PERIYAR EVR COLLEGE (AUTONOMOUS & ACCREDITED)

PG AND RESEARCH DEPARTMENT OF PHYSICS

M.Sc., PHYSICS – COURSE PATTERN (2015 -16 ONWARDS)

S.No	Subject code	Course	Instruction hours	Credits	Internal Exam	External Exam
SEMESTER – I						
1	CC01	Classical Mechanics	6	5	25	75
2	CC02	Mathematical Physics – 1	6	5	25	75
3	CC03	Thermodynamics and Statistical Mechanics	6	4	25	75
4	CC04	Advanced Electronics	6	4	25	75
5	CC05	Practical I (General)	6	4	25	75
		Total	**30**	**22**	**125**	**375**
SEMESTER – II						
6	CC06	Mathematical Physics –II	6	5	25	75
7	CC07	Electromagnetic Theory	6	5	25	75
8	CC08	Molecular Spectroscopy	6	5	25	75
9	CC09	Nano Physics	6	4	25	75
10	CC10	Practical – II (Electronics)	6	4	25	75
		Total	**30**	**23**	**125**	**375**
SEMESTER – III						
11	CC11	Quantum Mechanics	6	5	25	75
12	CC12	Nuclear and Particle Physics	6	5	25	75
13	CC13	Practical – III (Advanced General Experiments & C Programming)	6	5	25	75
14	CBE I	Laser and Non – Linear Optics	6	4	25	75
15	CBE II	Microprocessor and Microcontrollers	6	4	25	75
		Total	**30**	**23**	**125**	**375**
SEMESTER – IV						
16	CC14	Condensed Matter Physics	6	5	25	75
17	CC15	Practical – IV (Microprocessor)	6	5	25	75
18	CBE III	Communication Electronics	6	4	25	75
19	CBE IV	Crystal Growth and Thin Film Physics	6	4	25	75
20	CC16	Project	6	4	25	75*
		Total	**30**	**22**	**125**	**375**
		Grand Total	**120**	**90**	**500**	**1500**

*** Viva-voce.**

SEMESTER I ***Code: CC01***

CLASSICAL MECHANICS

Unit I: Lagrangian Formulation

Variational principle and Lagrangian formulation − Generalized co-ordinates − Constraints and degrees of freedom –holonomic and non-holonomic constraints- Principle of virtual work- D' Alembert's principle − Deduction of Lagrangian equation − Application: Simple pendulum and Atwood's machine.

Unit II: Hamiltonian formulation

Phase space and motion of the system − Hamiltonian function H− Hamilton equations- physical significance of Hamiltonian function-Applications: particle moving near the surface of the earth − Particle in a central field of force in polar and cylindrical co-ordinates−Variational principle-Hamiltonian equation from variational principle-Principle of least action − Proof.

Unit III: Transformation theory

Canonical or contact transformation − Advantages of canonical transformations − condition for a canonical transformation to be canonical − Simple problems - Poisson brackets − Properties − Invariance of Poisson brackets with respect to canonical transformations − Simple problems − Equation of motion in Poisson bracket form.

Unit IV: Rigid bodies

Euler's theorem − Euler angles − Angular velocity of a rigid body − Angular momentum of a rigid body − Moments and products of inertia − Euler's equations − The motion of symmetric top under the action of gravity − Precession without nutation − Nutational motion.

Unit V: Theory of small oscillations

Stable and unstable equilibrium − Two coupled oscillators − Formulation of the problem: Lagrange's equation of motion for a small oscillation − Properties of T,V,ω − Normal co-ordinates and normal frequencies of vibrations − systems with few degrees of freedom: Free vibrations of a linear tri-atomic molecule and parallel pendulum.

Books for study:

1. Classical mechanics-Gupta kumar and Sharma, Pragati prakashan, Meerut, second edition 2006.
2. Classical mechanics-B.D. Gupta and Sathya prakash, Kedarnath Ramnath, Meerut.
3. Classical mechanics Upathayaya

SEMESTER I ***Code: CC02***

MATHEMATICAL PHYSICS – I

Unit I: Matrix Theory

Matrix - Rank of Matrix – Characteristic equation and roots - Cayley-Hamilton equation - Diagonalisation of matrices – Sylvester theorem – Hermitian and Skew Hermitian matrix and unitary matrix.

Unit II: Vector field

Orthogonal curvilinear coordinates – Expression of gradient, divergent and curl functions – Laplacian in Cartesian, cylindrical and spherical co-ordinate system - Stoke's theorem - Gauss theorem - Green's theorem.

Unit III: Special Functions

Gamma and Beta functions – Legendre, Hermite, Laguerre and Bessal functions - Series solutions – Generating functions – Recurrence relations and orthogonal properties.

