ALAGAPPA UNIVERSITY KARAIKUDI
NEW SYLLABUS UNDER CBCS (w.e.f. 2017-18)

M.Sc., PHYSICS – PROGRAMME STRUCTURE

Sem.	Course Code	Name of the Course	Cr.	Hrs./ Week	Marks		
					Int.	Ext.	Total
I	7MPH1C1	**Core – I** – Mathematical Physics – I	5	5	25	75	100
	7MPH1C2	**Core – II** – Classical Dynamics and Relativity	5	5	25	75	100
	7MPH1C3	**Core – III** – Quantum Mechanics - I	5	5	25	75	100
	7MPH1P1	**Core – IV-** Physics Practical – I**	5	10	**40**	**60**	100
	7MPHE1A/ 7MPHE1B	**Elective – I-A)** Numerical Methods **(or) B)**Crystal Growth Processes and Characterization	4	5	25	75	100
		Total	**24**	**30**	**-**	**-**	**500**
II	7MPH2C1	**Core - V** - Solid State Physics	5	5	25	75	100
	7MPH2C2	**Core – VI** – Mathematical Physics-II	5	5	25	75	100
	7MPH2C3	**Core – VII** – Electromagnetic Theory	5	5	25	75	100
	7MPH2C4	**Core – VIII** – Quantum Mechanics-II	5	5	25	75	100
	7MPH2P1	**Core – IX** –Physics Practical –II**	5	10	**40**	**60**	100
		Total	**25**	**30**	**--**	**--**	**500**
III	7MPH3C1	**Core – X** – Atomic and Molecular Physics	5	5	25	75	100
	7MPH3C2	**Core – XI**– Nuclear and Particle Physics	5	5	25	75	100
	7MPH3C3	**Core – XII** – Advanced Electronics	5	5	25	75	100
	7MPH3P1	**Core – XIII** Physics Practical – III**	5	10	**40**	**60**	100
	7MPHE2A/ 7MPHE2B	**Elective – II A)** Microprocessor and Microcontrollers **(or)** **B)** Modern Optics and Laser Physics	4	5	25	75	100
		Total	**24**	**30**	**--**	**--**	**500**
IV	7MPHE3A/ 7MPHE3B	**Elective – III- A)** Nano Science **(or)B)** Analytical Instrumentation	4	5	25	75	100
	7MPHE4A/ 7MPHE4B	**Elective –IV- A)**Thermodynamics and Statistical Physics **(or)** **B)** Communication Electronics	4	5	25	75	100
	7MPHE5A/ 7MPHE5B	**Elective-V-A)** Energy and Environmental Physics **(or)** **B)** Medical Physics	4	5	25	75	100
	7MPH4PR	**Core-XIV**–Project Report & Viva-Voce	**5**	15	25*	75**	100
		Total	**17**	**30**	**--**	**--**	**400**
		Grand Total	**90**	**120**	**--**	**--**	**1900**

*** Tour Report – 25 Marks**

**** Project Report – 60 Marks**
Viva-Voce – 15 Marks **Total = 75 Marks**

Project Work:

Project report evaluation and viva voce done by External Examiner and Project Supervisor(s).

*Project Report Evaluation : 100 Marks ((i.e.) 60 Marks for Physics project undertaken and 25 Marks for Tour report.
Viva – voce : 15 Marks

As part of Curriculum Students must visit industries / scientific labs / educational Institutions during this (II) year. A tour report to be submitted along with Project (7MPH4PR), It carries 25 marks.

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M.Sc., PHYSICS

I YEAR – I SEMESTER
COURSE CODE: 7MPH1C1

CORE COURSE - I – MATHEMATICAL PHYSICS – I

Unit I: Vector analysis and linear vector space

Line integral – Surface integral and Volume integral- Gauss' theorem – Green's theorem – Stokes' theorem.

Definition of linear vector space- Linear independence of Vectors-basis and dimension-scalar product-orthonormal basis- Schwartz inequality-Gram Schmidt orthogonalization process-solution of linear algebraic equation.

Unit II: Matrix theory and ordinary differential equation

Cayley Hamilton's theorem – Eigen values and Eigen Vectors of a matrix – Matrix diagonalization – solution of linear homogeneous and non-homogeneous equation.

Linear first order and second differential equation with constant and variable coefficients-Frobenius method-Strum-Liouville differential equation.

Unit III: Complex analysis

Functions of complex variables – Differentiability – Cauchy-Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series– poles.

Residues and singularities – Cauchy's residue theorem – Evaluation of definite integrals.

Unit IV: Fourier series and Fourier integrals

Fourier series – Fourier's series for periodic functions – Half range series – Fourier cosine and sine series.

Fourier integral theorem – Fourier cosine and Sine integrals.

Unit V: Fourier transform and Application

Fourier transform –properties-Fourier sine transform – Fourier cosine transform – Application of Fourier transform to boundary value problem.

Books for study:

1. E. Butkov, *Mathematical Physics* (Addison Wesley, London, 1973)
2. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineering and Physicists* (McGrawHill, Singapore, 1967)
3. A.K. Gattak, T.C. Goyal & S.J. Chua, *Mathematical Physics* (Macmillan, New Delhi, 1995).

Books for Reference:

1. P.K. Chattopadhyay, *Mathematical Physics* (Wiley Eastern, New Delhi, 1990)
2. B.D. Gupta, *Mathematical Physics* (Vikas, Publishing House Pvt. Ltd., New Delhi, 2003).
3. Satya Prakash, *Mathematical Physics* (Sultan Chand and Sons, New Delhi, 2004).

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I YEAR – I SEMESTER
COURSE CODE: 7MPH1C2

CORE COURSE - II – CLASSICAL DYNAMICS AND RELATIVITY

Unit I: Fundamental principles and Lagrangian formulations

Mechanics of a particle and a system of particles – Conservation Laws – Constraints – Generalized co-ordinates – D'Alembert's Principle and Lagrange's equations.

Hamilton's principle – Lagrange's equations of motion – Examples– Conservations theorems and symmetry properties- invariance and Noether's theorem.

Unit II: Two body central force problems

Reduction to the equivalent to one body problem – Equations of motion and first integrals – Equivalent one dimensional problem and classification of orbits – The differential equation for the orbit and integral power-law potentials.

Kepler problem– Inverse square law of force – scattering in a central force problem– Virial theorem.

Unit III: Lagrangian formulations: applications

Rigid body dynamics: Euler angles – coriolis force- Moment and products of inertia – moment of inertia tensor -Euler's equations – Symmetrical top

Oscillatory Motion: Theory of small oscillations– periodic motion- Frequencies of vibration and Normal modes – Linear triatomic molecule.

Wave motion: Wave equation – Phase velocity – Dispersion – Wave pocket – Group velocity.

Unit IV: Hamilton's formulations

Hamilton's Equation from variational principle – Principle of Least action – Applications – Canonical transformations – Lagrange and Poisson brackets – Equation of motion and conservation theorems in Poisson brackets.

Hamilton's Jacobi method – Action – angle variables – Kepler problem in action angle variables.

Unit V: Relativity

Postulates of relativity – Lorentz transformation– Addition of velocities – Mass – energy – Mass – energy equivalence.

Lorentz transformation in four dimensional space – Invariance of Maxwell's equations under Lorentz transformation.

