M.Sc. Course Structure under CBCS
(Applicable to the candidates admitted from the academic year 2016-17)

Aim	
Objective	➢ Provide a scientific education which will equip students for a range of careers both in and beyond the boundaries of physics and cognate disciplines
Eligibility for Admission	

Semester	Paper No.	Paper Code No.	Paper	Instrn. Hrs.	Credit	Exam Hrs.	Marks			Total
							Int.	Ext.		
								Oral	W	
I	CC-I	P16PH1	Mathematical Physics	6	5	3	25		75	5
	CC-II	P16 PH2	Classical Mechanics	6	5	3	25		75	5
	CC-III	P16 PH3	Statistical Mechanics	6	5	3	25		75	5
	CC-IVP	P16 PH4P	Physics Practicals- I (General & Electronics)	6	5	4	25	70	5	5
	EC-I	P16 PH5E	Special Electronics - I	6	5	3	25		75	4
	Papers:5			**30**	**25**					**24**
II	CC-V	P16 PH6	Atomic and Molecular Physics	6	5	3	25		75	5
	CC-VI	P16 PH7	Quantum Mechanics	6	5	3	25		75	5
	CC-VII	P16 PH 8	Nuclear and Particle Physics	6	5	3	25		75	5
	CC-VIIIP	P16PH 9P	Physics Practicals - II (General & Electronics)	6	4	4	25	70	5	5
	EC-II	P16PH10E	Special Electronics - II	6	4	3	25		75	4
	Papers:5			**30**	**23**					**24**

III	CC-IX	P16PH11	Electromagnetic Theory	6	5	3	25		75	5
	CC-X	P16PH12	Crystal Growth and Thin Film Physics	6	5	3	25		75	5
	CC-XIP	P16PH13P	Physics Practicals-III Advanced Electronics	6	5	4	25	70	5	5
	EC III	P16PH14E	Numerical Methods and Programming	6	4	3	25		5	4
	EC IV	P16PH15E	Elements of Nano science and its applications	6	4	3	25		75	4
	Papers:5			**30**	**23**					**23**
IV	CCXII	P16PH16	Condensed Matter Physics	6	5	3	25		75	5
	CCXIIP	P16PH17P	Physics Practicals-IV Advanced Electronics	6	5	3	25	70	5	5
	EC V	P16PH18E	Advanced Optics	6	4	3	25		75	4
	PROJECT	P16PHP19	Project Work and Field Visit	12	5	--			100	5
	Papers:5			**30**	**19**					**19**
			Total Credits		**90**					**90**

Core course - I - MATHEMATICAL PHYSICS

Semester - I **Course Code: P16PH1**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To aim at providing extensive mathematical formalism for understanding and interpreting various physical problems.*

UNIT I:VECTOR ANALYSIS AND VECTOR SPACE

Concept of vector and scalar fields – Gradient, divergence, curl and Laplace operator – Line integral, surface integral (problems) and volume integral – Gauss divergence theorem (problems), Green's theorem, Stoke's theorem (Problems). VectorSpace: Definitions – Linear independence of vectors – Gram-Schmidt's orthogonalisation process.

UNIT II: SPECIAL FUNCTIONS

Beta and Gamma functions – Properties –Hermite polynomial –Legendre Polynomial – Bessel functions and their respective recursion relations.

UNIT III: COMPLEX ANALYSIS

Functions of complex variables – Differentiability - Cauchy-Riemann conditions – Cauchy's integral theorem and integral formula – Residues and singularities - Cauchy's residue theorem – Evaluation of definite integrals (Trignometric functions around the unit circles).

UNIT IV: GROUP THEORY

Basic definition –Multiplication table – Subgroups, cosets and classes -Point groups and space groups-Homomorphism and Isomorphism –Reducible and irreducible representations –Schur's lemma I and II -The great Orthogonality theorem-C_2V and C_3V Character table.

UNIT V: FOURIER SERIES AND TRANSFORMS

Trignometric series – Euler's formula and Fourier series – Dirichlet's theorem, condition – Problems on periods with simple functions sinx, cosx, sin2x, cos2x, sinnx, cosnx. –
Fourier transform – Integral theorem – Fourier Sine, Cosine transform - Shifting theorem – Change of scale – Evaluation of Fourier transform (Problems).

BOOK FOR STUDY

1. L. A. Pipes and L. R. Harvill, Applied Mathematics for Engineers and Physicists – McGraw-Hill (1987).
2. SatyaPrakash, Mathematical Physics, Sulthan, Chand & Sons., New Delhi (2006).
3. Laplace and Fourier Transforms, Goyal and Gupta. Pragati Prakashan Meerut-1995.

BOOKS FOR REFERENCE

1. B.D.Gupta, Mathematical Physics, Vikas Publishing House Pvt Ltd., New Delhi (2006).
2. A. K. Ghatak, I.C. Goyal and S. J. Chua, Mathematical Physics, Mac Millan India Ltd. (1995).

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Core Course - II - CLASSICAL MECHANICS

Semester – I **Course Code : P16PH2**
Instruction hours/week – 6 **Credit : 5**

Objectives:

- *To learn about the fundamentals of classical generalized coordinates and Formation*
- *To learn about both Lagrangian and Hamiltonian formalisms*
- *To apply both the formalism to certain examples*
- *Fundamentals of small oscillations*

UNIT-I: FUNDAMENTALS AND LAGRANGIAN FORMALISM

Principle of virtual work-Generalized co-ordinates – Generalized momentum – Generalized kinetic energy – D'Alembert's principle –Lagrangian's equation of motion from D.A.P – Cyclic co-ordinates – Conservation of angular momentum and total energy.

UNIT-II: HAMILTONIAN FORMALISM

Hamilton as total energy operator – Hamilton's variational principle – Deduction of Hamilton's principle from D'Alembert's principle – Deduction of Lagrangian equation of motion from Hamilton's principle – Hamilton's equation of motion – Hamilton's equation of motion from Hamilton's variational principle.

UNIT-III: APPLICATIONS AND CANONICAL TRANSFORMATIONS

Application of Lagrangian formalism a)Atwood's machine b)Simple pendulum – Transformations a)point or contact b)Canonical – Generating function of canonical transformation – Four types of canonical transformations - Δ Variation – Principle of Least Action.

UNIT-IV: BRACKETS AND HAMILTON – JACOBI THEORY

Lagrangian and Poisson's brackets – Symmetry, invariance of Poisson bracket under Canonical transformation – Hamilton's characteristic function – Hamilton-Jacobi equation – Physical significance of S – Action – angle formalism- Kepler's problem in action – angle variables.