Unit IV: (a) Vector Spaces

Vector space - Definitions and properties - Linear independence of vectors – Basis - Orthonormal basis - Schwartz inequality - Gram-Schmidt Orthogonolisation process.

(b) Tensors

Transformation of coordinates - Summation convention - Contravariant, co-variant and mixed tensors - Rank of Tensors - Symmetric and Antisymmetric tensors - Tensors of higher rank - Metric tensors.

Unit V: Complex Variables

Analytic function - Cauchy-Reimann equations - Classification of singularities – Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Cauchy's residue theorem - Evaluation of definite integrals.

Books for Study and Reference

1. Mathematical Physics - H.K. Dass, S. Chand & Co, New Delhi. (Unit I, II, III and V)
2. Mathematical Physics – Sathya Prakash, S. Chand & Co, New Delhi. (Unit IV)
3. Mathematical Physics – B.D. Gupta, Vikas Publishing House, 2008.
4. Mathematical Physics – P.K. Chattopadhyay, New Age International PVT. Ltd. 2004. ((Unit II)

SEMESTER I ***Code: CC03***

THERMODYNAMICS AND STATISTICAL MECHANICS

Unit I: Review of the laws of thermodynamic and their consequences

Energy and first law of thermodynamics – Heat content and heat capacity – Specific heat – Entropy and second law of thermodynamics – Thermodynamic potentials and reciprocity relations – Gibb's – Helmholtz relation – Thermodynamic equation – Nernst's heat theorem or the third law – Consequences of the third law.

Unit II: Kinetic Theory of Gases

Mean free path – Mean free path and collision probability – Law of distribution of free path – Viscosity – Variation of viscosity with temperature and pressure – Heat conduction – Boltzmann transport equation and its validity – Application to viscosity and electrical conductivity.

Unit III: Low Temperature Physics

Production of low temperature – Approach to absolute zero by adiabatic demagnetization – Measurement of low temperatures – Conversion of magnetic temperature to Kelvin temperature – Helium I and Helium II – Some peculiar properties of helium II.

Unit IV: General Principles of Statistical Mechanics

Phase Space – Ensembles – Types of ensembles- Liouvilles theorem – Macro and Microstates – Maxwell Boltzmann distribution law – Distribution of energy and velocity – Law of equipartition for energy – Partition function – Thermodynamical quantities in terms of partition function – Gibb's canonical ensemble – Thermodynamical functions of canonical ensembles.

Unit V: Quantum Statistical Mechanics

Quantum statistics of identical particles – Bose – Einstein gas – Bose – Einstein condensation – Fermi – Dirac gas – Degeneracy – Thermionic emission – Black body and Planck's radiation – Specific heat of solids: Einstein 's theory and Debye's theory.

Books for study

1. Statistical Mechanics, Gupta, Kumar and Pragathi Prakashan, Meerut.
2. Statistical Mechanics, Satya Prakash and J.P Agarwal, Kedarnath Ramnath & Co, Meerut.
3. Statistical Mechanics, R, Huang, Wiley Eastern Ltd., New Delhi, (1983)
4. Statistical and Thermal Physics, F. Reif, Mc Graw Hill, International Edition, Singapore (1979).

SEMESTER I ***Code: CC04***

ADVANCED ELECTRONICS

Unit I: Special Semiconductor Device

FET - Theory of FET - Characteristics and parameters measurement – FET as an amplifier - MOSFET - Depletion and enhancement mode - Tunnel diode – Forward & Reverse bias characteristics – SCR, TRIAC, DIAC & UJT - construction, working and characteristics and applications.

UNIT II: Digital Electronics

Arithmetic circuit – Half and Full adder – Half and Full subtractor – Parallel binary adder – 8421 adder – RS flip flop – Clocked RS flip flop – JK flip flop – Master Slave flip flop – Ripple counter – 4 bit ripple counter – Decade counter – Up and down counter – Ring counter – Serial and parallel registers

UNIT III: D/A AND A/D Converters

Digital to analog converter – Accuracy and resolution of DAC – Weighted register network – R-2R ladder network – Analog to digital converter – Simultaneous conversion – Successive approximation technique – Accuracy and resolution of ADC

UNIT IV: Operational Amplifier and its Applications

The basic operational amplifier – Characteristics of an ideal operational amplifier – Virtual ground – Open loop gain – Inverting and non – Inverting amplifier – Summing amplifier – Differential amplifier – Voltage follower – DC characteristics – Input bias current – Input offset voltage – Input offset current – Measurement of op-amp parameters – Common Mode Rejection Ratio – Slew rate.

UNIT V: Waveform Generators

Op-Amp. Multivibrators – Astable (square) – Monostable (pulse generators) – Bistable – Schmitt trigger circuits – Triangular wave generators – IC 555 timer – Astable, Monostable and trigger circuits – Phase shift and Wien bridge sine wave oscillators.