Books for study:

1. N.C. Rana, and P.S. Joag, *Classical Mechanics* (Tata McGraw Hill, New Delhi, 1998)
2. H. Goldstein, *Classical Mechanics* (Narosa Publication House, New Delhi, 2004)

Books for Reference:

1. T.L. Chow, *Classical Mechanics* (John – Wiley, New York, (1995)

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I YEAR – I SEMESTER
COURSE CODE: 7MPH1C3

CORE COURSE - III – QUANTUM MECHANICS - I

Unit I: General formalism of quantum mechanics

Linear Vector Space- Linear Operator- Eigen Functions and Eigen Values- Hermitian Operator- Postulates of Quantum Mechanics- Expectation values and Ehrenfest's theorem-General Uncertainty Relation- Dirac's Notation-Schwartz inequality- Equations of Motion; Schrodinger, Heisenberg and Dirac representation- momentum representation.

Unit II: Exactly solvable problems

Linear harmonic oscillator-solving the 1D Schrodinger equation - Abstract operator method-Particles in a box.

Square well potential-Tunnelling through a barrier -particle moving in a spherically symmetric potential-system of two interacting particles-rigid rotator-hydrogen atom.

Unit III: Angular momentum

Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components Ladder operators-Commutation Relation of J_z with J_+ and J_- - Eigen values of J^2, J_z- Matrix representation of J^2, J^z, J_+ and J_- - Addition of angular momenta- Clebsch Gordon Coefficients – Properties.

Unit IV: Approximation Methods

Time Independent Perturbation Theory in Non-Degenerate Case -- Degenerate Case-Stark Effect in Hydrogen atom – Spin-orbit interaction - Variation Method – Born-Oppenheimer approximation -- WKB Approximation.

Unit V: Many Electron Atoms

Indistinguishable particles – Pauli principle- Inclusion of spin – Pauli spin matrices – spin functions for two electrons- The Helium Atom – Central Field Approximation - Thomas-Fermi model of the Atom - Hartree Equation- Hartree -Fock equation.

Books for study:

1. Text Book of Quantum Mechanics -P.M. Mathews & K. Venkatesan-Tata McGraw Hill 2010
2. Quantum Mechanics – G Aruldhas - Prentice Hall of India 2006
3. Introduction to Quantum Mechanics – David J. Griffiths Pearson Prentice Hall, 2005
4. Quantum Mechanics – A Devanathan - Narosa Publishing-New Delhi

Books for Reference:

1. Quantum Mechanics – L.I Schiff - McGraw Hill 1968
2. Quantum Mechanics - A.K. Ghatak and S. Loganathan-McMillan India
3. Principles of Quantum Mechanics - R. Shankar, Springer 2005
4. Quantum Mechanics – Satya Prakash- Kathar Nath Ramnath – Meerut

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I YEAR – I SEMESTER
COURSE CODE: 7MPH1P1

CORE COURSE–IV- PHYSICS PRACTICAL – I

Any 12 Experiments

1. Elliptical fringes- Young's modulus
2. Ultrasonic interferometer – velocity and adiabatic compressibility of liquid
3. Polarimeter- Specific rotatory power of a liquid
4. Abbe's refractometer- Measurement of refractive index
5. Charge of an electron using Spectrometer
6. Thermal conductivity FORBEs method
7. JFET characteristics and CS-FET amplifier
8. SCR characteristics and Power control
9. Construction of Dual regulated power supply using IC 78XX
10. Two stage RC coupled Transistor Amplifier- with and without feedback
11. Half adder and Full adder
12. Half Subtractor and Full Subtractor
13. Microprocessor: 16 bit addition, 2's and 1's Complement subtraction
14. Microprocessor: Number conversion: decimal to Binary, Octal and hexa systems and Vice versa
15. Microprocessor: Ascending and Descending order
16. Microprocessor: Smallest and Largest number in a set of numbers
17. C-Programming :Newton- Rapson method- Roots of Algebric equation
18. C-Programming: Least- Square Curve fitting- Straight line fit
19. C-Programming: Solution of simultaneous linear algebraic equations- Gauss Elimination method
20. C-Programming: Mean standard deviation and Probability distribution of a set of random numbers.

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I YEAR – I SEMESTER
COURSE CODE: 7MPHE1A

ELECTIVE COURSE-I (A)–NUMERICAL METHODS

Unit I: Errors and the measurements

General formula for errors – Errors of observation and measurement – Empirical formula – Graphical method – Method of averages.

Linear and rank correlations- Least square fitting – Curve fitting – straight – line and Parabola. Linear regression, Polynomial regression, Exponential and Geometrical regression

Unit II: Numerical solution of algebraic and transcendental equations

The iteration method: The method of false position – Newton-Raphson method – Convergence criteria and rate of convergence – C Program for finding roots using Newton-Raphson method.

Simultaneous linear algebraic equations: Gauss elimination method – Jordon's modification – Gauss-seidel method of iteration – C Program for solution of linear equations.

Unit III: Interpolation

Linear interpolation – Lagrange interpolation – Gregory-Newton forward and backward interpolation formula – Central difference interpolation formula.

Gauss forward and backward interpolation formula – Divided differences – Properties – C Program for Lagrange interpolation.

Unit IV: Numerical solutions of ordinary differential equations

Euler method – Improved Euler method – Runge-Kutta method – second and third orders – Runge-kutta method for solving first order differential equations

C Program for solving ordinary differential equations using Runge-Kutta methods.

Unit V: Numerical differentiation and integration

Newton's forward and backward difference formula to compute derivatives – Numerical integration – The trapezoidal rule ad Simpson's rule.

Practical applications of Simpson's rule – C program to evaluate integrals using trapezoidal and Simpson's rules.

Books for study:

1. S.S. Sastry, *Introductory Methods of Numerical Analysis – 3rd edition* (Printice Hall, New Delhi, 2003)
2. J.H. Mathew, *Numerical Methods for Mathematics Science and Engineering* (Printice Hall, New Delhi, 1998)

Books for Reference:

1. W.H. Press, B.P. Flannery, S.A. Teukolsky, W.T. Vetterling, *Numerical Recipes* (Cambridge Univ. Press, Cambridge, 1996).
2. N. Balagurusamy, *Numerical methods*, TMH Publication, 2000
3. Gupta. S.C, *An Introduction to Statistical Methods*, Vikas Publications, New Delhi, 2005.

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I YEAR – I SEMESTER
COURSE CODE: 7MPHE1B

ELECTIVE COURSE - I (B) – CRYSTAL GROWTH PROCESSES AND CHARACTERIZATION

Unit I: Solution growth technique

Low temperature solution growth: Solution – Solubility and super solubility – Expression of super saturation – Miers T-C diagram.

Constant temperature bath and crystallizer – Seed preparation and mounting – Slow cooling and solvent evaporation methods.

Unit II: Gel growth techniques

Principle – various types – Structure of gel – Importance of gel – Experimental procedure- Chemical reaction method – single and double diffusion method.

Chemical reduction method – Complex and decomplexion method – Advantages of gel method.

Unit III: Other growth techniques

Melt Technique: Bridgman technique – Basic process – various crucible design – Thermal consideration – Vertical Bridgman technique – Czochralski technique – Experimental arrangement – Growth process.

Vapour technique: Physical vapour deposition – Chemical vapour deposition – Chemical Vapour Transport

Unit – IV: Thin film growth techniques

Physical vapour deposition-chemical vapour deposition – chemical vapour transport – definition – fundamentals – choice of transport reactions – specifications – Transported materials and agents-STP,LTVTP,OTP-Hydrothermal growth:Design aspect of autoclave-electro crystallization

Unit V: Characterization techniques

X-ray Diffraction (XRD) – Powder and single crystal – Fourier transform infrared analysis – Elemental analysis – Atomic absorption spectroscopy.

Scanning Electron Microscopy (SEM) – UV – VIS Spectrometer – Etching and surface morphology – Vickers Micro hardness tester.

Books for study:

1. P. Shanthana Ragavan and P. Ramasamy, *Crystal Growth Processes and Methods* (KRU Publications, Kumbakonam, 2001)
2. J.C. Brice, *Crystal Growth Processes*, John Wiley and Sons, New York, 1986.

