levels- insulators –dielectrics –ferro electricity –electro strict ion- Piezo electricity –uses of dielectrics –capacitors dielectric strength- magnetic properties of materials –magneto strict ion- magnetic domain –soft and hard magnetic materials.

TEXT BOOKS:-

1. Saxena B.S, Gupta. R.C and Saxena .P.N, Fundamentals of Solid State Physics
2. Singhal.R.L,2000-2001, Solid State Physics, Kedar Nath Ram Nath & Co, Meerut.
3. Kittel C,1992, Introduction to Solid State Physics, New India Publishing House.

REFERENCE BOOKS:-

1. Raghavan.V, 1990, *Materials Science and Engineering a first course, III Ed,* Prentice Hall of India.
2. Srtuctural M, 1990, *Materials Science,* Anuradha Agencies & Publishers
3. Manchandra. V.K, 1992, *A Text Book of Materials Science,* New India Publishing House.
4. William D. Calister, Fundamentals of Material Science & Engineering, Jr. John William & sons Inc, 2001.

II – M.Sc (Physics)	ELECTRONIC INSTRUMENTATION	EPPH1014
SEMESTER - IV	For the students admitted in the	HRS/WK - 5
ELECTIVE- 6	year 2008	CREDIT - 4

Objectives

- ❖ To understand the various transducers.
- ❖ To study digital instrumentation methods.
- ❖ To know the analytical instrumentation techniques.
- ❖ To study the bio medical instrumentation.
- ❖ To learn computer peripherals

UNIT-I: TRANSDUCERS (15 Hours)

Classification of transducers –Principle, construction and working of Thermistor, LVDT, Electrical strain gauges and capacitive transducers - Measurement of non – electrical quantities –strain, Displacement, temperature, pressure and force.

UNIT-II: DIGITAL INSTRUMENTATION (15 Hours)

Principle, block diagram and working of Digital frequency counter. Digital multimeter, digital pH meter, digital conductivity meter and digital storage oscilloscope.

UNIT-III: ANALYTICAL INSTRUMENTATION (15 Hours)

Principle ,block diagram , description ,working and application of UV-VIS Spectrometer, IR spectrometer, Flame emission spectrometer and ICP-AES Spectrometer – Basic concept of gas and liquid chromatography.

UNIT-IV BIO –MEDICAL INSTRUMENTATION (15 Hours)

Physiological transducers to measure blood pressure, body temperature. Source of Bio- electric potentials – resting potential action potential, bio-potential, block diagram and operation of ECG an EEG –Records.

UNTI-V: COMPUTER PERIPHERALS (15 Hours)

Printers – Printer mechanism – Classification - Dot matrix, Ink jet and Laser printer .Basic concept of key board and mouse - Mass data storage - floppy disk – Hard Disk -Operation Dick(CD) - Pen drive (thumb drive).

TEXT BOOKS:-

1. Rajendra Prasad, *Electronic Measurement and instrumentation*, Khanna Publications.
2. Ramambhadran S, *Electronic Measurements & Instrumentation,* Khanna Publications.
3. Dhir S.M, *Electronics and instrumentation*, Khanna Publications.
4. Khandpur, *Hand Book of Biomedical Instrumentation*, TMH. Publications.

REFERENCE BOOKS:-

1. Gromwell L, *Bio medical instrumentation and measurement*, Prentice Hall.
2. John R. Cameran and James G. Skofronick, 1978, *Medical physics*, John Wiley & Sons.
3. Aplen E.L, 1990, *Radiation Physics,* Prentice Hall.

II – M.Sc (Physics)	ASTRONOMY AND ASTROPHYSICS	EPPH1015
SEMESTER - IV		HRS/WK - 5
ELECTIVE – 6A		CREDIT - 4

Objectives

- To understand the principles of relativity.
- To know the different frame works of relativity.
- To study the Einstein's equation and its solutions.
- To have knowledge of cosmological models
- To explore the thermal history of the universe.

UNIT I PRINCIPLES OF RELATIVITY (15 Hours)

Overview of Special Relativity, space time diagrams, Lorentz metric, light cones, electrodynamics in 4 dimensional language. Introduction to general relativity (GR), equivalence principle, gravitation as a manifestation of the curvature of space time.

UNIT II GEOMETRICAL FRAMEWORK OF GENERAL RELATIVITY (15 Hours)

Curved spaces, tensor algebra, metric, affine connection, covariant derivatives, physics in curved space time, curvature - Riemann tensor, Bianchi identities, action principle, Einstein's field equations, energy momentum tensors, energy-momentum tensor for a perfect fluid, connection with Newton's theory.