UNIT-V: LINEAR OSCILLATIONS

Theory of small oscillations – Normal modes of oscillations and frequencies (frequencies) – Simple harmonic oscillator. Double pendulum and its normal modes – CO_2 as linear symmetrical molecule, its normal frequencies and its normal modes.

BOOK FOR STUDY

1. G. Aruldhas – Classical Mechanics – PHI Learning Pvt. New Delhi (2009).

Unit	Chapter	Sections
I	3	3.3, 3.2, 3.7, 3.6, 3.4, 3.5, 3.8, 3.9
II	4, 6	4.1, 4.2, 4.3, 6.2, 6.3
III	3, 6	3.12, 6.5, 6.10, 6.11
IV	6, 7	6.9, 6.8, 7.2, 7.1, 7.4, 7.6
V	9	9.2, 9.3, 9.4, 9.5

BOOK FOR REFERENCE

1. Gupta-Kumar-Sharma,Classical Mechanics, S. Chand and Co. 1987.
2. H. Goldstein,Classical Mechanics, Mc Graw Hill Pvt. New Delhi - 1981.

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Core Course - III - STATISTICAL MECHANICS

Semester – I **Course Code : P16PH3**
Instruction hours/week – 6 **Credit : 5**

Objectives:

- *To understand the fundamental principles of statistical mechanics.*
- *To apply the quantum mechanical ideas to statistical mechanics.*

UNIT – I: REVIEW OF THERMODYNAMICS

First law –Entropy and second law - Principle of degradation of energy-Thermodynamic Potentials and its reciprocity relations-Gibb's-Helmholtz relation- Thermodynamic equilibria- Nernst heat theorem-Chemical potential-Phase transitions-First order and Second order.

UNIT – II: KINETIC THEORY

Distribution function-Boltzmann transport equation for Homogeneous and Heterogeneous medium and its validity.

Kinetic theory of gases-Maxwell Boltzmann distribution law of velocities-Mean free path-Expression and experimental determination-Viscosity.

UNIT – III: STATISTICAL MECHANICS

Macro and micro states – Stirling's approximation –Classical Maxwell- Boltzmann distribution law - Principle of equipartition of energy- Phase space and ensembles - Characteristics of micro, macro and grand canonical ensemble - Liouville's theorem-Statistical equilibrium- Partition function - Relation between partition function and thermodynamic quantities-B.E statistics, F.D statistics.

UNIT – IV: QUANTUM STATISTICAL MECHANICS

Black body and Planck's radiation - Specific heat of solids-Dulong and Petit's Law-Einstein's theory- Debye's theory.

Ideal Bose gas - Energy, pressure of a gas-Gas degeneracy-Bose-Einstein condensation – properties of liquid helium.

UNIT – V: ADVANCED STATISTICAL MECHANICS

Electron gas - Free electron model and thermionic emission – Pauli's theory of para magnetism- White Dwarfs- Wiener- - Khinchine theorem and its correlation function-Bragg- Williams approximation- One dimensional Ising model.

BOOK FOR STUDY

1. Gupta, Kumar, Sharma , Statistical Mechanics, Pragat iPrakashan Publications(2005).

Unit	***Sections***
I	*A-1 to A-7, 13.1, 13.2.*
II	*10, 10.1, k-1, k-2, k-3.*
III	*2.1, 2.2, 2.7, 2.12, 1.1, 1.3, 1.7, 1.10, 3.0-4, 6.2, 6.3.*
IV	*6.10, 7.2-1 to 7.2-3, 8.0 to 8.2, 8.4.*
V	*9.2, 9.3, 9.4, 9.5, 12.8, 13.3, 13.4.*

BOOKS FOR REFERENCE

1. Statistical Mechanics, Sathya Prakash, Pragati Prakasam Publications (2004).
2. Statistical Mechanics, K Huang, Wiley Eastern Ltd., New Delhi (1986).
3. F. Reif, Statistical and Thermal Physics, Mc Graw Hill, International Edition, Singapore (1975).
4. B.K Agarwal and N. Eisnor, Statistical Mechanics, Wiley Eastern Limited, New Delhi, 2nd Edn (1989).
5. Mayer Joseph Edward, Statistical Mechanics, John Wiley and Son, New York (1949).

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Core Course - IV P PHYSICS PRACTICALS- I (General and Electronics)

Semester-I **Course Code : P16PH4P**
Instruction hrs /week. : 6 hrs. **Credit : 5**

Objectives:

- *To understand the concepts, techniques in physics experiments and develop instrument handling skills.*
- *To develop circuit building skills and trouble shooting ability in electronic experiments.*

Any 15 Experiments only

1. Determination of q, n, σ by elliptical fringes method.
2. Determination of Stefan's constant.
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation-Acoustic Grating.
4. Determination of Rydberg's constant.
5. Study of Hall effect in a semiconductor.
6. Determination of dielectric constant at high frequency by Lecher wire.
7. Michelson Interferometer- Determination of wavelength of monochromatic source.
8. Determination of wavelength of monochromatic source using Biprism.
9. Charge of an electron by spectrometer.
10. Differential scanning calorimeter.
11. Spectrum Photo – Cu/Fe spectrum.
12. Construction of dual regulated power supply.
13. Astable and monostable multivibrator using IC 555.
14. Design and study of Wein bridge oscillator (Op-amp).
15. Characteristics of UJT and applications.
16. Active 2^{nd}order filter circuits: Low pass, High pass and Band pass filters.
17. V-I characteristics of a solar cell.
18. FET amplifier (CD/CS configuration).
19. Polarization of light – Verification of Malus law and Brewster angle of glass.
20. Instrumentation amplifier using four IC 741.

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Core Course - V - ATOMIC AND MOLECULAR PHYSICS

Semester - II **Course Code : P16PH6**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To facilitate, introduce and make the students understand the basic concept to atomic spectra*
- *Atoms in external fields and quantum chemistry*
- *Microwave and IR spectroscopy, Raman Spectroscopy and electronic spectroscopy and resonance Spectroscopy of molecules.*

UNIT I : ATOMIC SPECTRA

Concept of Vector atom model and its quantum numbers-Stern –Gerlach experiments – Fine structure of hydrogen lines – Spin orbit interaction – LS-JJ coupling schemes – Selection rules-Hyperfine structure-Exchange symmetry of wave functions-Pauli's exclusion principle and its physical significance-Periodic table-Alkali type spectra-Equivalent electrons-Hund's rule.