Books for study:

1. Integrated Electronics – Millman – Halkias, Tata Mc Graw Hill.
2. Linear Integrated circuits – D. Ray Chaudhury, Shail Jain, New Age International Publishing.
3. Digital Principle and Application – Malvino and Leech, Tata Mc Graw Hill
4. Op-Amps & Linear Integrated Circuits - Ramakant A.Gayakwad

SEMESTER I ***Code: CC05***

PRACTICAL - I (GENERAL)

Any 12 Experiments:

1. Determination of q, n, σ - Elliptical Fringes
2. Determination of q, n, σ – Hyperbolic Fringes
3. Determination of Stefan's constant
4. Ultrasonic interferometer - Bulk modulus of a liquid.
5. e/m - Thomson's method
6. e/m - magnetron method.
7. Rydberg's constant - Hydrogen spectrum
8. Rydberg's constant - solar spectrum
9. Hartmann's formula - wavelength of mercury spectrum
10. Co-efficient of viscosity of a liquid - Mayer's oscillating disc method
11. Anderson bridge method - measurement of M
12. Thermionic work function
13. Dielectric constant - Lecher wire
14. Study of laser beam parameters
15. Determination of Plank's constant

SEMESTER II ***Code: CC06***

MATHEMATICAL PHYSICS - II

Unit I: Integral transforms

Fourier series − Dirichilet's theorem − Fourier integral theorem − Fourier sine and cosine integrals − Fourier sine and cosine transforms − Laplace transform − Laplace transform of the derivative of f(t) – Laplace transform of the derivative of order n − Laplace transform of integral of t, f(t), Laplace transform of f(t)/t − Relation between Laplace and Fourier transform

Unit II: Group theory

Basic definitions – Multiplication table – Sub–groups, Co–sets and classes – Direct product groups – Point groups and space groups – Representation theory – Homomorphism and Isomorphism – Reducible and irreducible representations – Schur's lemma (no derivation) - The great orthogonality theorem – Character tables – C2v.

Unit III: Partial differential equations

Solution of equation by direct integration − Partial differential equation non-linear in p and q − Charpit's method − Linear homogenous partial differential equation of n^{th} order with constant co-efficient − Rules for finding complimentary function − Rules for finding the particular integral.

Unit IV: Numerical analysis - 1

Curve fitting by least square method (straight line and parabola) − Lagrange's interpolation - Newton interpolation formula (forward and backward) − Error Newton interpolation formula - Numerical integration by Trapezoidal rule and Simpson rule − program for the above methods in C languages.

Unit V: Numerical analysis - 2

Solutions to linear equations − Euler's Method: Modified and improved Euler's method - Newton Raphson method − solution of differential equations − Runge Kutta II and IV order method − program for the above methods in C languages.

Books for study

1. Mathematical Physics - H. K. Dass., Chand & Co., New Delhi.
2. Mathematical Physics - Sathya Prakash, Sultan Chand & Sons.
3. Numerical methods - M.K. Venkatraman, Sultan Chand & Sons, 2007.

SEMESTER II ***Code: CC07***

ELECTROMAGNETIC THEORY

Unit I: Electrostatics

Coulomb's law – Electric field – Continuous charge distributions – Divergence of E –Applications of Gauss Law - Curl of E - Electric Potential - Poisson's equations - Laplace's equations: Cartesian coordinates, Cylindrical coordinates and spherical coordinates - Conducting spheres in a uniform field – Dielectric sphere in a uniform field - Force on dielectrics - Multipole expansion: potential at a large distance, monopole and dipole.

Unit II: Magnetostatics

Biot-Savart law-Magnetic field due to a straight wire and circular loop-Ampere's law in circuital form- Force between current carrying conductors-Magnetic field due to long straight wire-Magnetic vector Potential – Multipole expansion of a current distribution-Force, torque and energy of a localized current distribution, in an external magnetic induction-Methods of solving boundary value problem in magneto statistics.

Unit III: Field equations, Maxwell's equations and conservation laws

Faraday law of induction – Maxwell's displacement current - Maxwell equation in differential and integral form in free space and linear isotropic media-boundary conditions on the fields at interfaces. Poynting's theorem –Electromagnetic scalar and vector potential – Gauge transformation- Coulomb gauge and Lorentz gauge.

Unit IV: Wave propagation

Plane wave equation - Plane waves in non-homogeneous non-conducting medium: poynting vector, power flow, energy density and significance - Partly conducting medium: skin effect, relative direction of E and H, pointing vector, energy density - propagation in ionized gases – Reflection and refraction of EMW at the interface of non-conducting medium: kinetic and dynamic properties – Brewster law and degree of polarization.

