**THANTHAI HANS ROEVER COLLEGE, PERAMBALUR – 621220**
**(AUTONOMOUS)**
**M.Sc. PHYSICS – COURSE STRUCTURE UNDER CBCS**
**(For the candidates admitted from the academic year 2018-2019 onwards)**

| SEMESTER | COURSE | COURSE CODE | COURSE TITLE | HRS/WEEK | CREDIT | EXAM HRS | CIA MARKS | UNI EXAM MARKS | TOTAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| | CORE-I | 18PPH1CC1 | Mathematical Physics | 6 | 4 | 3 | 25 | 75 | 100 |
| | CORE-II | 18PPH1CC2 | Classical Mechanics and relativity | 6 | 4 | 3 | 25 | 75 | 100 |
| | CORE-III | 18PPH1CC3 | Electronics | 5 | 4 | 3 | 25 | 75 | 100 |
| I | CORE-IV | 18PPH1CC4 | Atomic and Molecular Spectroscopy | 5 | 4 | 3 | 25 | 75 | 100 |
| | CORE Practical I | 18PPH1CP1 | Physics Practical – I (General and Electronics Practical) | 8 | 4 | 3 | 40 | 60 | 100 |
| **TOTAL** | | | | **30** | **20** | | | | **500** |
| | CORE-V | 18PPH2CC5 | Electromagnetic Theory | 6 | 5 | 3 | 25 | 75 | 100 |
| | CORE-VI | 18PPH2CC6 | Quantum Mechanics | 6 | 5 | 3 | 25 | 75 | 100 |
| | CORE Practical II | 18PPH2CP2 | Physics Practical – II (Microprocessor and C programming practical) | 8 | 4 | 3 | 40 | 60 | 100 |
| II | Elective Course-I | 18PPH2EC1 | Microprocessor and Communication Electronics | 5 | 5 | 3 | 25 | 75 | 100 |
| | Elective Course-II | 18PPH2EC2 | Numerical methods and Programming | 5 | 5 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **24** | | | | **500** |
| | CORE-VII | 18PPH3CC7 | Statistical Mechanics | 6 | 5 | 3 | 25 | 75 | 100 |
| | CORE-VIII | 18PPH3CC8 | Solid State Physics | 6 | 5 | 3 | 25 | 75 | 100 |
| | CORE Practical III | 18PPH3CP3 | Physics Practical – III (Liquid state and Solid State Physics Practical) | 8 | 4 | 3 | 40 | 60 | 100 |
| III | Elective Course-III | 18PPH3EC3 | Crystal growth and Thin film Physics | 5 | 5 | 3 | 25 | 75 | 100 |
| | Elective Course-IV | 18PPH3EC4 | Nonlinear Optics | 5 | 5 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **24** | | | | **500** |
| | CORE-IX | 18PPH4CC9 | Nuclear & Particle Physics | 5 | 5 | 3 | 25 | 75 | 100 |
| | CORE-X | 18PPH4CC10 | Advanced Physics | 5 | 5 | 3 | 25 | 75 | 100 |
| | CORE Practical IV | 18PPH4CP4 | Physics Practical – IV (Analog & Digital Electronics Lab) | 8 | 4 | 3 | 40 | 60 | 100 |
| IV | Elective Course-V | 18PPH4EC5 | Nanoscience and Nanotechnology | 5 | 4 | 3 | 25 | 75 | 100 |
| | PROJECT | 18PPH4PW | Project Work – Dissertation – 80 Marks; Viva – 20 Marks | 7 | 4 | - | - | - | 100 |
| | TOTAL | | | **30** | **22** | | | | 500 |
| | | | | **120** | **90** | | | | **2000** |

| CIA Splitting | MID SEMESTER I | MID SEMESTER II | ASSIGNMENT | TOTAL |
|---|---|---|---|---|
| | 10 MARKS | 10 MARKS | 5 MARKS | 25 MARKS |

- Core Course - 10
- Core Practical - 4
- Elective Course - 5
- Project - 1

## List of Major Based Elective (For 2018 – 2019)

| Elective | Semester | Course Code | Title of the Course |
|---|---|---|---|
| Elective-I | II | 18PPH2EC1 | Microprocessor and Communication Electronics |
| Elective-II | II | 18PPH2EC2 | Numerical methods and Programming |
| Elective-III | III | 18PPH3EC3 | Crystal growth and Thin film Physics |
| Elective-IV | III | 18PPH3EC4 | Nonlinear Optics |
| Elective-V | IV | 18PPH4EC5 | Nanoscience and Nanotechnology |

## MATHEMATICAL PHYSICS

| | |
|---|---|
| Core Course: I | Semester: I |
| Course Code: 18PPH1CC1 | Max. Marks : 100 |
| Hours / Week: 6 | Internal Marks : 25 |
| Credit: 4 | External Marks : 75 |

**Objectives:**

- ❖ To practice mathematical methods for Physics through vector analysis
- ❖ To know about the evaluation of definite integrals
- ❖ To derive some special functions like Legendre, Bessel, Laugerre and Hermite differential equations

**Unit I: Vector analysis and Matrix theory**

Line integral, surface integral and volume integral – Gauss theorem, Green's theorem, Stoke's theorem and applications – Orthogonal curvilinear coordinates – Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates – Characteristics equation of a matrix – Eigen values and Eigen vectors – Cayley-Hamilton theorem – Reduction of a matrix to diagonal form.