UNIT II: ATOMS IN EXTERNAL FIELDS AND QUANTUM CHEMISTRY

Atoms in external fields: Zeeman effect-Paschen-Back effect-and its quantum mechanical treatment- Zeeman effect-Paschen-Back effect in two electron systems-selection rules-Stark effect.

Quantum chemistry of molecules: Born-Oppenheimer approximation-Heitler-London and molecular orbital theories of hydrogen molecule-Bonding and anti-bonding MOs-Huckel's molecular approximation-Application to butadine molecule.

UNIT III-MICROWAVE AND IR SPECTROSCOPY

Classification of molecules-Rotational spectra of diatomic molecules-Effect of isotropic substitution-the non- Rigid rotator-Rotational spectra of polyatomic molecules-Linear, symmetric top and asymmetric top molecules-Experimental techniques-Vibrating diatomic molecule-Diatomic vibrating rotator-Linear and symmetric top molecules-Analysis of infra Red techniques-Characteristic and group frequencies-IRspectrophotometer:Instrumentation and sample handling.

UNIT IV-RAMAN AND ELECTRONIC SPECTROSCOPY

Raman effect: Classical and quantum theory of Raman effect- Pure rotational and Vibrational Raman spectra of diatomic molecules-Raman spectrometer.

Electronic spectroscopy of diatomic molecules: Vibrational coarse structure-Progressions and sequences-The Franck-Condon principle-Dissociation energy and dissociation products-Rotational fine structure of electronic vibration transitions-the Fortrat parabolae.

UNIT V-RESONANCE SPECTROSCOPY

Nuclear magnetic resonance: Magnetic properties of nuclei-Resonance condition-NMR instrumentation-Additional techniques-Relaxation processes-Bloch equation-Dipolar Interaction-Chemical shift.

Electron Spin Resonance: Principle-ESR spectrometer-Total Hamiltonian-Hyperfine Structure-Spectra of free radicals in solution.

BOOKS FOR STUDY

1. C.N.Banwell, Elaine M.Mc Cash, Fundamental of Molecular Spectroscopy (Mc Graw Hill, New Delhi 2010).
2. Molecular Structure and Spectroscopy, G. Aruldhas, PHI Learning Private Limited, New Delhi (2009).
3. Gupta, S.L.Kumar, Sharma, Elements of Spectroscopy, Pragati Prakashan Publication, Meerut (2009).

UNIT	SECTIONS
I	3.6-3.11 in Book1 and relevant topics in Book2.
II	3.12-3.16-4.1-4.3,4.6-4.8 in Book1 and relevant topics in Book2
III	6.1-6.10,6.14,6.15,7.1-7.6,7.11,7.14,7.16,7.17 in Book1
IV	8.2-8.6,9.2,9.4,9.6-9.9 in Book1.
V	10.1-10.8,11.2-11.5(11.5.1 only),11.6(11.6.1-11.6.3 only) in Book1.

BOOKS FOR REFERENCE

1. P.S.Sindhu, Elements of Molecular Spectroscopy, New Age International, 2007.
2. A.K.Chandra, Introductory Quantum Chemistry, Mc Graw Hill, New Delhi, 2003

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Core Course - VI - QUANTUM MECHANICS

Semester - II **Course Code : P16PH7**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To learn about the fundamentals of quantum mechanical formalism*
- *To learn about Hamiltonian operator formalisms*
- *To apply certain exactly solvable examples*
- *Fundamentals of approximations*

UNIT – I INTRODUCTION TO QUANTUM MECHANICS

Wave – Particle - Dual nature of electron – De-Broglie wave length derivation – Wave (Eigen)function – Normalization technique – Orthonormal technique – Operator Formalism – Total energy, momentum, kinetic and potential energy operators – Ehrenfest Theorem - Derivation of Schrodinger's Equation – Time dependant and independent.

UNIT – II EXACTLY SOLVABLE PROBLEMS

Hydrogen atom – Ground state of Deuteron – Linear harmonic oscillator – Particle in a Box – Kronig-Penney square-Well periodic potential.

UNIT – III APPROXIMATIONS

Time dependant – Time independent perturbation theories - Stark effect - W.K.B approximation and its validity – Transition to continuum states "Fermi's Golden rule" – Adiabatic approximation.

UNIT - IV REPRESENTATION THEORY

Variation technique – Secular determinant – Hydrogen atom ion - Bracket notation - Schrodinger's, Heisenberg's and interaction pictures – Harmonic oscillator in matrix theory.

UNIT - V ANGULAR MOMENTUM AND RELATIVISTIC QUANTUM MECH.

Angular momentum formulation, L and J – Operator formulation of L and J – commutation properties – C-G coefficient (only qualitative treatment) – Klein-Gordon equation – Pauli's spin matrices.

BOOKS FOR STUDY

1.Gupta, Kumar and Sharma – Quantum Mechanics, S. Chand and Company publications.

2.G. Aruldhas - Quantum Mechanics – PHI Publications – 2008.

3.P.G. Puranik – Quantum Particle Dynamics,S. Chand and Company Publications.

4.L. Schiff – Quantum Mechanics – Tata Mc Graw Hill Publications, New Delhi.

UNIT	BOOK	CHAPTER/SECTION
I	1	1 (1.1,1.2,1.3,2.1—2.9)
II	1	2 /5 (5.1—5.13)
III	2/1	9.1,9.2,9.7,11.1,12.1 / 11,12
IV	2	3,3.9, 6.8,10.1,10.6
V	2/3	8.1,8.2,8.6, 14.1,14.2,14.3

BOOKS FOR REFERENCES:

1. V.Devanathan, Quantum Mechanics, Narosa Publishing House(2005).
2. P.M.Mathews and K.Venkatesan, A Text Book of Quantum Mechanics, Tata Mc Graw Hill publications, New Delhi, 1987).
3. V.K.Thankappan, Quantum Mechanics (Wiley –Eastern, New Delhi, 1985).

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Core Course - VII - NUCLEAR AND PARTICLE PHYSICS

Semester - II **Course Code :P16PH8**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To understand the basic structure and properties of the nucleus.*
- *To know the mechanism of the natural radioactivity.*
- *To learn the different types of nuclear reactions.*
- *To understand the properties of various fundamental particles.*

UNIT 1: PROPERTIES OF ATOMIC NUCLEI

Nuclear size and shape – Semi empirical mass formula -Parity- Nuclear forces – properties of Deuteron-Simple theory of ground state of deuteron– Spin dependence of nuclear forces– Singlet and triplet states in deuteron ground state-Properties of nuclear forces- Meson theory of nuclear forces.