Books for Reference:

1. Buckly H.E, 1986, Crystal growth, John Wiley & sons , New York.
2. Gilman J, 1956, The art of science of growing crystals, John wiley & sons ,New York.

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I YEAR–II SEMESTER
COURSE CODE: 7MPH2C1

CORE COURSE-V–SOLID STATE PHYSICS

Unit I: Crystallography

Crystal classes and systems – 2d & 3d lattices – Bravais lattice – Point groups – Space groups – plane groups – Bonding in solids – Binding of common crystals NaCl, CsCl, ZnS, Diamond – Defects and dislocations of crystals – Colour Center – Diffraction Methods – Laue method – Rotating crystal method – powder Crystal Method. Reciprocal lattice for BCC and FCC structure.

Unit II: Elastic properties and lattice vibrations

Elastic Constants of crystals – analysis of stress – Analysis of strain – Analysis of stiffness constants – Elastic waves in cubic crystals – waves in [100], [110], [111]directions.

Lattice vibrations – Vibrations of mono atomic lattices – Lattice with two atoms per primitive cell – Quantization of lattice vibrations– Phonon momentum – Inelastic scatterings of neutrons and phonons – Lattice thermal conductivity – Umklapp processes.

Unit III: Band theory of solids

Energy levels and density of orbital in one dimension – Effect of temperature on the Fermi Dirac distribution – Heat capacity of electron gas – Electrical conductivity and Ohm's law-Matthiessen's rule- Umklapp scattering – Motion in magnetic fields – Hall effect.

Nearly free electron model – Blochfunctions and Theorem – Kronig Penny model – Brilouin Zones – Electron in periodic potential – Crystal Momentum of an electron energy bands in metals and insulators – Semiconductor crystals – Band gap – Tight bound approximation – Effective mass and density of status – De Hass Van Alphen effect.

Unit IV: Dielectrics and ferroelectrics

Macroscopic electric field – Local electric field in an atom – Dielectric constant and polarizability – Clausius – Mossotti equation – Dielectric loss – Ferro electric crystals – Polarization catastrophe – Ferro electric domains – Antiferro electricity .

Quantum Theories of Dia and Para magnetism – Rare earth ions – Hund's rule – Crystal field splitting – Quenching of the orbital angular momentum – Cooling by adiabatic demagnetization – Paramagnetic susceptibility of conduction electrons.

Unit V: Ferromagnetism and super conductivity

Ferromagnetism: Ferromagnetic Order- Curie- Weiss law- Heisenberg model, Exchange energy- Magnons: Quantization of spin waves- Thermal excitation of magnons (Bloch $T^{3/2}$ law)- Neutron magnetic scattering- Ferromagnetic domain

Super Conductivity: Occurrence of Superconductivity – Experimental and theoretical survey of superconductors – Meissner effect – Thermodynamics of super conducting transition – London equation – BCS theory of superconductivity. Type I and II superconductors – Flux quantization – Coherence length – Josephson Tunneling – Josephson DC and AC effect- Super fluidity- High Temperature super conducting materials – Applications – SQUID – Cryoelectronics.

Books for study:

1. C. Kittel, *Introduction to Solid State Physics– VIIth Edition*, Wiley Eastern, New Delhi 2004.
2. A.J. Dekker, *Solid State Physics* (Macmillan India Ltd, Madras. 1986).
3. R.L. Singhal, *Solid State Physics – 3rd Edition*, Kedarnath and Ramnath & Co., Meerut, New Delhi, 1987
4. S.O. Pillai, *Solid State Physics*, 3rd edition, New Age International Publishers, New Delhi 1999

Books for Reference:

1. N.W. Ashcroft and N.D. Mermin, *Solid State Physics* (Harcourt Asia Pvt. Ltd, Singapore, 2001.
2. S. Arumugam, *Material Science,* Anuradha Agencies publications, Kumbakonam, 2003.
3. B.S. Saxena, R.C. Gupta, P.N. Saxena- *Fundamentals of Solid State Physics*- 13th edition, Pragati Pragashan, Meerat, 2009.

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I YEAR – II SEMESTER
COURSE CODE: 7MPH2C2

CORE COURSE-VI–MATHEMATICAL PHYSICS – II

Unit I: Laplace transforms

Laplace transform – Properties –Laplace transform of derivatives and integral of a function- Inverse Laplace transform – Convolution theorem – solution of second order linear ordinary differential equations-applications of Laplace transform to boundary value problem.

Unit II: Partial differential equations

Linear partial differential equation-Heat conducting equations-Vibrating string equation-Laplace equations-Longitudinal and transverse vibration of a beam-General solution to boundary value problem-separation of variables-Laplace transform method.

Unit III: Tensor analysis

Transformation of Coordinates – summation convention – Contravariant, Covariant and mixed tensors – Rank of a tensor – Kronecker delta – Symmetric and anti-Symmetric tensors.

Contraction of a tensor – Raising and lowering of suffixes – Metric tensor – Covariant formulation of electrodynamics – Application to the dynamics of a particle.

Unit IV: Group Theory

Basic definitions – Sub groups – Cosets – Factor groups – Permutation groups – Cyclic groups – Homomorphism and Isomorphism B – Classes of the group – Group representation – Reducible and irreducible representation.

Symmetry elements and Symmetry operations – Schur'slemma–Orthogonality theorem – Character of representation – Construction of Character table – C_{2v} and C_{3v} point groups.

Unit V: Special Functions

Gamma and Beta functions – Bessel differential equation and Bessel functions of first kind-generating function-recurrence relations-Orthonormality of Bessel functions – Laguerre's differential equation and Laguerre polynomial-generating function-Recurrence relations-orthogonal property of Laguerre polynomial.

Legendre differential equation and Legendre polynomial-generating functions – Rodrigue's formula- Orthogonal property –Recurrence relations-Hermite differential equation and Hermite polynomial-generating function-Recurrence relations –Rodrigue's formula-Orthogonal property.

Books for study:

1. W. Joshi, *Matrices and Tensors in physics* (New Age International (P) Ltd Publishers, New Delhi, (1995)
2. A.W.Joshi,*Elements of Group theory for physicists*(Wiley Eastern Ltd, New Delhi, 1988).
3. Dr. J.K. Goyal & K.P. Gupta *Laplace and Fourier transforms* (Pragati Prakashan, Meerut (U.P), India)
4. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineering and Physicists* (McGraw Hill, Singapore, 1967)

Books for Reference:

1. A.K. Gattak,T.C. Goyal and S.J. Chua,*Mathematical Physics* (Macmillan, New Delhi, (1995).
2. W.W. Bell, *Special Functions for Scientists and Engineers* (Van Nostrand, New York, 1968)
3. F.A. Cotton, *Chemical Applications of Group Theory* (Wiley Easterm, New Delhi, 1987)
4. B.D. Gupta, *Mathematical Physics* (Vikas Publishing House Pvt. Ltd., New Delhi, 2003).
5. P.K. Chattopadhyay, *Mathematical Physics* (Wiley Eastern, New Delhi, 1990)
6. Satya Prakash, *Mathematical Physics* (Sultan Chand and Sons, New Delhi, 2004).

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I YEAR–II SEMESTER
COURSE CODE: 7MPH2C3

CORE COURSE-VII–ELECTROMAGNETIC THEORY

Unit I: Electrostatics

Coulomb's law- The electric field - Continuous charge distribution - Gauss's law - The curl of E - Electric potential - Poisson and Laplace equations - The potential of a localized charge distribution - Electrostatic boundary conditions and boundary value problems in Cartesian - Cylindrical and Spherical coordinates.