**Unit II: 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 – Residues and singularities – Cauchy's residue theorem – Evaluation of definite integrals.

**Unit III: Special functions**

Gamma and Beta functions – Series solution: Legendre, Bessel, Laugerre and Hermite differential equations – Rodrigues formula – Generating functions – Orthogonality relations – Important recurrence relations.

**Unit IV: Fourier series & Laplace transforms**

Fourier series – Dirichlet's theorem - Change of interval - Complex form - Fourier series in the interval (0, ∞) - Uses of Fourier series - Laplace transform: Definition, Properties - Translation property - Inverse Laplace transform: properties, example problems.

**Unit V: Group theory & Tensors**

**Group theory:** Definition of Groups - Groups of transformation - Multiplication Table (C4**V**) - Subgroups and conjugate classes - Cyclic groups - Symmetry Elements - Transformation & matrix representation - Point & space groups - Reducible & irreducible representation of a group.

**Tensors:** Transformation of coordinates – Summation convention – Contravariant, covariant and mixed tensors – Rank of a tensor – Symmetric and antisymmetric tensors – Contraction of tensor.

**Books for study**

1. Sathya Prakash, Mathematical Physics, Sultan Chand & Sons, 1997.
2. Balaji, Engineering mathematics-I, G. Balaji publishers, 2008.
3. Balaji, Engineering mathematics-II, G. Balaji publishers, 2009.
4. H.K.Dass and Rama Verma, Mathematical Physics, 8th edition, 2018

**Books for References**

1. A.W. Joshi, Matrices and Tensors in Physics, New Age International (P) Ltd., New Delhi, 3rd Edition, 1995,
   Reprint 2005.
2. Erwin Kreyzig, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 2006.

3. S. Arumugam, A. Thangapandi Isaac and A. Somasundaram, Engineering Mathematics, Vol I-III,First edition-Scitech Publications (India) pvt.Ltd., 2009.
4.Granino A.Korn and therasa M.Korn, Mathematical hand book for Scientists and Engineers, Dover publications ins, New York, 2013
5. B.D. Gupta, Mathematical Physics, Vikas Publishing House, Noida, 4$^{th}$ Edition, 2010.
6. B.S. Rajput, Mathematical Physics, Pragati Prakashan, Meerut, 17$^{th}$ Edition, 2004.
7. A.W. Joshi, Elements of Group Theory for Physicists, New Age International (P) Limited, New Delhi, 1997.

## CLASSICAL MECHANICS AND RELATIVITY

Core Course: II Semester: I

| | |
|---|---|
| Course Code: 18PPH1CC2 | Max. Marks : 100 |
| Hours / Week: 6 | Internal Marks : 25 |
| Credit: 4 | External Marks : 75 |

**Objectives:**

- ❖ To learn about the fundamentals of classical generalized coordinates and formation
- ❖ To know about both Lagrangian and Hamiltonian formalisms
- ❖ To study the general theory of small oscillations and rigid body dynamics

**Unit I: Lagrangian formalism**

Constraints and Degrees of Freedom - Generalized Coordinates: Generalized displacement, acceleration, momentum, force & potential – Virtual work- D'Alemberts principle- Lagrange's equation of motion from - Application of Lagrange's equation of motion: Linear Harmonic Oscillator, Simple pendulum, Atwood machine.

**Unit II: Hamiltonian formalism**

Phase space – Hamiltonian – Hamilton's canonical equation of motion - Significance of H - Deduction of canonical equation from variation principle - Application of Hamilton's equation of motion: Bead on a rotating wire, particle in a core - Principle of least action - Canonical transformations - Generating function and different forms.

**Unit III: Hamilton – Jacobi method**

Hamilton Jacobi method - Solution of harmonic oscillator by Hamilton Jacobi method – Application of Hamilton Jacobi method: Particle falling freely - Kepler problem - Poisson's brackets: Definition, Equation of motion in Poisson's bracket form

**Unit IV: Rigid body and theory of small oscillations**

Rigid bodies – Moments and products of inertia – Euler's angles – Euler's equation of motion of a rigid body – Motion of a symmetric top in a gravitational field – Theory of small oscillations – Normal coordinates and normal modes – Linear triatomic molecules.