Unit V: Wave guide and Interaction of EM waves with matter

Wave Guide - Propagation of waves in a rectangular wave guide - Scattering and scattering parameters by a free electron (Thomson's scattering) and bound electron (Rayleigh scattering) - Coherence and Incoherence of scattered light – Dispersion – Normal and Anomalous dispersion in liquids and solids – Dispersion in Gases.

Books for study

1. Introduction to Electrodynamics by David J. Griffith, Prentice Hall. (Unit I & II)
2. Electrodynamics - Chopra and Agarwal. (Unit III, IV & V)
3. Electromagnetic Theory - Sathya Prakash. (Unit IV)

SEMESTER II ***Code: CC08***

MOLECULAR SPECTROSCOPY

Unit I: Microwave spectroscopy

Rotation of diatomic molecules – Rigid and non-rigid rotator – Intensities of rotational spectral line - Rotations of linear, poly-atomic molecules and symmetric top molecules – Stark effect in linear molecules - Instrumentation – applications: structural determination of molecules (simple molecules) - Inversion spectra of ammonia - Measurement of Barrier heights.

Unit II: IR and Raman spectroscopy

Theory – Vibration spectra of diatomic and linear molecules – poly-atomic molecules – Linear and symmetric top molecules – Modes of vibration in poly atomic molecules –Instrumentation of IR Spectroscopy, FTIR spectroscopy.

Raman Spectroscopy – Principle - Characteristics - Classical and quantum mechanical theories – Pure rotation and rotation – vibration Raman spectra – Rule of Mutual exclusion principle - Moment of inertia of diatomic molecules and Raman spectroscopy – Instrumentation (FT Raman) – Importance of Raman spectra – Application of Raman spectroscopy - Advantages of Raman spectroscopy over IR spectroscopy.

Unit III: UV and Electronic spectra

Introduction – Absorption Laws – Types of electronic transition – Transition probability – Chromophore – Auxochrome - Absorption and Intensity shifts – Types of absorption bands - Solvent effect – Instrumentation – Woodward – Fieser rules for calculating absorption maximum in dienes.

Introduction - Frank – Condon principle – Vibrational coarse structure-rotational fine structure-Fortrat diagram-charge transfer spectra-Applications.

Unit IV: NMR and ESR Spectroscopy

NMR spectroscopy – Theory –width of Absorption lines-chemical shift-Single coil and double coil spectrometers – High resolution spectrometer – NMR spectra in liquids – spin interaction – Chemical analysis by NMR.

ESR spectroscopy – ESR spectrometer – Hyper-fine splitting – Line-width - Applications.

Unit V: Atomic fluorescence and Mossbauer spectroscopy

Introduction - theory – Advantages – Limitations - Atomic fluorescence Spectroscopy as an analytical tool - Atomization process, absorption process and fluorescence process - Types of fluorescence - Instrumentation.

Mossbauer spectroscopy – principles - Experimental arrangement – Chemical shifts Quadruple and Zeeman splitting – Applications.

Books for Study

1 Spectroscopy (Atomic and molecular) Gurdeep R. Chatwal, Shan. K. Anand.

2 Fundamentals of Molecular Spectroscopy (II Edition) by C.N. Banwell, Tata Mc Graw Hill.

3 Elementary Organic Spectroscopy- Y. R. Sharma

4 Spectroscopy - H. Kaur (Pragati prakashan publication).

5 Spectroscopy (vol. I, II & III) by B.P. Stroughan and Walker, Chopman & Hall

SEMESTER II ***Code: CC09***

NANO PHYSICS

Unit I: Nanoscale System

Definition: Nanometer, Nanomaterial - Classification of nanomaterial - Energy considerations: bound states and density of states in 3D, 2D, 1D and zero dimensional – Properties of Nano particles - Optical, Electrical and magnetic properties – Landauer - Buttikar formalism for conduction in confined geometries.

Unit II: Synthesis of Nanomaterials

Top down and Bottom up approach - Ball milling - Pulsed Laser deposition - Electro deposition - Plasma arc discharge – Sputtering - Thermal evaporation – Electron beam evaporation – Chemical vapour deposition.

Unit III: Characterization Methods

X - ray diffraction – Debye Scherer formula - Dislocation density - Transmission electron microscope (TEM) - Scanning Tunnelling microscope and Atomic Force microscope – Principle and working.

Unit IV: Lithography

Introduction – Photolithograpy - Electron beam lithography – X - ray lithography - Iron beam deposition – Molecular beam epitaxy.

Unit V: Applications of Nanomaterials

Quantum dots: single electron transistors, coulomb blockades effects in ultrathin Metallic tunnel junctions, white LED, LASER. Nano particles based solar cells –Carbon nanotubes based transistors-fuel cells - Chemical sensors.