UNIT 2: RADIOACTIVE DECAYS

Range of alpha particles and Geiger-Nuttal law – Gamow's theory – Neutrino hypothesis – Fermi theory of beta decay – Selection rules –Parity violation – Selection rules of Gamma radiation – Gas filled detectors –G.M counters -Scintillation counter.

UNIT 3: NUCLEAR REACTIONS AND NUCLEAR MODELS

Reaction Energetics-Q-Value-Threshold energy – Level Width- Types of Nuclear Reactions- Compound Nucleus Theory – Breit - Wigner Formula– Liquid Drop Model-Shell Model-Optical Model.

UNIT 4: ACCELERATORS REACTORS AND PLASMA PHYSICS

Linear accelerator-Cyclotron – Synchro cyclotron – Betatron–Nuclear fission – distribution of mass of fission products –Bohr-Wheeler's theory of nuclear fission – chain reaction-Four factor formula-nuclear reactor- Nuclear fusion-Plasma-Fusion reactions in the plasma- conditions for maintained fusion reactions- Stellar energy.

UNIT 5: ELEMENTARY PARTICLES

Classification of Elementary Particles–Fundamental interactions among particles-Quantum numbers specifying states of particles-Discovery of antiparticles- Conservation Laws in production and decay processes– Symmetry and Conservation laws– Quark model-Unification of fundamental interactions.

BOOK FOR STUDY:

1. 1.Sathya Prakash, Text Book of Nuclear and particle Physics, Sultan Chand and Sons, New Delhi (2005).

Units	Sections
I	1.5, 1.6, 1.17, 1.18, 7.4, 1.25, 2.1 to 2.4, 2.20.
II	4.4, 4.7, 5.5, 5.7, 5.9, 5.11, 6.5, 10.12, 10.15, 10.16.
III	8.1, 8.4, 8.5, 8.10 to 8.13, 7.3, 7.6, 7.11.
IV	10.5 to 10.8, 9.2, 9.3, 9.10 to 9.13, 9.17 to 9.21.
V	11.5 to 11.8, 11.10, 11.11, 11.14, 11.16.

BOOKS FOR REFERENCE:

1. V. Devanathan, Nuclear Physics, Naroso Publishing House (2006).
2. S. B. Patel, An Introduction to Nuclear Physics (Wiley-Eastern, New Delhi, 2008).
3. B. L. Cohen, Concepts of Nuclear Physics Tata Mc Graw Hill, New Delhi, (1993).
4. D. Griffiths, Introduction to Elementary Particles, Wiley International, New York,1987
5. Arora. C. L, Nuclear Physics, S.Chand and Co, New Delhi (1999).
6. Sharma.R. C, Nuclear Physics, K. Nath and Co, Meerut (1997).

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Core Course – VIII P PHYSICS PRACTICALS - II (General and Electronics)

Semester - II ` **Course Code : P16PH9P**
Instruction hrs /week: 6 hrs. **Credit : 5**

Objectives:

- *To understand the concepts and techniques in physics experiments and develop instrument handling skills.*
- *To develop circuit building skills and trouble shooting ability in electronic experiments.*

Any 15 Experiments only

1. Determination of q, n, σ by hyperbolic fringes method.
2. Determination of thermal conductivity of a good conductor – Forbe's method.
3. Determination of bulk modulus of a liquid by ultrasonic interferometer.
4. Planck's constant- Photo electric cell.
5. Band gap energy of a semiconductor - Four probe method.
6. Determination of L of a coil by Anderson's method.
7. Determination of e/m of an electron by Thomson's method
8. Determinations of wavelength of a laser source and thickness of a wire using Plane diffraction grating and thickness of a wire.
9. Polarizability of liquids by finding the refractive indices at different wavelengths.
10. Study of a fiber optic cable – Numerical aperture and other parameters.
11. Magnetic susceptibility of a paramagnetic solution using Quincke's tube method.
12. Determination of specific rotatory power of a liquid using polarimeter.
13. K-map simplification (SOP and POS expressions) – implementation with logic gates.
14. Characteristics of SCR and its applications.
15. Design and study of phase shift oscillator (Op-amp).
16. Design and study of bistable multivibrator.
17. Design and study of single stage amplifier (BJT)
18. Op -amp – Current to Voltage and Voltage to current converters.
19. Dissociation energy of Iodine molecule – Absorption spectrum.
20. Temperature coefficient using 555 timer.

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Core Course - IX - ELECTROMAGNETIC THEORY

Semester - III **Course Code : P16PH11**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To understand the basic concepts of electrostatics, magneto statics and Maxwell's equations.*
- *To learn electrostatics of macroscopic media.*
- *To study the propagation of plane electromagnetic waves..*

UNIT I: INTRODUCTION TO ELECTROSTATICS

Coulomb's law – Electric field –Electrostatic potential- Electric field and potential of a Dipole- Gauss law – Applied to determination of electric field intensity due to infinite line charge distribution - Poisson and Laplace Equations in differential form–Method of images – Illustration: Point charge in the presence of (i) a grounded conducting sphere – Boundary condition for D vector and E vector.

UNIT II: MAGNETOSTATICS

Ampere's force law-Biot and Savart law and its applications-Long straight wire- Ampere's circuital law – Amperian loop - Application to magnetic flux density due to infinite current carrying sheet - Magnetic scalar potential-Magnetic vector potential – Boundary conditions on B and H – Drichlet and Newmann conditions.

UNIT III: ELECTRODYNAMICS

Equation of continuity- Maxwell's displacement current – Maxwell's equations – differential and integral forms - Poynting's theorem-Diffrential form of Poynting's theorem -Electromagnetic Potential (A and Φ) – Maxwell's equations in terms of Electromagnetic Potential- Gauge transformations – Lorentz gauge.

UNIT IV: PLANE ELECTRO MAGNETIC WAVES AND WAVE PROPAGATION

Plane wave equation – Propagation of e.m. waves in free space - in a nonconducting isotropic medium – in a conducting medium- Reflection and refraction of electromagnetic waves (Snell's Law) – Propagation of electromagnetic waves in a rectangular wave guide - TM and TE modes.

UNIT V: INTRODUCTION TO ANTENNAS

Radiation by an oscillating dipole – Skip distance – Radiation patterns of antennas – Directional characteristics – Gain of an antenna – Linear array of antennas (N-arrays) – Qualitative analysis of a dipole antenna.