Calculation of potential: Laplace equation in one dimension - The classic image problem - The induced surface charge - Multipole expansion - Force and energy - Approximate potentials at large distances. Energy in an electric field - Equation of continuity - Electrodynamics of a charged particle in an electric field.

Unit II: Magneto statics

Lorentz force law – Magnetic fields - Magnetic forces, currents - Biot- Savart law and application: steady currents - magnetic field of steady current - straight line currents - Ampere's theorem - Application of ampere's law.

Comparison of electrostatics and magneto statics - Magnetic vector potential - Magneto static boundary conditions - Multipole expansion of vector potential - Ampere's law in magnetized materials - Magnetic susceptibility and permeability - Dynamics of a charged particle in the magnetic field.

Unit III: Electromagnetism

Electromagnetic induction - Faraday's law of induction - Integral and Differential Forms - Energy in the magnetic field - Displacement current - Formulation of Maxwell's equations - Maxwell's equations in free space and in linear isotropic media - Boundary conditions on the fields at interfaces - Vector and scalar potential.

Gauge transformations - Lorentz gauge and invariance - Coulomb gauge and invariance - Derivations of macroscopic electromagnetic equations - Pointing vector - Poynting theorem: conservation of energy - Momentum in the electromagnetic phenomena - On the question of magnetic monopoles - Discussion of Dirac Quantization condition.

Unit IV: Plane Electromagnetic waves and wave propagation

Plane waves in free space - Isotropic medium - Equation of telegraphy and skin effect - Reflection and refraction of electromagnetic waves at a plane interface between dielectric- Polarization by reflection and total internal reflection - Linear and circular polarization - Fresnel's law interference coherence and diffractions- Stokes parameters - frequency dispersion characteristics of dielectrics - Conductors and plasmas.

Simplified model of propagation in the ionosphere and magnetosphere - Waves in a dissipative medium - Superposition of waves on one dimension - Group velocity. Propagation of electromagnetic waves in hollow metallic cylindrical and rectangular wave guides- TM and TE modes- Transmission lines.

Unit V: Interaction of EMW with matter:

Fields and radiation of a localized oscillating source - Dipole radiation: Retarded potential - Jefimenko's equations - Electric dipole radiation and magnetic dipole radiation - Multipole expansion for localized source.

Scattering and scattering parameters- scattering by free electrons(Thomson scattering)- Scattering by a bound electron(Rayleigh scattering)- State of polarization and scattered radiation- Coherence and incoherence in scattered light- Disperson- Normal and Anomalous- Dispersion in gases(Lorentz Theory)- Dispersion in liquids and solids.

Books for study:

1. David J. Griffiths, *Introduction to Electrodynamics*, Prentice-Hall of India, New Delhi 1995.
2. J.D. Jackson, *Classical Electrodynamics*, Wiley Eastern, 1988.
3. K.K. Chopra and G.C. Agarwal, Electromagnetic Theory, K. Nath & Co., 5th Edition, 2010.

Books for Reference:

1. Edward C. Jorden, Keith G. Balmin, *Electromagnetic Waves and Radiating Systems* (Prentice-Hall of India Ltd, New Delhi, 2003)
2. J.R. Reitz, F.J. Milford, R.W. Christy, *Foundations of Electromagnetic Theory* (Norosa Publishing House, New Delhi, 1998)

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I YEAR – II SEMESTER
COURSE CODE: 7MPH2C4

CORE COURSE-VIII–QUANTUM MECHANICS-II

Unit I: Time dependent perturbation

Theory Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Collision, Adiabatic and Sudden Approximation.

Unit II: Scattering theory

Scattering Amplitude - Expression in terms of Green's Function - Born Approximation and Its validity- Partial wave analysis - Phase Shifts –The Scattering Amplitude in Terms of Phase Shift- Scattering by Coulomb Potential and Yukawa Potential.

Unit III: Theory of radiation (semi classical treatment)

Einstein's Coefficients-Spontaneous and Induced Emission of Radiation from Semi Classical Theory-Radiation Field as an Assembly of Oscillators-Interaction with Atoms - Emission and Absorption Rates-Density Matrix and its Applications.

Unit IV: Relativistic Wave Equation

Klein Gordon Equation- Klein Gordon equation in electromagnetic potential - Dirac Relativistic Equation for a Free Particle –charge and current density-Dirac Matrices -Dirac Equation in Electromagnetic Field –spin angular momentum-spin orbit coupling-zitterbewegung- Negative Energy States.

Unit V: Quantum Field Theory

Quantization of Wave Fields- Classical Lagrangian Equation-Classical Hamiltonian Equation - Field Quantization of the Non-Relativistic Schrodinger Equation-Creation, Destruction and Number Operators-Anti Commutation Relations-Quantization of Electromagnetic Field Energy and Momentum.

Books for study:

1. Text Book of Quantum Mechanics -P.M. Mathews & K. Venkatesan-Tata McGraw Hill 2010
2. Quantum Mechanics – G Aruldhas - Prentice Hall of India 2006
3. Introduction to Quantum Mechanics – David J. Griffiths Pearson Prentice Hall, 2005
4. Quantum Mechanics – A Devanathan - Narosa Publishing-New Delhi

Books for Reference:

1. Quantum Mechanics – L.I Schiff - McGraw Hill 1968
2. Quantum Mechanics - A.K. Ghatak and S. Loganathan-McMillan India
3. Principles of Quantum Mechanics - R. Shankar, Springer 2005
4. Quantum Mechanics – Satya Prakash- Kathar Nath Ramnath – Meerut

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I YEAR- II SEMESTER
COURSE CODE: 7MPH2P1

CORE COURSE–IX-PHYSICS PRACTICAL-II

Any 12 experiments

1. Hyper bolic fringes- Determination of elastic constants
2. Biprism- Determination of wavelength of a monochromatic source- Spectrometer
3. Magnetic Susceptibility- Quincke's method
4. Anderson's bridge- Determination of 'L' of a coil
5. De Sauty's bridge- Comparison of Capacities
6. Determination of Stefan's constant
7. UJT characteristics and Relaxation Oscillator
8. Voltage to current and current to voltage converter- OP AMP
9. Study of Flip-Flops [RS,JK and D]
10. Square wave generator using IC741 and IC555
11. Wien's bridge Oscillator -using OPAMP
12. Differentiator and Integrator -using OPAMP
13. Microprocessor: Temperature Controller
14. Microprocessor: DAC interfacing (DAC 900)
15. Microprocessor: ADC interfacing (ADC0809)
16. Microprocessor: Stepper motor Control
17. C Programming: Monte-Carlo Method- Evaluation of definite integrals
18. C Programming: Numerical Integration- Composite Simpson's rule
19. C Programming: Composite Trapezoidal rule
20. C Programming: Euler's method

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II YEAR – III SEMESTER
COURSE CODE: 7MPH3C1

CORE COURSE-X–ATOMIC AND MOLECULAR PHYSICS

Unit I: Atomic spectra

Quantum states of electron in atoms – Hydrogen atom spectrum – Electron spin – Stern – Gerlach experiment – Spin-orbit interaction – Two electron systems – LS-JJ coupling schemes – Fine structure.

Spectroscopic terms and selection rules – Hyperfine structure – Isotope effect- Exchange symmetry of wave functions – Pauli's exclusion principle – Periodic table – spectrum of Helium and Alkaliatom- Equivalent electrons – Hund's rule.

Unit II: Atoms in external fields, quantum chemistry and lasers

Zeeman and Paschen – Back effect of one and two electron systems – Selection rules – Stark effect.

Quantum Chemistry of Molecules: Covalent, ionic and van der Wall interactions – Born – Oppenheimer approximation – Heitler – London and molecular orbital theories of H_2 – Bonding and anti-bonding MOs –Huckel's molecular approximation– Application to butadiene and benzene.