Book for Reference:

1. Nano science and Nanotechnology – M.S. Ramachandra Rao and Shubra Singh.
2. Introduction Nanotechnology-Charles P. Poole, Jr., and Frank J. Owens, John Wiley and Sons, 2003.
3. Introduction to Nanoscience and Nanotechnology - K. K. Chattopadhyay and A. N. Bannerjee, PHI Learning Private Ltd.
4. Nanomaterials – B. Viswanathan, National Centre for Catalysis Research 2006

SEMESTER II ***Code: CC10***

PRACTICAL - II (ELECTRONICS)

Any 12 Experiments:

1. Construction of IC regulated power supply (5V, 9-0-9 Volt)
2. Characteristics of UJT
3. Characteristics of SCR
4. Pulse generator using NAND and NOR gates
5. UJT relaxation oscillator
6. OP-AMP- wave generator (square and sine)
7. Common source amplifier
8. OP-AMP-D/A converter
9. Study of flip-flop (RS, D, JK)
10. Schmidt trigger using OP-AMP
11. OP-AMP- active filters
12. Modulo ‘n’ counter
13. Encoder and decoder
14. Up and down counter using JK flip-flop
15. Astable multivibrator using 555 timer
16. Half and Full adder
17. Half and Full subtractor

SEMESTER III ***Code: CC11***

QUANTUM MECHANICS

Unit I: The Schrödinger Equation and exactly solvable problems

The Schrödinger Equation – Physical interpretation and conditions on the wave function–postulates – Expectation values and Ehrenfest's theorem – Particle in a square well potential- Linear harmonic oscillator — Three dimensional harmonic Oscillator – Orbital angular momentum and parity commutation relation – Rigid Rotator – Particle in a central potential – Hydrogen atom.

Unit II: Time independent perturbation and time dependent pertubation

Time Independent problems – Non–degenerate – First and second order perturbation–Degenerate case – Zeeman Effect – Stark effect – Variational method – WKB Approximation – Application to tunneling problem and quantization rule.

Time dependent problems – Time dependent perturbation theory – First order perturbation – Harmonic perturbation – Transition probability – Fermi's golden rule – Adiabatic approximation – Sudden approximation.

Unit III: Quantum Theory of Scattering

Scattering cross section – Born approximation – Condition for validity of Born approximation – Scattering by a screened Coulomb potential – Rutherford's scattering formula – Partial wave analysis – Phase shifts.

Unit IV: Angular momentum

Eigen values and Eigen functions of angular momentum – Commutation rules among orbital, spin and total angular momentum operators, raising and lowering operators – Matrix representation of angular momenta [J_x, J_y, $J_x+ J_y$, $J_x- J_y$ – Pauli spin matrix – Addition of angular momentum – Clebsch – Gordon coefficients, CG for J_1=1, J_2= ½.

Unit V: Relativistic wave equation

The Klein Gordon equation – Dirac equation – Dirac matrices and their properties – Free particle solution of Dirac equation – Dirac equation in central field and electromagnetic field.

Books for study:

1. A text book of quantum mechanics−Mathews and Venkatesan, Tata McGraw-Hill Publication Company limited, New Delhi.
2. Quantum Mechanics - Sathya Prakash,

SEMESTER III ***Code: CC12***

NUCLEAR AND PARTICLE PHYSICS

Unit I: Nuclear properties

Basic idea in Rutherford scattering of α-Particles - nuclear size, nuclear force, shape and charge distribution, spin and parity - Binding energy - semi empirical mass formula - Nuclear stability - Mass parabolas.

Unit II: Nuclear models and Nuclear reactions

Liquid drop model - Single particle shell model - Its validity and limitations - Collective model - Nuclear fission and fusion – Bohr - wheeler theory of nuclear fission and nuclear reactions - Compound nuclei.

Unit III: Nuclear forces

Nature and properties of nuclear forces - Properties of deuteron-Ground state of deuteron-Neutron-proton scattering at low energies -Tensor forces and Exchange forces- Meson theory of nuclear forces- Basic ideas on the theories of weak and strong interactions.

Unit IV: Radioactive decays

Alpha emission - Geiger-Nuttal law - Gamow's theory - Neutrino hypothesis - Fermi theory of beta decay - Non conservation of parity - Gamma emission - internal conversions - Nuclear isomerism.

Unit V: Elementary particle Physics

Building blocks of nucleus: leptons, mesons, baryons, hyperons, Hadrons, Strange particles - Classification of fundamental forces and elementary particles - Conservation laws: Baryonic, Lepontic, strangeness isospin charge and quantum numbers - Gell-Mann-Nishijima formula - Quark model - CPT invariance.