BOOKS FOR STUDY:

1. S.L.Gupta and V.Kumar, Electrodynamics,Pragati Prakashan Publications(2004).
2. K.K.Chopra and G.C.Agarwal, Electromagnteic Theory, K.Nath and Co.(1993).
3. Sathya Prakash, Electromagnetic Theory, Sulthan Chand and Sons, New Delhi (2005).
4. S.K. Dash and S.R.Khunita – Fundamentals of Electromagnetic Theory, PHI Publications, New Delhi – 2011.

Unit	Books
I	Relevant chapters in Book 1&3
II	Relevant chapters in Book 2
III	Relevant chapters in Book 2
IV	Relevant chapters in Book 2&3
V	Relevant chapters in Book 2 & 4

BOOKS FOR REFERENCE:

1. D. Jackson, *Classical Electrodynamics* (Wiley Eastern Ltd., New Delhi, 1993).
2.D. Griffiths, *Introduction to Electrodynamics* (Prentice-Hall, New Delhi, 1995).

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Core Course – X CRYSTAL GROWTH AND THIN FILM PHYSICS

Semester - III **Course Code : P16PH12**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To study the nucleation and growth*
- *To learn solution growth, gel growth, melt and vapour growth techniques*
- *To learn fundamentals of thin film deposition techniques.*
- *To learn the various methods of characterizing materials*

UNIT 1: NUCLEATION AND GROWTH

Nucleation –Classical theory of nucleation - Spherical and cylindrical nucleus - Growth Kinetics - singular and rough faces- Models on surface roughness- Kossel, Stranski, Volmer (KSV) theory- Burton, Cabrera, Frank (BCF) theory

UNIT II: LOW TEMPERATURE GROWTH TECHNIQUES

Solution Growth Technique:

Solution - Solubility and super solubility – Expression of super saturation –Mier's T-C diagram - Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.

Gel Growth Technique:

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: MELT AND VAPOUR GROWTH TECHNIQUES

Melt Growth: Bridgman technique - Basic process – Various crucibles design - Thermal consideration – Vertical Bridgman technique - Czochralski technique – Experimental arrangement – Growth process.

Vapour Growth: Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical vapour Transport.

UNIT IV: THIN FILM DEPOSITION TECHNIQUES

Introduction- Thin Film growth stages- Application of thin films- Properties of thin films – Deposition techniques - Physical methods– Chemical methods- Resistive heating, Electron beam gun, Laser gun evaporation and flash evaporations, sputtering - Reactive Sputtering, Radio-Frequency sputtering - Chemical methods – Spray pyrolysis – Preparation of TCO tin oxide thin films .

UNIT V: CHARACTERIZATION TECHNIQUES

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier Transform Infra Red Analysis(FT-IR) – Elemental analysis – Elemental Dispersive X-ray Analysis (EDAX) - Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vicker's micro hardness.

BOOKS FOR STUDY:

Relevant Chapters In

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986).

2. P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods,KRU Publications, Kumbakonam (2006).

3. A. Goswami, Thin Film Fundamentals, New Age International (P) Limited, New Delhi (1996).

4. Kasturi L. Chopra, Thin film Phenomena, Mc Graw Hill Book Company (1969).

BOOKS FOR REFERENCE:

1. Smith Donald.L, Thin Film Deposition, Mc Graw Hill, London (1995).

2. K.Ravichandran, K.Swaminathan, B.Sakthivel, Introduction to Thin Films, Research India Publications(2013).

3. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Thin Film Fundamentals, CBS, Publishers and Distributors, New Delhi.

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Core Course - XI P PHYSICS PRACTICALS-III ADVANCED ELECTRONICS - I

Semester - III **Course Code : P16PH13P**
Instruction hrs /week: 6 hrs. **Credit : 5**

(Any FIFTEEN Experiments)

1. BCD to seven segment display
2. Study the function of Decoder and Encoder
3. Digital 8-Bit comparator
4. Study of counter using IC 7490 (0-9 and 00-99)
5. Study of DAC interfacing (DAC 0900).
6. Study of ADC interfacing (ADC 0809).
7. Phase Shift Network and Oscillator using IC 741
8. Wien Bridge Oscillator using IC 741
9. Digital to Analog Converter - R-2R and weighted methods.
10. Study the function of Multiplexer and Demultiplexer.
11. Low pass and High pass filters using IC 741.
12. Traffic control system using microprocessor.
13. Control of stepper motor using microprocessor.
14. Digital Clock using microprocessor.
15. Microcontroller- 8-Bit addition and subtraction.
16. Microcontroller- 8 Bit multiplication and division.
17. Microcontroller- 16Bit division and multiplication.
18. Microcontroller- Ascending and Descending order.
19. Microcontroller- Pattern comparison
20. Solving linear equations by Operational Amplifier.

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Core Course - XII - CONDENSED MATTER PHYSICS

Semester - IV **Course Code : P16PH16**
Instruction hrs. /week: 6 hrs. **Credit : 5**

Objectives:

- *To study the crystal structure, lattice vibrations and thermal properties.*
- *To learn free electron theory, energy bands and semiconductor crystals*
- *To learn diamagnetism, paramagnetism, ferro magnetism and anti ferromagnetism*
- *To study dielectrics and ferroelectrics and superconductivity.*

UNIT I: CRYSTAL STRUCTURE

Crystal classes and symmetry – 2D, 3D lattices – Bravais lattices – Point groups – Space groups — Ewald's sphere construction – Bragg's law – Laue theory of X-ray diffraction, Geometrical structure factor, Atomic scattering factor, calculations for diamond structure BCC, FCC and hcp structure - Powder and single crystal diffraction methods - Diffractometers.

UNIT II: LATTICE VIBRATIONS AND THERMAL PROPERTIES

Vibration of monoatomic lattices – Lattices with two atoms per primitive cell – Phonon momentum – Inelastic scattering of neutrons by phonons –Dulong and Petit's Law– Einstein model – Density of modes in one-dimension and three-dimension – Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process.

UNIT III: ELECTRICAL PROPERTIES OF METALS AND SEMICONDUCTORS

Free electron gas- Ohm's law- Electrical conductivity and thermal conductivity-Wiedemann and Franz ratio- Quantum theory free electrons - Free electron gas in one dimension and three-dimension. Band theory of solids – The Kronig Penny model – Brillouin zone (Basic idea only) – Semiconductors –Intrinsic semiconductor-Carrier concentration in intrinsic Semiconductor-Hall effect-Experimental determination of Hall coefficient.