**Unit V: Relativity**

Reviews of basic ideas of special relativity – Energy momentum four vector – Minkowski's four dimensional space – Lorentz transformation as rotation in Minkowski's space – Compositions of Lorentz transformation about two orthogonal directions – Thomas precession – Invariance of Maxwell's equations under Lorentz transformation – Elements of general theory of relativity.

**Books for study**

1. S.L. Gupta, V. Kumar & H.V. Sharma, Classical Mechanics, Pragati Prakashan, Meerut, 2010.
2. H. Goldstein, Classical Mechanics, Addison Wesley, London, 2002.

**Books for References**

1. John Robert Toyler, Classical Mechanics, University Science books, Sausation, Californiya, 2005.
2. David Morin, Introduction to classical mechanics with problems and solutions, Cambridge University press, 2008.

## ELECTRONICS

Core Course: III — Semester: I
Course Code: 18PPH1CC3 — Max. Marks : 100
Hours / Week: 5 — Internal Marks : 25
Credit: 4 — External Marks : 75

**Objectives:**

- ❖ To understand the I-V characteristics of the semiconducting materials
- ❖ To study the idea of conversion of digital signal to analog signal and vice versa
- ❖ To know about the characteristics of Operational Amplifier

**Unit I: Special semiconductors**

JFET- Structure and working – I-V characteristics under different conditions – Biasing circuits – CS amplifier design – AC analysis – MOSFET: Depletion and enhancement type MOSFFT – UJT characteristics – Relaxation oscillator — Application in power control DIAC, TRIAC.

**Unit II: Semiconductor devices**

FET as a voltage variable resistor - Common source amplifier at high frequencies - Common drain amplifier at high frequencies - Silicon Controlled Rectifier (SCR) Characteristics - SCR power control - Tunnel diode -Optoelectronics: Photo resistor, Photo diode, Photo transistor, LED, Photo voltaic effect, Solar cells.

**Unit III: Operational amplifier**

Operational amplifier characteristics – Inverting and non-inverting amplifier – Instrumentation amplifier – Voltage follower – Integrating and differential circuits – Log & antilog amplifiers – Opamp as comparator – Voltage to current and current to voltage conversions - Active filters: Low pass, high pass, band pass & band rejection filters - Solving simultaneous and differential equations.

**Unit IV: Signal processing & Data acquisition**

Wave form generators and wave shaping circuits - Sinusoidal oscillators - Phase shift oscillator - Wein bridge Oscillator - Crystal oscillator – Multivibrators - Comparators - Schmitt trigger - Square wave & triangular wave
generators - Pulse generators - IC 555 timer and its application - Signal and signal processing - Analog multiplexer and demultiplexer - D/A converters - A/D converters.

**Unit V: IC fabrication and IC timer**

Basic monolithic ICs – Epitaxial growth – Masking – Etching impurity diffusion - Fabricating monolithic resistors, diodes, transistors, inductors and capacitors – Circuit layout – Contacts and inter connections – Charge Coupled Device (CCD) – Applications of CCDs - 555 timer – Description of the functional diagram – Mono stable operation – Applications of mono shots – Astable operation - Pulse generation.

**Books for Study**

1. Albert Malvino, David J Bates, Electronics Principles, 7th Edition, Tata McGraw Hill Publishing Company
Ltd., New Delhi, 2007.
2. V. K. Mehta, Principles of Electronics, S. Chand & Co, New Delhi, 2015.

**Books for References**

1. Jacob Millman & Arvin Grabel, Microelectronics, Tata McGraw Hill Publishing Company Ltd., New Delhi,
22nd Reprint, 2009.
2. Thomas L. Floyd, Electronic Devices, Pearson Education, New York, 2004.
3. J. Milman and C.C. Halkias, Integrated Electronics, Tata McGraw Hill, New Delhi, 1991.
4. A. Mottershed, Semiconductor Devices and Applications, New Age Int. Publications, New Delhi.

## ATOMIC AND MOLECULAR SPECTROSCOPY

| | |
|---|---|
| Core Course: IV | Semester: I |
| Course Code: 18PPH1CC4 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 4 | External Marks : 75 |

**Objectives:**

- ❖ To understand the elements of atomic and molecular spectroscopy
- ❖ To define the basic idea of the atomic spectra through Pauli's exclusion principle
- ❖ To explain about the experimental procedure of NMR and ESR spectrum

**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 – Hyperfine structure - Exchange symmetry of wave functions – Pauli's exclusion principle – Alkali type spectra – Equivalent electrons – Hund's rule.