Books for study and references:

1. Nuclear Physics by Roy and Nigam (John Wiley & sons) .
2. V. Devanathan, Nuclear Physics, Narosa Publishing house (2006).
3. Introduction to Elementary Particles by D. Griffith (Wiley publication).
4. S.B. Patel, Nuclear Physics: An Introduction (Wiley-Eastern, New Delhi, 1991).
5. B.L. Cochen, Concepts of Nuclear Physics: Tata McGraw Hill, New Delhi, 1998).
6. H.S Hans, Nuclear Physics: Experimental and Theoretical (New Age International Publishers, New Delhi, 2001).

SEMESTER III ***Code: CC13***

PRACTICAL – III

Advanced General Experiments & C Programming

Any 12 Experiments:

1. Four probe method – Determination of Resistivity
2. Determination of carrier concentration and Hall coefficients in Semiconductor
3. Determination of magnetic susceptibility – Guoy's method
4. Determination of magnetic susceptibility of liquids by Quincke's method
5. Determination of separation of wavelength λ and dλ – Michelson's interferometer.
6. Determination of thickness of a thin film – Michelson interferometer.
7. Charge of an electron – Spectrometer.
8. Polarizability of liquids – Spectrometer.
9. Determination of wavelength of monochromatic source using bi – prism.
10. Determination of refractive index of liquids using bi – prism - telescope method.
11. Determination of coefficient of coupling by AC bridge method.
12. "g" factor determination by using ESR spectrometer.
13. Laser grating – Determination of λ.

COMPUTER PRACTICALS

1. Roots of algebraic equations – Newton Raphson method.
2. Least square curve fitting – Straight line fit.
3. Interpolation – Lagrange method.

Numerical Integration

4. Trapezoidal rules.
5. Simpson's rules.

Solutions of ordinary differential equations

Runge – Kutta second order method.

SEMESTER III ***Code: CBE1***

LASER AND NONLINEAR OPTICS

Unit I: Laser Fundamentals

Principle of Laser – Distinct Properties – Directionality – Intensity – monochromaticity – Coherence – Population inversion – Methods of achieving population inversion – Einstein coefficients – Rate equations – Two level, three level and four level systems – Q factor – Resonating modes.

Unit II: Types of Lasers

Solid state lasers – Ruby laser – Nd: YAG laser – Excitation mechanism – Applications – Gas lasers: He-Ne laser and CO_2 laser – Structure – Two modes of excitation – Applications – Semiconductor lasers: Ga-As laser – Structural details – Excitation mechanism – Applications – Dye laser – Chemical lasers – Hydrogen Fluoride laser.

Unit III: Applications of Lasers

Scientific: Optical data storage – Detection of absolute rotation of the earth – Isotope separation – Laser Doppler Velocimetry (LDV) – Industrial: Laser Cutting and welding – Medical – Communication – Long distance transmission – Holography : Basics – Production of a hologram – Reconstruction of images – Applications.

Unit IV: Advances in Laser Physics and Laser Spectroscopy

Laser Physics: Q – switching – Mechanical, Acousto- optic and Electro-optic Q switches – Spectroscopy: Rayleigh and Raman scattering – Stimulated Raman effect – Hyper – Raman Effect – Classical treatment – Coherent Anti-Stokes Raman Scattering (CARS) – Photo – Acoustic Raman Spectroscopy (PARS).

Unit V: Nonlinear Optics

Harmonic generation – Second harmonic generation – Polarization in a non-linear optical medium – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self focusing of light.

Books for Study:

1. Laser and Nonlinear Optics – B.B. Laud, New Age International (P) Ltd. Publishers, New Delhi, 2000.
2. Laser – Theory and Applications – K. Thyagarajan and A. Ghatak, Tata Mc Graw Hill, Publishing Co., New Delhi.
3. Semiconductor Physics and Optoelectronics, P. K. Palanisamy, Scitech Publications (India) Pvt. Ltd., Chennai, 2003.

SEMESTER III ***Code: CBE2***

MICROPROCESSOR AND MICROCONTROLLER

Unit I: Microprocessor Architecture, Instruction set and Interfacing

Intel 8085 Microprocessor Architecture, Pin configuration, Instruction cycle, Timing diagram, Instruction and data formats, Addressing modes, Status flags, Intel 8085 instructions. Address space partitioning, Memory and I/O Interfacing, Data transfer schemes, Interrupts of Intel 8085. Generation of control signals for memory and I/O devices.

Unit II: Microprocessor Programming

Assembly language, Stacks, Subroutines, MACRO, Delay Subroutine - Examples of Assembly language Programming – addition – Subroutine – complement – shift – mask – look – up table – To find the largest and smallest number in a data array – sorting – sum of a series – Multiplication – Division – multi – byte addition and subtraction.

Unit III: Microcontroller – 8051

Microprocessor and Microcontroller – Overview of 8051 Family – Pin Description of 8051 – Registers – Program Counter, ROM space, RAM space, stack, PSW, SFR – Addressing Modes –Jump call Instructions – Time delay generations and Calculations – Arithmetic and Logic Instructions – Assembly Language Programming – Data Types and Directives.