UNIT IV: MAGNETIC PROPERTIES OF MATERIALS

Langevin classical theory of diamagnetism and paramagnetism – Weiss theory -Quantum theory of paramagnetism –Ferromagnetism-Classical theory of ferromagnetism- Temperature dependence of spontaneous magnetisation – Domain theory-Anti ferromagnetism-Ferrites.

UNIT-V: DIELECTRICS AND FERROELECTRICS AND SUPERCONDUCTIVITY

Macroscopic electric field – Local electric field at an atom –Clausius- Mossotti equation - Occurrence of superconductivity – Meissner effect – London equation – Coherence length – BCS theory –Type I and Type II superconductors – Application of superconductors- Josephson superconductor tunneling – DC and AC Josephson effect— Flux quantization — SQUID.

BOOKS FOR STUDY:

Relevant Chapters in

1. Fundamental of Crystal Physics, Yu. L.S Irotin and M.P. Shaskolskaya Mir Publics Moscow (1983).
2. C. Kittel, Introduction to Solid State Physics (Wiley Eastern, New Delhi, 2008).
3. M. M. Woolfson, An Introduction to X-ray Crystallography (Cambridge University Press, Cambridge, 1970).
4. S. O. Pillai, Solid State Physics, New Age International, New Delhi (2007).

BOOKS FOR REFERENCE:

1. N. W. Ashcrof and N. D. Mermin, Solid State Physics (Holt, Rinehart and Winston, Philadelphia, 1976).
2. J. S. Blakemore, Solid State Physics (Cambridge University Press, Cambridge, 1974).
3. A. J. Dekker, Solid State Physics (Mc Millan, Madras, 1998).
4. A Compendium based on Introductory Solid State Physics by HP Myers, C & C Press (1997).

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Core Course – XIII P PHYSICS PRACTICAL IV : ADVANCED ELECTRONICS -II – P16PH17P

Semester : IV **Core Course:XIII**

Instruction Hours/Week: 6 **Credit: 5**

CHARACTERIZATION TECHNIQUES AND COMPUTER PRACTICALS

(Any Fifteen only -- Choosing a minimum of six experiments from each part)

CHARACTERIZATION TECHNIQUES

To characterize the given samples by using the following methods and their interpretations

1. XRD
2. FTIR
3. EDAX
4. SEM
5. UV-Vis
6. Micro hardness
7. Etching studies

COMPUTER PRACTICALS

1. Roots of algebraic equations - Newton-Raphson method.
2. Least-squares curve fitting – straight-line fit
3. Least-squares curve fitting – exponential fit.
4. Solution of simultaneous linear algebraic equations – Gauss elimination method.
5. Solution of simultaneous linear algebraic equations – Gauss-Seidal method.
6. Interpolation – Lagrange method.
7. Numerical differentiation – Euler method.
8. Solution of ordinary differential equations – Runge-Kutta 2^{nd}order method.
9. Evaluation of definite integrals – Monte Carlo method.
10. Numerical integration –Trapezoidal rule
11. Numerical integration –Simpson's 1/3rd rule.
12. Solution of ordinary differential equations – Runge-Kutta 4^{th} order method.
13. Calculation of mean, standard deviation and probability distribution of a set of random numbers.

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Elective Course – I - SPECIAL ELECTRONICS - I Micro Electronic Devices

Semester - I **Course Code : P16PH5E**
Instruction hrs /week: 6 hrs. **Credit : 4**

Objectives:

- *To understand various techniques and concepts in electronics.*
- *To learn about the working diodes.*
- *To develop IC fabrications.*

UNIT- I: SEMI CONDUCTOR DIODES

Continuity Equation (PN Junction) -Tunnel diode - Backward diode -Varactor diode – PIN diode-Schottky diode - IMPATT Diode - Gunn diode, Step recovery diode-Opto electronic diodes - LED and photo diode, Laser diode.

UNIT -II: SPECIAL SEMICONDUCTOR DEVICES

JFET- Structure and working - V-I Characteristics under different conditions - Biasing of JFET-DC load line-CS amplifier design-MOSFET: Depletion and enhancement type MOSFFT - Comparison of p with n-channel FETs - Digital MOSFET circuits-Complementary MOS, biasing the FET - FET as a voltage variable resistor (VVR) – Low Frequency common source and common drain amplifiers – Common source and drain amplifier at high frequencies.

UNIT – III: OPERATIONAL AMPLIFIERS

Operational amplifier characteristics-Input offset current and voltage- Frequency response - Inverting and non-inverting amplifier -Voltage follower -Differential amplifier-Instrumentation amplifier- Voltage to current and current to voltage conversions- log and antilog amplifiers -Integrating and differential circuits.

UNIT-IV: OP-AMP APPLICATIONS (OSCILLATORS AND CONVERTORS)

Oscillators: Schmitt's trigger -Square (Astable multivibrator)- Triangular-Sine wave generators-Phase shift and Wien bridge oscillator-Filter circuits - First order low pass Filter-Band pass filter-High pass filter.

Convertors**:** Triangular, basic D to A conversion: weighted resistor DAC - Binary R-2R ladder DAC -Basic A to D conversion: counter type ADC - successive approximation converter – Dual slope ADC.

UNIT – V: IC FABRICATIONS AND IC TIMER

Fabrications: Basic monolithic ICs - Epitaxial growth -Masking -Etching -Impurity diffusion-Fabricating monolithic resistors, diodes, transistors, inductors and capacitors - Circuit layout - Contacts and inter connections

555 Timer – Description of the functional diagram -Mono stable operation - Bistable multi vibrator - Applications-Missing pulse detector - Pulse width modulation - Schmitt's trigger.

BOOKS FOR STUDY:

1. Foundations of Electronics- D Chattopadhyay, P C Rakshit, B Saha, N.Purkait, New Age International Publishers, New Delhi (2006)
2. Operational Amplifier and Integrated Electronics – Roy Choudry, New Age International Publishers, New Delhi (2006)
3. Basic Electronics- B.L. Theraja, S.Chand and Co - New Age (2006).
4. Integrated Electronics - J.Milmann and C.C. Halkias, Mc Graw Hill , New Delhi

Unit	**Book**	**Section**
I	1	5.1, 5.4, 5.5, 5.6
	3	15.6,1 5.8 -15.10, 16.3, 16.8
II	3	26.1 - 26.2, 26.4, 26.5, 26.8-26.10 26.13 – 26.18, 27.1 – 27.4, 27.7 – 27.8
III	2	2.3, 2.3.3 -2.3.7, 4.3-4.5, 4.8, 4.10
IV	2	5.3, 5.4, 5.6, 5.7, 10.2, 10.2.1, 10.2.2, 10.3, 10.3.2, 10.3.4, 10.3.6
V	3	31.1-31.16 (selected portions)
	2	8.1-8.3, 8.3.1(selected portion) 8.4, 8.4.1(selected portion)

BOOKS FOR REFERENCES:

1. Principles of Electronics- V. K. Mehta, Rohit Mehta, S.Chand and Co, New Delhi, 2008.
2. Semiconductor Devices and Applications - A. Mottershed, New Age Int. Pub, New Delhi.