Lasers: spontaneous and stimulated emission- Einstein's A and B coefficients- Optical Pumping- population inversion- Rate equation- Modes of Resonators and Coherence length.

Unit III: Microwave and IR spectroscopy

Microwave spectroscopy: Rotational spectra of diatomic molecules – Effect of isotopic substitution – The non – rigid rotor – Rotational spectra of polyatomic molecules – Linear, symmetric top and asymmetric top molecules – Experimental techniques.

IR Spectroscopy: Vibrating diatomic molecule – Diatomic vibrating rotator – Linear and symmetric top molecules – Analysis by infrared techniques – Characteristic and group frequencies.

Unit IV: Raman spectroscopy and electronic spectroscopy of molecules

Raman Spectroscopy: Raman Effect – Quantum theory of Raman Effect – Rotational and vibrational Raman shifts of diatomic molecules – Selection rules.

Electronic spectroscopy of molecules: Electronic spectra of diatomic molecules – The Franck-Condon principle – Dissociation energy and dissociation products – Rotational fine structure of electronic vibration transitions.

Unit V: Resonance spectroscopy

NMR: Basic principles – Classical and quantum mechanical description – Bloch equations – Spin-spin and spin-lattice relaxation times – Chemical Shift and Coupling Constant – Experimental methods – Single coil and double coil methods – High resolution methods.

ESR: Basic principles – ESR spectrometer – nuclear interaction and hyperfine structure – relaxation effects – g-factor – Characteristics – Free radical studies and biological applications.

Books for study:

1. C.N. Banwell, *Fundamentals of Molecular Spectroscopy* (McGraw Hill, New York, 1981).
2. B.P. Straughan and S. Walker, *Spectroscopy Vol. I.* (Chapman and Hall, 1976).
3. R.P. Feynman et al. *The Feynman Lecturers on Physics Vol. III.* (Narosa, New Delhi, 1989).
4. H.S. Mani and G.K. Metha, *Introduction to Modern Physics* (Affiliated East West, New Delhi, 1991).
5. A.K. Chandra, Introductory Quantum Chemistry (Tata McGraw Hill, New Delhi, 1989).

Books for Reference:

1. Manas Chanda, *Atomic Structure and Chemical Bond* (Tata McGraw Hill, New Delhi, 1991).
2. Ira N. Levine, *Quantum Chemistry* (Prentice-Hall, New Delhi, 1994).
3. Arthur Beiser, *Concepts of Modern Physics* (McGraw Hill, New York, 1995).
4. K. Thiyagaragan, A.K. Ghatak- Laser Theory and Applications, Cambridge University press.
5. Avadhanulu M.N., -An introduction to lasers, theory & applications, S. Chand & Co, New Delhi (2001).
6. Molecular Structure and Spectroscopy by G. Aruldhas, 2nd Edition, 2007, PHI PVT. Ltd.

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II YEAR – III SEMESTER
COURSE CODE: 7MPH3C2

CORE COURSE-XI–NUCLEAR AND PARTICLE PHYSICS

Unit I: Basic nuclear properties and nuclear forces

Basic nuclear properties: size, shape charge distribution – spin and parity – determination of nuclear Mass – Binding Energy– Semi-empirical mass formula– Nuclear Stability – Mass parabolas – Nuclear Shell model- Single particle model ,its validity & limitation – Liquid drop Model – Optical model – Collective model.

Nuclear Forces: Nature of Nuclear forces – general forms of nucleon-nucleon potential- Elements of two body problem – Ground state of deuteron – phase shift analysis – scattering length– scattering amplitude – low energy n-p Scattering – Non-Central forces (Tensor forces) – Yukawa's meson theory – Yukawa potential – Spin independence – Charge symmetry of Nuclear forces.

Unit II: Radioactive decays and radiation detectors

Radioactive Decays : Gamow's theory of α decay– Fermi theory of β decay – Selection rules – Non conservation of parity in beta decay – Gamma decay – Selection rules – internal conversion – Nuclear isomerism.

Nuclear radiation Detectors: Interaction of charged particles & energy with matter – Basic principles of Particle detectors – ionization chamber – scintillation counter – Semiconductor detector

Unit III: Accelerators, nuclear fission and fusion

Accelerators: Cyclotron – Synchrocyclotron – Betatron

Nuclear Fission: Characteristics of fission – Mass & energy distribution of nuclear fragments – Energy in fission – nuclear chain reaction –Four-factor formula – Bohr Wheelers theory of nuclear fission – Fission reactors – Power type reactor

Nuclear Fusion: Basic fusion processes – Solar fusion – Cold fusion – Controlled thermonuclear reactions – Pinch effect

Unit IV: Nuclear reactions

Nuclear Reactions: Kinds of Nuclear reaction – Conservation laws – Nuclear reaction kinematics – Q equation– Nuclear cross-section – partial wave analysis – compound nucleus Resonance: Breitwigner Dispersion formula – Direct Reactions: stripping and pick – up reactions.

Unit V: Elementary particles

Classification of elementary particles – Gravitational, Electromagnetic, strong and weak interactions – conservation laws – strange particles – strangeness – GellMann Nishijima formula.

Symmetries C, P and T- Charge conjugation – Space inversion invariance (Parity) – Time reversal – CPT theorem –Parity non conservation in weak interaction- K. Meson –

Mass of kaons – CP violation in neutral K-decay– Hyperons – Elementary Particle Symmetries: SU (2) symmetry – SU (3) symmetry – Quark theory.

Books for study:

1. K.S. Krane, *Introductory Nuclear Physics* (John - Wiley, New York, 1987.
2. M.L. Pandya and R.P.S. Yadav, *Elements of Nuclear Physics*, Kedar Nath Ram Nath, Meerut, 2004.
3. D.C, Dayal, *Nuclear Physics*, Himalayan Publishing House, Bombay, 2000.
4. B.L. Cohen, *Concepts of Nuclear Physics* (Tata McGraw Hill, New Delhi, 1983)

Books for Reference:

1. D. Griffiths, *Introduction to Elementary Particles*, Wiley International Edition, New York, 1987)
2. D.C. Cheng and G.K. O'Neill, *Elementary Particle Physics: An Introduction* (Addison– Wesley, New York, 1979).

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II YEAR – III SEMESTER
COURSE CODE: 7MPH3C3

CORE COURSE-XII–ADVANCED ELECTRONICS

Unit I: Semiconductor devices

Introduction to semiconductor – Intrinsic and Extrinsic semiconductors - PN Junction diode- characteristics of forward bias and reverse biased diode- Zener diode, Varactor diode, Schottky diode, Optoelectronic devices- LASER diode, LED, Photodiode, phototransistor, solar cells.

Structure, working and I-V characteristics of BJT, JFET, MOSFET (Depletion and Enhancement), UJT, SCR, DIAC and TRIAC under different conditions- frequency dependence- applications

Unit II: Operational amplifier

Operationalamplifier- Basic operational amplifier- ideal OPAMP characteristics- OPAMP parameters- Inverting and non- inverting amplifier- OPAMP applications- Instrumentation amplifier- voltage follower- Integrator and differentiator.