Unit IV: Microcontroller SFRs and Programming

Counter / Timer – Counter Programming – Basics of serial Communication – RS232 Connections and ICs Max 232 – 8051 serial Communication Registers – Serial Communication Programming – Interrupts – Interrupts Registers – Internal and External Interrupt Programming.

Unit V: Microprocessor and Microcontroller Applications

Microprocessor Interfacing and Applications:

Programmable peripheral interface Intel 8255, Interfacing 7 segment LED display, Measurement of frequency, voltage and current, Measurement of temperature. Microprocessor based traffic control, Generate square wave or pulse using Microprocessor.

Microcontroller Interfacing and Applications:

Interfacing – LCD, ADC 0809, Stepper Motor, Keyboard and DAC.

Books for study:

1. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications (P) LTD., New Delhi (2005).
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi – The 8051 Microcontroller and Embedded Systems, Pearson Education, Delhi, Seventh Indian Reprint 2004.

Books for Reference

1. A. P. Godse and D. A. Godse, Microprocessors and its Applications, Technical Publications, Pune, 2006.
2. A. Nagoor Kani, Microprocessor and Microcontrollers, RBA Publications, Chennai, 2006.
3. R. Goankar, Microprocessor Architecture, Programming and Application (Wiley Eastern, New Delhi, 1985)

SEMESTER IV ***Code: CC14***

CONDENSED MATTER PHYSICS

Unit I: Magnetic Materials

Introduction to Magnetic Materials – Different Types of Magnetic Materials – Weiss Theory of Ferromagnetism – Domain Theory of Ferromagnetism - Hysteresis – Hard and Soft Magnetic Materials – Ferrites (Ferri Magnetic Materials) – Structure and Properties of Ferrites – Application of Ferrites – Magnetic Recording (Storage) Materials – Magnetic Floppy Disks – Hard Disk Memory – Floppy Disk Drive.

Unit II: Super Conducting Materials

Introduction to Super Conductors – Properties of Super Conductors – Types of Super Conductors – High Temperature Super Conductors (HTS) – Application of Super Conducting Materials – Cryotron – Josephson Device – SQUID – Magnetic Levitated Train (MagLev)

Unit III: Optical Material

Introduction – Optical Absorption in Metals, Semiconductors and Insulators – Traps, Recombination Centres And Excitons – Color Centres – Optical Absorption in Dielectrics – Display Devices and Display Materials – Fluorescence of Phosphorescence – LED – LCD – Photoconductivity and Photoconducting Materials.

Unit IV: Dielectric Materials

Dielectrics – Definition – Different Types of Dielectrics – Types of Electric Polarization – Frequency and Temperature – Effects on Polarization – Dielectric loss – Local Field or Internal Field – Clausius - Mosotti Relation – Dielectric Breakdown.

Unit V: Modern Engineering Materials

Introduction to Metallic Glasses – Properties and Applications – Shape Memory Alloys – Introduction – Classification – Working Principle of SMA – Basic Component of SMA system – Application of Thermoelectric SMAs – Advanced Ceramics – Introduction to Ceramics – Modern Application of Advanced Ceramics – Biomaterials.

Books for Study:

1. Material Science – Dr. M. Arumugam
2. Material Science – P. K. Palanisamy (SCITECH Publications)

   Material Science – V. Ragahvan.

SEMESTER IV ***Code: CC15***

PRACTICAL – IV

MICROPROCESSOR LAB

Any 12 Experiments:

1. Program for addition and subtraction in 8 bit & 16 bit.
2. Program for multiplication and division.
3. Finding the biggest number / smallest number in a list.
4. Arranging a given set of number in ascending and descending order.
5. Masking desired nibble in a given set of number.
6. Program to display the names on the seven segment display.
7. Making an 8 bit A.D.C.
8. Program to transfer a block of data from one location to another location.
9. Hexa, octa to decimal conversion and vice-versa.
10. Displaying a six letter message – plain display.
11. Generation of square, triangular, saw-tooth, staircase and sine wave.
12. Control of stepper motor using microprocessor.
13. Traffic control system using microprocessor.

SEMESTER IV ***Code: CBE3***

COMMUNICATION ELECTRONICS

Unit I: **Modulation and Demodulation**

Modulation - Types of modulation - Spectrum and power in AM signal – Generation of SSB Signal – VSB – Frequency and Phase modulation - FET Reactance – FM modulator – Armstrong method of FM generation – Frequency discriminator – Band width requirements – signal to noise ratio – Phase modulation, FM modulation and AM modulation Comparisons of AM, FM and PM – Pulse code modulation – Delta modulation – PCM reception – Advantages of PCM and DM - VSB Demodulator - Super heterodyne receiver –TRF receiver – straight receiver.