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Elective Course – II - SPECIAL ELECTRONICS - II
MICROCONTROLLER AND COMMUNICATION ELECTRONICS

Semester - II ` **Course Code : P16PH10E**
Instruction hrs /week: 6 hrs. **Credit : 4**

Objectives: *To gain knowledge in advanced electronics.*

UNIT I: MICROCONTROLLER ARCHITECTURE -8051

Review of Intel 8085 microprocessor architecture* - Microprocessor and Microcontrollers comparison- The 8051 architecture - 8051 oscillator and clock - Program counter data pointer - CPU registers-Flags and the program status word (PSW) Internal memory- Internal RAM and ROM -The stack and the stack pointers. Special function registers-Signals of 8051-I/O ports -Timers and counters

UNIT II: ASSEMBLY LANGUAGE PROGRAMMING CONCEPTS:

8051-Programming - 8051 instruction syntax - Moving data: addressing modes – External data moves- Code memory- Read only data moves -Push and pop opcodes- Data exchanges example programs - Logical operations: Byte-level logical operations –Bit level logical operations- Rotate and swap operations- Example programs

UNIT III: ANTENNAS AND MICROWAVES

Antennas-Power gain-Effective parameters of an antenna-Hertzian dipole-Half wave Dipole-VHF,UHF and microwave antennas-TV Types of scanning-TV receiver-TV transmitter-Colour picture tubes-Microwave generation and application, Klystron - Magnetron-Wave guides-Rectangular wave guide-Mode of propagation-Circular wave guide-Riged and flexible wave guides

UNIT IV: COMMUNICATION SYSTEMS

Amplitude modulation-AM transmitter-Single Side Band principle-Balanced modulator-SSB generation and reception-Independent side band system-Frequency modulation-FM transmitted-FM detector-Pulse modulation-PAM-Pulse-time modulation-Pulse width modulation-Pulse code modulation-Frequency shift keying-Pulse shift keying-Telemetry.

UNIT V: CELLULAR TELEPHONE AND SATELLITE COMMUNICATIONS

Evolution of Cellular telephone-Analog cellular telephone - personal communication system, Digital cellular telephone, Global system for mobile communication.

Kepler’s laws-Orbits-Geostationary orbit-Altitude and attitude control-Satellite station keeping-Transponders uplink-Power budget calculation-Down link power budget calculations-Multiple access methods.

BOOKS FOR STUDY

1. Kenneth J.Ayala, The 8051 Microcontroller-Architecture, Programming and Applications.
2. Krishnakanth - Microprocessors and microcontroller, Prentice Hall of India (2013).
3. G.Kennedy, Electronic communication systems (TATA Mc Graw Hill publications, New Delhi (2003).
4. Dennis Roddy-John Coolen, Electronic Communications-IV Edition-Prentice Hall of India(2004).
5. Wayne Tomasi -Electronic Communication systems -Pearson Education.

***Only for the recap of learned concepts. Questions not to be asked from this portion.**

Unit1	Book-1 chapters-3.1,3.2,2.4.2,4.3,4.6,6.3,6.4,6.5,6.21,6.24,6.25,6.29,6.30,6.36
Unit2	Book-2 chapters-7.3,7.4,7.7,7.8,7.9,7.10,7.11,9.2,9.5.1,9.6.1,9.6.4,9.8
Unit3	Book-3 chapters-16.2,16.4,16.5,16.6,16.7,16.8,16.9,16.10,16.18 Book-2 chapters-11.2,11.4 Book-3 chapters-14.1,14.2,14.3,13.2.1,13.2.2,213.2.3,13.2.4,13.3.1,13.3.2.
Unit4	Book-2 chapters-4.1,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.43, Book-3 chapters-10.2,10.13,10.14 Book-4 chapters-10.1,10.2,11.14,11.18,11.20
Unit5	Book-3 chapters-19.2,19.3,19.4,19.5,19.6,19.8,19.9,19.13,9.14,19.15,19.18.

BOOKS FOR REFERENCE

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085 (Penram International Publishing (India) Private Limited, Fifth Edition.

2. Gupta S.L and Kumar - Hand book of Electronics, Pragati Prakasan Publications.

3. B.Ram, Fundamentals of Microprocessors and Microcomputers (Dhanpat Rai publication (P)Ltd, New Delhi, Fifth Reprint 1998.

4. Microprocessors and Microcontroller –P.S. Manoharan- Charulatha Publications (2013).

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Elective Course – III NUMERICAL METHODS AND PROGRAMMING

Semester - III ` **Course Code : P16PH14E**
Instruction hrs /week: 6 hrs. **Credit : 4**

Objectives:

- *To study the errors and measurements*
- *To learn algebraic, transcendental equations and interpolation*
- *To study numerical differentiation and integration*
- *To program computer programming*

UNIT I: ERRORS AND MEASUREMENTS

General formula for Errors-Errors and its types-Empirical formula-Principle of least squares- Fitting a straight line-Fitting a parabola-Fitting an exponential curves – Fitting the curve ($y=ae^{bx}$)- C program for fitting a straight line..

UNIT II: ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

The iteration method- Newton- Raphson method –Convergence of Newton-Raphson method-C program for Newton-Raphson method.

Linear Algebraic Equations

Gauss elimination method-Jordan's modification-Gauss-Seidel method of iteration.

UNIT III: INTERPOLATION

Linear interpolation-Gregory-Newton forward and backward interpolation formula-Central difference formula-Gauss forward and backward interpolation formula-Lagrange's interpolation formula-Newton's formula for unequal intervals.

UNIT IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Numerical differentiation for solving first order differential equations:-Euler's method-Improved Euler's method-Runge-Kutta second and fourth order method for solving first orders differential equations-.C program for Euler's method, Runge -Kutta order method.
Numerical integration: Trapezoidal rule-Simpson's $1/3^{rd}$rule-Formula and derivation.