Log and antilog amplifier- Comparator- Voltage to current and current to voltage converters- Active filters- first order low pass, high pass, band pass and band reflection filters- analog computation

Unit III: Digital circuits and systems

Logic gates- Logic families (RTL, DTL, TTL and DCTL) – flip –flops (RS, JK, D and T)- counters, asynchronous (ripple) counter- different modulli counters- updown counters-synchronus counter – Registor- Shift registors- (SISO, SIPO, PISO, PIPO)- Ring counters- Johnson ring counter

Memory devices: RAM- Static and dynamic random access memories (SRAM and DRAM)- ROM- PROM, EPROMS, EEPROMS- charged coupled devices (CCD)

Unit IV: Signal processing and data acquisition

Wave form generators and wave shaping circuits: Sinusoidal oscillator- Phase shift oscillator- Wein bridge oscillator, crystal oscillator- Multivibrators- comparators- Schmitt trigger circuits- square, Triangular wave generators- Pulse generators- Sample & hold circuits- voltage controlled oscillator- IC555 Timer and its applications

Digital to analog converters- weighted resistor and Binary R-2R ladder DAC- DAC accuracy and resolution- Analog to digital converters (ADC)- simultaneous conversion- Counter method- Successive approximation and Dual slope ADC- ADC accuracy and resolution.

Unit V: Communication and microwave devices

Amplitude modulation theory- Frequency spectrum of AM wave- Generation of AM- Grid and plate modulated class C amplifiers- SSB techniques- suppression of carrier and unwanted sideband- Description of frequency and phase modulation- Mathematical representation of FM- Frequency spectrum of FM wave- Generation of FM- Direct and

indirect methods- Phase modulation- Types of pulse modulations-Pulse width, Pulse position and pulse code modulation.

Microwave devices: Tunnel diode, Gunn diode, avalanche transit time devices- IMPATT diodes- parametric devices- Magnetron, Klystron, Reflex Klystron.

Books for study:

1. T.F. Schubert and E.M. Kim, *Active and Nonlinear Electronics* (John Wiley, New York, 1996).
2. L. Floyd, *Electronic Devices* (Pearson Education, New York, 2004).
3. Dennis Le Croissitte, *Transistors* (Printice Hall, 1963)
4. J. Milman and C.C. Halkias, *Integrated Electronics* (McGraw Hill, 1972).
5. A. Mottershed, *Semiconductor Devices and Application* (New Age)
6. M. Goodge, *Semiconductor Device Technology* (McMillan, 1983)

Books for Reference:

1. S.M. Sze, *Physics of Semiconductor Devices* (Wiley-Eastern, 1981)
2. Millman and Taub, Pulse, *Digital and Switching Waveforms* (McGraw Hill, 1965).
3. Ben. G. Streetman, *SolidState Electronic Devices* (Printice Hall, New Jersey, 1995).
4. A. Gayakwad, *Op-Amps and Linear Integrated Circuits* (Printice Hall, 1999).
5. S. Salivaganam and S. Arivazhagan, Digital Circuits and Design(Vikas Pub. House, Pvt ltd, 2000)
6. Electronic communication Systems-George Kennedy III Edition (2005) McGraw Hill Co.,

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II YEAR-III SEMESTER
COURSSE CODE: 7MPH3P1

CORE COURSE–XIII-PHYSICS PRACTICAL-III

Any 12 Experiments

1. Michelson's Interferometer- Determination of wave length of a monochromatic source and thickness of a film
2. Mutual Inductance by Carey Foster's bridge
3. Four probe Method- Determination of resistivity of a given material
4. Surface Tension by Jaegar's method
5. Calibration of Thermo couple- Potentiometer
6. Magnetic susceptibility – Guoy's method
7. Hall effect
8. Photo cell determination of Plank's constant
9. Characteristics of Photodiode and Photo transistor
10. Study of Counters using IC7490
11. D/A Converter- R-2R method
12. D/A Converter- Weighted Resistor method
13. Active filters[Low, high, Band- Pass] using OPAMP
14. Triangular and Saw tooth waveform generators using OPAMP
15. Solution of simultaneous equation using IC 741
16. Microprocessor: Traffic control
17. Microprocessor: Generation of sine square, triangular, saw-tooth waves using DAC 0800
18. C Programming: Euler's method
19. C Programming: Uniform Random Number generation- Park and Miller Method
20. C Programming: Gaussian random number generation- Box and Muller method

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II YEAR – III SEMESTER
COURSE CODE: 7MPHE2A

ELECTIVE COURSE-II (A) – MICROPROCESSOR AND MICROCONTROLLERS

Unit I: 8085 Microprocessor

Pin description of 8085 – Architecture – Addressing modes – Instruction classification – Instruction format 8085 instructions.

Data transfer – arithmetic, logical, branching and control instructions – stack and subroutine – time delay calculations – simple programs

Unit II: Date transfer technique and peripheral devices

Data transfer scheme – Synchronous and Asynchronous data transfer – interrupt driven data transfer and DMA data transfer scheme.

Programmable Peripheral interface (8255A) – Programmable Interval Timer (8253A) – Programmable Interrupt Controller (8259) – USART (8251A) – DMA controller (8257A) – Keyboard/display interface (8279).

Unit III: 8051 Microcontroller architecture

Microprocessors and microcontrollers – 8051 architecture – Microcontroller hardware.

Program and data memory – External memory – counters – timers – serial data I/O – interrupts.

Unit IV: 8051 Microcontroller instructions and simple programs

Addressing modes – Instructions – data transfer instructions – logical – arithmetic – jump and call instructions.

Bit manipulation – Addition – sum of N numbers, Multibyte addition – subtraction – multiplication – division – biggest and smallest numbers.

Unit V: Applications of 8051 Microcontroller

Interfacing – Data acquisition system – D/A converter – A/D converter – pulse measurement– temperature measurement – pressure measurement.

Stepper motor interfacing– traffic light problem – water level indicator – seven segment display interfacing.

Books for study:

1. R.S. Gaonkar, *Microprocessor Architecture, programming and application with 8085* (Pen ram International, New Delhi, 2000), (Unit –I)
2. Kenneth J. Ayala, *The 8051 Microcontroller, architecture, programming and applications* (Thomson, Delmar Learning (ISE) (2004). (Unit – II, III & IV))
3. *Lecture notes on Microcontroller applications* (Department of Applied Physics, Nehru Memorial College, Puthanampatti) (Unit – V)

Books for reference:

1. Badri Ram, *Advanced Microprocessor and Interfacing* (Tata McGraw Hill Publishing Company Ltd, New Delhi, 2002)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, *The 8051 Microcontroller and Embedded system* (Pearson Education, 2004).

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II YEAR – III SEMESTER
COURSE CODE: 7MPHE2B

ELECTIVE COURSE - II (B) – MODERN OPTICS AND LASER PHYSICS

Unit I: Propagation and nature of light

Propagation of light: Elementary optical phenomena- Electrical constants and speed of light- Plane harmonic waves (Phase velocity) - Group velocity- Doppler effect.

Nature of Light: Energy flow- Linear Polarization- Circular and elliptical Polarization- Matrix representation of polarization (Jones Calculus)- Reflection and refraction at a plane boundary- Amplitudes of reflected and refracted waves- Brewster's angle- Evanescent waves in total reflection- Phase changes in total internal reflection- Reflection matrix.

Unit II: Coherence and interference

Principle of Linear position- Young's experiment- Michelson Interferometer- Theory of partial coherence- visibility of fringes- Coherence time and Coherence length- Spatial coherence- Intensity interferometry- Fourier transform spectroscopy.

Multiple beam interference:

Interference with multiple beam- Fabry- Perot interferometer- Resolution of Fabry Perot instruments- Theory of multi layer films.

Unit III: Fourier optics and holography

Scalar diffraction theory: Mathematical preliminaries- kirchoff formulation of diffraction by a plane screen- Rayligh- Sommerfeld formulation of diffraction by a plane screen- Approximation to the Huygens- Fresnel principle- Examples of Fraunhofer diffraction patterns- thin lenses as phase transformation- Fourier transforming properties of lenses.