Unit II: Optical Fiber Communication - Fundamentals

Introduction to fibers: Introduction, advantages, disadvantages and applications of optical fiber communication. Basic optical laws and definitions, optical fiber modes and configurations. Mode theory – overview of modes, key model concepts. Single mode fibers – Mode field diameter, propagation modes. Graded - index fiber structure.

Transmission characteristics of optical fibers: Attenuation, absorption, scattering losses, bending loss. Dispersion, Intra model dispersion, modal delay, group delay, material dispersion, waveguide dispersion.

Unit III: Optical Sources, Detectors and Connectors

Optical Sources**:** Direct and Indirect band gaps. Light Emitting Diodes - LED Structures, Quantum efficiency and LED power. Laser Diodes – Laser diode modes and threshold conditions, Laser diode rate equations, external quantum efficiency.

Photo detectors: Pin Photo detector, Avalanche photodiodes, Photo detector noise, Detector response time.

Fiber joints and Connectors: Fiber-to fiber joints – mechanical misalignment, fiber Splicing, Fiber connectors – connector.

Unit IV: Fascimile and Wireless Transmission

Fascimile: Fascimile transmitter – Fascimile receiver – Conversion of electrical signal to an optical image – Transmission of facsimile telegraph signal.

Wireless Transmission: Frequencies for radio transmission – Signals – Antennas – Signal propagation – Multiplexing (SDM, FDM, TDM & FDM) – Modulation (ASK, FSK, PSK, Advanced FSK, Advanced PSK).

Unit V: Mobile Communication

Cellular Concept – GSM - Mobile services – System Architecture – Network and Switching – Radio interface – Logical channels – Protocols – DECT (Digital Enhanced Cordless Telecommunication) – System and Protocol architecture.

Books for study:

1. Principles of communication Engineering – Umesh Singh – Tech India Publication, New Delhi.
2. Communication Electronics – Deshpande N.D., Deshpande D.A, Rangole P.K., Tata Mc Graw Hill publishing company limited, New Delhi.
3. Electronics Communication – Dennis Roddy, John Coolen – Prentice – Hall of India Private Limited, New Delhi.
4. Mobile Communications – Jochen Schiller – Pearson Education (Singapore) Private Limited, Indian Branch – Patparganj – New Delhi.
5. Optical Fibre Communication, Gerd Keiser, Tata Mc Graw Hill, 1984.

Books for Reference:

1. Electronic Communication system – George Kennedy – Tata Mc Graw Hill, 3rd Edition.
2. Electronic Communications system – Wayne Tomasi – Addison Wesley Longman (Singapore) Private Limited, Patparganj – New Delhi.

SEMESTER IV ***Code: CBE4***

CRYSTAL GROWTH AND THIN FILM PHYSICS

Unit I: Nucleation and Growth

Nucleation – Different kinds of nucleation – Concept of formation of critical nucleus – Classical theory of nucleation – Spherical and cylindrical nucleus – Crystal system and symmetry.

Unit II: Solution Growth Technique

Low temperature solution growth: solution – Solubility and Supersolubility – Expression for supersaturation – Miers T- C diagram – Constant temperature bath and crystallizer – Seed preparation and mounting – Slow cooling and solvent evaporation method. Structures and importance of gel – Experimental procedure – chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and decomplexion method – Advantage of gel method.

Unit III: Melt Technique

Bridgman technique – Basic process – Various crucibles design – Thermal consideration vertical Bridgman technique – Czochralski technique – Experimental arrangement – Growth process.

Vapour Technique*:*

Physical vapour deposition (PVD) – Chemical vapour deposition (CVD) – Chemical vapour transport.

Unit IV: Thin film Deposition Technique

Thin film – Growth kinetics of thin film – Deposition Techniques – Physical vapour Deposition – Resistance Heating – Thermal Evaporation – Flash evaporation – Laser gun Evaporation Sputtering – Reactive sputtering , Radio frequency sputtering – Chemical Vapour Deposition- Pyrolysis – Electrodeposition – electroless plating.

Unit V: Characterization Technique

X- ray diffraction (XRD) – Powder method and Single crystal method – Fourier transform infrared analysis (FT - IR) – Dispersive X- ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – UV – VIS – NIR spectrometer – Etching – Vickers microhardness.

Books for study:

1. Crystal growth processes, J.C Brice, John Wiley Sons, New York (1986)
2. Crystal Growth Processes and Methods P. Santhanaragavan and P. Ramasamy, , KRU publications, Kumbakonam.
3. Thin Film fundamentals, A. Goswami, New Age International (p) Limited, New Delhi (1996)
4. Instrumental Methods of Analysis, H.H. Willard, L.L Merit, J.A Dean and F.A. Settle, CBS Publishers and Distributors, New Delhi.