UNIT V: C PROGRAMMING

Structure of a C program – Primary data types- Constants- Integers- Various types of operators and expressions – Control structure- if – if –else- switch- go to –break and Continue statements – while – do, while – for statements – Declaration and initialization of arrays- functions – calling a function –return values and their types – structure definition and initialization – arrays of structures – arrays within structures –unions.

BOOKS FOR STUDY:

1. Numerical Recipes in C, W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling, Cambridge University (1996).
2. M.K.Venkataraman, Numerical methods in Science and Engineering, National Publishing Company, Chennai (2004).
3. Programming in ANSI-C – E.Balagurusamy- Tata Mc Graw Hill Publications (2004).
4. Program Materials given by the Department of Physics, National College, Tiruchirappalli. Unit V.

BOOKS FOR REFERENCE:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi (2003).
2. Numerical Methods in Science and Engineering – The National Publishing Co. Madras (2001).
3. Numerical Methods in C and C++, Veerarajan, S.Chand, New Delhi (2006).

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Elective Course – IV ELEMENTS OF NANOSCIENCE AND ITS APPLICATIONS

Semester - III **Course Code : P16PH15E**
Instruction hrs /week: 6 hrs. **Credit : 4**

***Objective**:*

- *To understand the history, background and the nature of the nano science and technology as well as the quantum and nano sized scale effects at nano phase.*
- *To get familiar with the nano characterization methods and to understand the potential applications of nanotechnology.*

UNIT I: INTRODUCTION TO NANO AND TYPES OF NANOMATERIALS

Nanoscience and nanotechnology – Need of nano - Origins of concepts of nano-nano and energetics – Top down and Bottom up approaches – Types of nanomaterials (introductory ideas only):-One dimensional(1D)– Two dimensional(2D)- Three dimensional(3D) nanostructured materials – Quantum dots – Quantum wire. Quantum well – Quantum Dot – Excitation confinement in Quantum Dots.

Unit II: NANO STRUCTURESEFFECTS

Fullerenes - properties of fullerenes-Carbon Nano Tubes (CNTs)- Types, properties, synthesis and applications of CNTs. Polymers – Biometics – Self assembled monolayers – Nano structured metals and alloys – Semiconductors – Band gap engineering and optical response.

Unit III: NANOMATERIALS FABRICATION

Synthesis of oxide nanoparticles by sol – gel processing - Electrochemical deposition – Electro spinning – Lithography –Atomic Layer Deposition – Langmuir - Biodgett films – Zeolite cages – Core Shell structures – Organic – Inorganic hybrids.

UNIT IV: NANOMATERIAL CHARACTERIZATION

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Probe Microscopy (SPM) techniques-(Principle, Experimental set up, procedure and utility for the all the techniques)

UNIT V: APPLICATIONS

Molecular electronics and Nano electronics – Nanobots- Biological applications of Nanoparticles- catalysis by gold Nanoparticles- band gap engineered quantum devices- Nano mechanics- CNT emitters- Photo electro chemical cells- Photonic crystals- Plasmon Waveguides.

BOOKS FOR STUDY:

1. T.Pradeep et al., A text book of Nano science and Nanotechnology, (2012), TMGH, New Delhi.
2. Guozhong Cao, Nanostructures and Nano materials (2004) Imperial College Press, London.
3. C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley-India, 2009.

BOOKS FOR REFERENCE:

1. Lusia Filipponian Duncan Sutherland, NANOTECHNOLOGIES: Principles, Applications, Implications and Hands-on Activities, 2013 (ISBN 978 -92 -79 -21437 -0)European Commission, B-1049 Brussels.
2. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.
3. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press India Pvt. Ltd, New Delhi, First Edition, 2005.
4. Nanotechnology by S. Shanmugam (2010), MJP Publishers, Chennai.

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Elective Course - V ADVANCED OPTICS

Semester - IV **Course Code : P16PH18E**
Instruction hrs /week: 6 hrs. **Credit : 4**

Objective:

- *To Study the ideas of fibre optics and lasers.*
- *To introduce the non-linear optics and nonlinear optical materials.*
- *To get familiar with the optical solitons.*

UNIT I: FIBER OPTICS

Introduction-Principle of optical fiber-Acceptance angle-Numerical aperture-Types of Optical fribres-Single mode and multimode optical fibres-Characteristics of step index and graded index fibres characteristics-Fiber attenuation-Dispersion and its types-Bandwidth- Distance product-Light sources-LED-Detectors-Photo diode-Optic fiber communication system-Advantages of optic fiber communication.

UNIT II: LASERS

Spontaneous emission – Stimulated emission – Einstein coefficients – Population Inversion –Pumping action – Schawlow and Town condition-Laser Characteristics.
Solid state laser: Nd-YAG- Ruby laser- Gas lasers: Helium – Neon –CO_2 laser –Argon-Ion laser- Semiconductor laser-Dye laser.

UNIT III: UNIT V: OPTICAL SOLITONS

Modulation instability: Linear stability analysis - Gain spectrum - Experimental Observation – Ultra short pulse generation - Impact on light wave systems - Fiber Solitons - Inverse scattering method - Fundamental soliton - Higher-Order solitons - Experimental confirmation – Soliton stability.
Types of solitons: Dark solitons - Dispersion-Managed solitons- Bistable solitons.

UNIT IV: NON-LINEAR OPTICS

Introduction -Harmonic Generation-Second Harmonic Generation- Phase matching-Third Harmonic Generation-Optical mixing: sum and difference frequencies-Parametric Generation of light-Self-focusing of intense light beams-Phase matching-Optical Matching-Multi quantum photo electric effect-Two photon process and its theory.

UNIT V: NON LINEAR OPTICAL MATERIALS

Basic requirements-Inorganics-Borates-Organics-Urea-Nitro aniline-Semi organics-Thiourea complex-Laser induced surface damage threshold-Kurtz and Perry powder technique.

BOOKS FOR STUDY:

1. Govind, P. Agarwal, Fiber-Optics Communication Systems, 3rd Edn. John Wiley and Sons, Singapore (2003).
2. B. B. Laud, Lasers and Non-Linear Optics, New Age International Publishers, New Delhi (2008).
3. Nonlinear Fiber Optics, Third Edition, Govind P. Agrawal Academic Press,2001.
4. Lecture notes and course material: Non Linear Optical Materials, Department of Physics, National College (Autonomous), Tiruchirappalli for Unit V.

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