Holography: Wave front reconstruction- Gabor hologram- The Leith- Upatniek's hologram- effects of film nonlinearity and thickness- reflection hologram- Applications: Microscopy- Interferometry- Vibration analysis

Unit IV: Non- linear optics

Non linear response- Non-linear phenomenon and optical harmonic generation- Franken's experiment- phase matching- parametric amplifiers- Manley- Rowe relations.

Stimulated Raman scattering- self focusing- theory of self focusing-theory of Laser Raman spectroscopy

Unit V: Lasers and applications

Lasers: Stimulated and spontaneous emission- Einstein's A & B coefficients- relation between them- condition for light amplification- Population inversion- Pumping methods and schemes- optical resonator-theory and condition for oscillation- modes-Laser Rate equations- solid state lasers: Ruby & Nd:YAG- Gas lasers: He-Ne and Co_2 lasers- Dye laser- semiconductor diode laser.

Applications: Lasers in mechanical industry, Electronics industry, nuclear energy, medicine, Defense, communication- measurement of distance and velocity

Books for study:

1. Grant R. Fowles- Introduction to Modern Optics, Halt. Rinehart and Winston. Inc. Newyork, IInd edition, 1975 [For unit I&II]
2. Joseph W. Goodman- Introduction to Fourier Optics, McGraw-Hill Book Company, Istediion, 1968 [For unit III]

Books for Reference:

1. G.D. Barugh- Lasers and Non-linear Optics, Pragati Prakashan, Meerut, IIIrd Edition, 2009 [For unit IV].
2. M.N. Avadhanulu, An Introduction to Lasers: Theory and Applications, S. Chand and Company Ltd, New Delhi, Ist Edition, 2001[For unit V].

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II YEAR – IV SEMESTER
COURSE CODE: 7MPHE3A

ELECTIVE COURSE-III (A)–NANO SCIENCE

Unit I: Background to nanotechnology

Scientific revolution – Types of Nanotechnology – Periodic table – Atomic structure. Molecules and phases – Energy – Molecular and atomic size – Surfaces and dimensional space – Top down and bottom up.

Unit II: Nanopowders, nanomaterials

Nanomaterials – Preparation – Plasma arcing – Chemical vapour deposition – Sol-gels.

Electro deposition – Ball miling – Using natural Nano particles – Application of Nano materials.

Unit III: Carbon age and nano biometrics

Carbon age: New form of Carbon – Types of Nano tubes – Formation of Nano tubes – assemblies – Purification of carbon tubes – Properties – uses.

Nano biometrics: Introduction – Lipids as Nano bricks and mortar – Self assembled monolayers – Proteins – Structure is information DNA – biological Nano technological future.

Unit IV: Optics, photonics and solar energy

Properties of light and Nano technology – Interaction of light and Nano technology.

Nano holes and Photons – Imaging – New low cost energy efficient windows – photonic crystals.

Unit V: Nano electronics

Nano electronics – Birth of electronics – Micro and Nano fabrication – Quantum electronic devices.

Quantum information and Quantum computers – Experimental implementation of quantum computers – MEMS.

Books for study:

1. M. Wilson, K.K.G. Smith, M. Simmons, B. Ragase, *Nano technology – First Edition* (Overseas Press India Pvt, Ltd., New Delhi, 2005)

Books for reference:

1. Mark Ratner, Daniel Ratner, *Nano technology* (Pearson Education, 2003)

II YEAR – IV SEMESTER
COURSE CODE: 7MPHE3B

ELECTIVE COURSE-III (B)–ANALYTICAL INSTRUMENTATION

Unit I: UV, visible and IR spectrophotometry

Ultraviolet absorption spectrophotometry – Instrumentation – Detectors – Filters – Monochromators.

Instruments for absorption photometry.

Unit II: Atomic emission spectroscopy

Spectroscopic Sources – Atomic emission spectrometer – Photographic and Photoelectric detection.

Infrared spectrophotometry – Instrumentation – Radiation sources – Detectors – Fourier Transform Interferometer.

Unit III: X-ray and Raman spectroscopy

Instrumentation – Detectors – X-ray fluorescence spectrometer.

Laser Raman spectrometer – Laser sources – Detectors – Sample handling.

Unit IV: NMR and ESR spectroscopy

NMR basic principles – Continuous wave NMR spectrometer – ESR basic principles – ESR spectrometer.

Scanning Electron Microscope (SEM) – Electron Spectroscopy for Chemical Analysis (ESCA)

Unit V: Flame emission atomic absorption spectroscopy

Instrumentation for Flame Spectrometer methods – Flame emission spectrometry – Atomic Absorption Spectrometry.

Atomic fluorescence spectrometry – Comparison of FES and AAS.

Books for study:

1. Instrumental methods of Analysis – H.H. Willard & Merritretal CBS Pub & Co, New Delhi
2. Molecular Spectroscopy – P.S. Sindu, TMH, New Delhi

Books for Reference:

1. Spectroscopy Vol. I & II Ed. Straugan & Walker Chapman & Hail, 1976

II YEAR – IV SEMESTER
COURSE CODE: 7MPHE4A

ELECTIVE COURSE-IV-(A)–THERMODYNAMICS AND STATISTICAL PHYSICS

Unit I: Thermodynamics

Laws of thermodynamics – some consequences of the laws of thermodynamics – Entropy – Calculation of entropy changes in reversible processes – The principle of increase of entropy.

Thermodynamic Potentials – Enthalpy, Helmholtz and the Gibbs functions – Phase transitions (I and II orders) – The Clausius – Clayperon equation – Vander Waals Equation of State.

Unit II: Kinetic theory

Distribution function and its evolution – Boltzmann transport equation and its validity – Boltzmann's H theorem – Maxwell – Boltzmann distribution.

Transport phenomena – Mean free path – Conservation laws – Hydrodynamics (no derivation) – Diffusion equation- Random walk and Brownian motion.

Unit III: Classical statistical mechanics

Review of probability theory – Macro and micro states – Statistical equilibrium – Phase space – ensembles – Density function – Liouville's theorem.

Maxwell Boltzmann distribution law – Micro canonical ensemble – principles of equipartition energy – Canonical and grand canonical ensembles.

Unit IV: Quantum Statistical Mechanics

Basic Concepts – Quantum ideal gas – Bose Einstein and Fermi Dirac Statistics – Distribution laws.

Sackur – Tetrode equation – Equations of State – Bose Einstein condensation.

Unit V: Applications of Quantum Statistical Mechanics

Ideal Bose Gas: Photons – Black body radiation and Plank distribution formula – Photons – Specific heat of Solids – Liquid Helium.

Ideal Fermi Gas: Properties – Degeneracy – Electron Gas- Landau's diamagnetism – Pauli Para magnetism.

Fluctuation: Energy, Pressure enthalpy- Ferromagnetism: One dimensional Ising model

Books for study:

1. K. Huang, *Statistical Mechanics* (Wiley Eastern Ltd, New York 1963)
2. B.K. Agarwal and M. Eisner, *Statistical Mechanics* (Wiley Eastern Ltd, New Delhi, 1994).
3. F. Reif, *Statistical and Thermal Physics* (McGraw Hill, International Edition, Singapore 1979)

Books for Reference:

1. F. Mandl, *Statistical Physics* (John Wiley Eastern Ltd, New Delhi (1983)
2. Singhal, Agarwal, Prakash, *Thermodynamics and Statistical Physics*(Prakashan, Meerut, 2003)
3. Donald, A. McQuarrie, *Statistical Mechanics* (Vikas Books Private Ltd, New Delhi, 2003)

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II YEAR – IV SEMESTER
COURSE CODE: 7MPHE4B

ELECTIVE COURSE-IV (B)-COMMUNICATION ELECTRONICS

Unit I: Communication system

Theory of amplitude modulation – Theory of frequency modulation – Theory of phase modulation- Internal noise – External noise – noise calculation – noise figure – noise temperature.