UNIT III SOLUTIONS TO EINSTEIN'S EQUATIONS AND THEIR PROPERTIES (15 Hours)

Spherical symmetry, derivation of the Schwarzschild solution, test particle orbits for massive and massless particles. The three classical tests of GR, blackholes, event horizon - one way membranes, gravitational waves.

UNIT IV COSMOLOGICAL MODELS (15 Hours)

Cosmological principle, Robertson-Walker metric, cosmological redshift, Hubble's law, observable quantities - luminosity and angular diameter distances, dynamics of Friedmann-Robertson- Walker models : Solutions of Einstein's equations for closed, open and flat universes.

UNIT V PHYSICAL COSMOLOGY AND THE EARLY UNIVERSE (15 Hours)

Thermal history of the universe: Temperature-redshift relation, distribution functions in the early universe - relativistic and non-relativistic limits. Decoupling of neutrinos and the relic neutrino background - nucleosynthesis - decoupling of matter and radiation; Cosmic microwave background radiation - inflation - origin and growth of density perturbations.

TEXT BOOKS:

1. General Relativity and Cosmology, J. V. Narlikar, Delhi: Macmillan Company of India Ltd.
2. Classical Theory of Fields, Vol. 2, L. D. Landau and E. M. Lifshitz, Oxford : Pergamon Press.
3. First Course in General Relativity, B. F. Schutz, Cambridge University Press.
4. Introduction to Cosmology, J. V. Narlikar, Cambridge University Press.
5. Structure Formation in the Universe. T. Padmanabhan, Cambridge University Press.

REFERENCE BOOKS:

1. Telescopes and Techniques, C.R.Kitchin, Springer.
2. Observational Astrophysics, R.C. Smith, Cambridge University Press.
3. Detection of Light: from the Ultraviolet to the Submillimetre, G. H. Rieke, Cambridge University Press.
4. Astronomical Observations, G. Walker, Cambridge University Press.
5. Astronomical Photometry, A.A. Henden & R.H. Kaitchuk, Willmann-Bell.
6. Electronic Imaging in Astronomy, I.S. McLean, Wiley-Praxis.
7. An Introduction to Radio Astronomy, B. F. Burke & Francis Graham-Smith, Cambridge University Press.
8. Radio Astronomy, John D. Kraus, Cygnus-Quasar Books.

II – M.Sc (Physics)	SCIENTIFIC ANALYSIS	JPPH1018
SEMESTER - IV		HRS/WK - 5
Skill Based subject		CREDIT - 1

Any One Unit Out Of Ten (Problems only)
Online mode of Examination.

UNIT-I. Mathematical Methods of Physics (60 Hours)

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem. Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory: SU(2), O(3).

UNIT-II. Classical Mechanics (60 Hours)

Newton's laws. Dynamical systems, 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 pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence. Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

UNIT-III. Electromagnetic Theory (60 Hours)

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

UNIT-IV. Quantum Mechanics (60 Hours)

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection. Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

UNIT-V. Thermodynamic and Statistical Physics (60 Hours)

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

UNIT-VI. Electronics and Experimental Methods (60 Hours)

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics.

Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting, Linear and nonlinear curve fitting, chi-square test. Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors). Measurement and control. Signal conditioning and recovery. Impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding. Fourier transforms, lock-in detector, box-car integrator, modulation techniques. High frequency devices (including generators and detectors).

UNIT-VII. Atomic & Molecular Physics (60 Hours)

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

UNIT-VIII. Condensed Matter Physics (60 Hours)

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

UNIT-IX. Nuclear and Particle Physics (60 Hours)

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

THEORY EXAMINATION

Question Paper Pattern

Continuous internal assessment (CIA) (25 marks)

Two internal Examinations	15 marks
Assignment / Seminar	10 marks
Total	**25 marks**

External Examination (75 marks)

Question Pattern – PG

Time: 3 Hours | **Max. Marks: 75**

Section – A (10 X 2 = 20)
(Answer ALL the questions)
(Two questions from each Unit)

Section – B (5 X 5 = 25)
(Answer all the questions)
(One question from each Unit; either or pattern and any one of the questions will be a problem; both part)

Section C (3 X 10 = 30)
(Answer any Three Questions out of five)
(One Question from each unit and it may have subdivisions may contain problems also)

PRACTICAL EXAMINATION

Continuous internal assessment (CIA) (40 marks)

Based on the periodical evaluation of record and experiments assessed by the staff in charge

External Examination (60 marks)

4 Hrs. Exam

Total Marks: 60

1. Experiment	50 Marks
2. Viva	5 Marks
3. Record	5 Marks