Antenna equivalent circuits – coordinate system – radiation fields – Polarization – power gain of Antenna –Hertzian dipole – Half wave dipole–Vertical antenna – Loop ferrite rod antenna – non – resonant antenna – driven array Parasitic arrays – UHF – VHF antenna – microwave antenna.

Unit II: Digital communication

Pulse amplitude modulation – pulse code modulation – delta modulation – pulse frequency modulation – pulse time modulation – pulse position modulation – pulse width modulation.

Digital carrier system – Amplitude shift keying – Frequency shift keying – Phase shift keying– differential and quadra polar phase shift keying – error control coding – multiplex transmission – frequency and time division multiplexing.

Unit III: Microwaves and radar communication

Generation of microwaves – Klystron: Reflex Klystron, Multicavity Klystron – Magnetron – detection of microwaves – IMPATT, TRAPATT and Gunn diodes.

Radar – Radar equation –Pulse and CW radar – MTI and automatic tracking radar.

Unit IV: Optic fiber communication

Fiber optics – Different types of fiber: Step index and Graded index fibers – signal degradation fibers: Absorption, attenuation, Scattering losses and dispersion.

Optical sources and detectors (quantitative only) – Power launching and coupling: Source to fiber launching – fiber joints – Splicing techniques – general optical communication system.

Unit V: Satellite and cellular communication

Satellite links – Eclipses – orbits and inclination – satellite construction – Satellite communication frequencies – Different domestic satellites – Intelsat system – MARISAT satellites – telemetry.

Cellular concept – Multiple Access Cellular Systems – Cellular system Operation and Planning – General Principles – analog cellular systems – Digital Cellular mobile Systems – GSM – CDMA – Cellular standards.

Books for study:

1. Dennis Roddy and John Coolen, *Electronic Communication – fourth edition* (PHI private Ltd, 1999)
2. G. Kennedy and Davis, *Electronic Communication system* (TMH, New Delhi, 1999).
3. Gerd Keiser, *Optical Fiber Communication, Third Edition* (McGraw – Hill, Singapore 2000).
4. Raj Pandya, *Mobile and Personal Communication Services and Systems* (Prentice Hall of India Private Ltd., New Delhi, 2003).

Books for Reference:

1. Sanjeev Gupta, *Electronic Communication Systems* (Khanna Publications, New Delhi, 1995).
2. N.D. Deshandae, P.K. Rangole, *Communication Electronics* (Tata McGraw Hill Pvt. Ltd., 1998).
3. M. Arumugam, *Optical Fiber Communication and Sensors* (Anuradha Agencies, Kumbakonam, 2002).

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II YEAR – IV SEMESTER
COURSE CODE: 7MPHE5A

ELECTIVE COURSE-V (A)-ENERGY AND ENVIRONMENTAL PHYSICS

Unit I: Essential of environmental physics

Structure and thermodynamics of the atmosphere-Temperature, pressure and density variations with height-composition of air-Radiation temperature of the earth and Greenhouse effect-Transport of matter, energy and momentum in nature-Raynold's transport theorem-energy and momentum equations- Hydrostatic equilibrium- Stratification and stability of atmosphere- General circulation of the tropics- Indian monsoon-elements of weather and climate.

Unit II: Solar energy

Solar Constant- solar Radiation at the earth's surface-Solar Radiation Measurements-Estimation of Average Solar Radiation-Solar Radiation on Tilted surfaces.

Solar Energy Collectors-Physical principle of the conversion-Flat-Plate Collectors-Transmissivity of cover system-Energy balance equation and collector efficiency-Thermal analysis of flat-plate collector and useful heat gained by the fluid.

Unit III: Bio-energy

Biomass Conversion Technologies-Photosynthesis - Biogas Generation-Factors affecting bio digestion-Classification of biogas plants-Advantages and Disadvantages-Types-Constructional details of some main digesters.

Unit IV: Hydrogen energy: safety and utilization

Relevance in relation to depletion of fossil fuels and environmental considerations-Various factors relevant to safety, use of Hydrogen as Fuel, Use in vehicular transport, Hydrogen for electricity generation, Fuel Cells, Various type of Fuel Cells, Applications of Fuel Cell, Elementary concepts of other hydrogen- Based devices such as Hydride Batteries.

Unit V: Environmental pollution

Factors governing air, water and noise pollution - Air and water quality standards - Waste disposal- Heat island effect. Land and sea breeze. Puffs and plumes - Purification and control devices of water and air pollution.

Books for study:

1. Non- Conventional sources of Energy – G.D. Rai, Khanna Publishers, New Delhi.(1998)
2. Hydrogen as an Energy Carrier Technologies Systems Economy: Winter & Nitch (Eds.)(1988)
3. Hydrogen as a Future Energy Carrier: Andreas Zuttel, Andreas Borgschulte and Louis Schlapbach (2008)

Books for Reference:

1. Atmospheric Science: An Introductory Survey(Academic Press, 1977)
2. Environmental Physics(John Wiley, 2011)
3. The Physics of Atmosphere (Cambridge Univ. Press, 1977)

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II YEAR – IV SEMESTER
COURSE CODE: 7MPHE5B

ELECTIVE COURSE-V (B) – MEDICAL PHYSICS

Unit I

The Physics of the Lungs and Breathing: The Airways– How the blood interact – Measurement of Lung Volumes – Pressure, Airflow, Volume Relationships of the Lungs – Physics of the Alveoli – The Breathing Mechanism – Airway Resistance – work of Breathing – Physics of some common Lung Diseases.

Electricity within the Body: Electric signals – from the Heart (Electro Cardiogram) – From the Brain (Electro encephalogram) – From the Eye (Electro retinogram and electrooculogram) – Magnetic signals from Heart and Brain (Magnetocardiogram and Magnetoencephalogram) – Current Research involving electricity in the body.

Unit II

Sound in Medicine: General properties of sound, the body as a drum (percussion in medicine) The stethoscope, ultrasound pictures of the body, ultrasound to measure motion, physiological effects of ultrasound in therapy, the production of speech.

Physics of the ear and hearing: The outer ear, the middle ear, the inner ear, sensitivity of the ears, testing your hearing, deafness and hearing aids

Unit III

Light in Medicine: Measurement of light and its units, applications of visible light in medicine, applications of ultraviolet and infrared light in medicine, Lasers in Medicine applications of microscopes in medicine.

Physics of eye and vision: Focusing elements of the eye, some other elements of the eye, the retina – the light detector of the eye, how sharp are your eye? Optical illusions and related phenomena, defective vision and its correction, colour vision and chromatic aberration, instruments used in ophthalmology.

Unit IV

Physics of diagnostic X-rays :Production of X-ray beam, how X-ray are absorbed, making an X-ray image, radiation to patients from X-rays, producting live X-ray images – fluoroscopy, X-ray slices of the body, radiographs taken without film.

Physics of Radiation Therapy: The dose units used in radiotherapy – the red and the gray, principles of radiation therapy, a short course in radiotherapy planning, megavoltage therapy, short distance radiotherapy or brachytherapy other radiation sources, closing thought of radiotherapy.

Unit V

Physics of the Cardiovascular System: Major Components of the Cardiovascular system – O_2 and CO_2 Exchange in the Capillary system – Work done by the Heart – Blood pressure and its measurement Transmural Pressure– Bernoulli's Principle – Blood flow – Heart Sounds – Cardiovascular Diseases – Functions of Blood

Cardiovascular Instrumentation: Biopotentials of the Heart – Electrodes – Amplifiers – Patient Monitoring – Defibrillators – Pacemakers

Book for study and Reference:

1. *Medical Physics* – John R. Cameron and James G. Skofronick, (John Wiley & Sons, NeYork 1978)

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