**Unit II: Atoms in external magnetic and electric fields**

Experimental study of Zeeman effect – Classical interpretation – Normal Zeeman effect – Anomalous Zeeman effect - Paschen-Back effect – Quantum mechanical treatment of Zeeman and Paschen Back effect – Stark effect.

**Unit III: Microwave and IR 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 - Vibrating diatomic molecule – Diatomic vibrating rotator – Linear and symmetric top molecules – Analysis by infrared techniques.

**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 – Experimental techniques – Stimulated Raman scattering.

**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 – Experimental techniques.

**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

**ESR:** Basic principles – ESR spectrometer – Nuclear interaction and hyperfine structure – Relaxation effects – g-factor – Experimental methods.

**Books for study**

1. C. N. Banwell, Fundamentals of Molecular Spectroscopy, McGraw Hill, New York, Fourth Edition, 2008.
2. R. Murugesan, Modern Physics, $17^{th}$ edition, S. Chand Pvt Ltd, New Delhi, 2013.
3. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice-Hall of India Pvt. Limited, 2004

**Books for References**

1. Arther Beiser, Concept of Modern Physics, $6^{th}$ Edition, Tata Mc Graw Hill Pvt ltd, New Delhi 2003.
2. S.L. Gupta, V. Kumar, R.C. Sharma, Elements of Spectroscopy, Pragati Prakashan, Meerut, 1996.

## PHYSICS PRACTICAL - I
## GENERAL & ELECTRONICS PRACTICAL

| | |
|---|---|
| Core Practical - I | Semester: I |
| Course Code: 18PPH1CP1 | Max. Marks : 100 |
| Hours / Week: 8 | Internal Marks : 40 |
| Credit: 4 | External Marks : 60 |

Any **TWELVE** Experiments (choosing a minimum of six experiments from each part)

**A. General Experiments**

1. Determination of q, n, b by elliptical fringes method
2. Determination of q, n, b by hyperbolic fringes method
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation
4. Determination of Stefan's constant
5. Identification of prominent lines by spectrum photography – Copper spectrum
6. Identification of prominent lines by spectrum photography – Iron spectrum
7. BH loop – Energy loss of a magnetic material – Anchor ring using B.G.
8. Determination of dielectric constant at high frequency by Lecher wire
9. Determination of e/m of an electron by magnetron method
10. Determination of e/m of an electron by Thomson's method
11. Determination of L of a coil by Anderson's method
12. Photoelectric effect (Planck's constant Determination)

**B. Electronics Experiments**

13. Study of a feedback amplifier – Determination of band width, input and output impedances.
14. Design and study of monostable multivibrator
15. Design and study of bistable multivibrator
16. Design and study of phase shift Oscillator (Op-amp)
17. Characteristics of FET
18. Characteristics of UJT
19. Characteristics of SCR
20. Common source amplifier using FET
21. Common drain amplifier using FET
22. Relaxation oscillator using UJT (or) Op-amp

## ELECTROMAGNETIC THEORY

Core Course: V Semester: II

Course Code: 18PPH2CC5 Max. Marks : 100
Hours / Week: 6 Internal Marks : 25
Credit: 5 External Marks : 75

**Objectives:**

- ❖ To know about the derivation of Poisson's and Laplace equation
- ❖ To understand the relation connecting the different parameters in electrostatics and magnetostatics
- ❖ To derive the Maxwell equations in terms of the vector and scalar potentials

**Unit I: Electrostatics**

Electric field: Coulomb's law – Continuous charge distribution - Electrostatic potential – Poisson's and Laplace equations – Multipole expansion of a charge distribution – Dirichelt and Neumann boundary conditions: Methods of separation of variable – Potentials within a conducting box – Methods of images – Point charges in the presence of a grounded conducting sphere.

**Unit II: Electrostatics in macroscopic media**

Potential and field due to an electric dipole - Dielectric polarization - External field of a dielectric medium - Gauss theorem - Electric displacement vector **D** - Linear dielectrics - Relations connecting electric susceptibility $\chi_e$, Polarization **P**, Displacement **D** and Dielectric constant - Boundary conditions of field vectors - Molecular field - Clausius Mosotti relation for non-polar molecules - Electrostatic energy and energy density.

**Unit III: Magnetostatics**

Lorentz force law – Biot and Savart law – Magnetic field due to straight conductor – Ampere's law in differential form – Magnetic vector potential – Multipole expansion of a vector potential – Boundary conditions on B and H – Magnetic flux – Intensity of magnetization – Magnetic susceptibility - Magnetic susceptibility and permeability in linear and non-linear media.

**Unit IV: Electromagnetics**

Faraday's law of induction – Maxwell's displacement current – Maxwell equations – Maxwell equations in terms of vector and scalar potentials – Lorentz invariance of Maxwell's equation - Gauge transformations: Lorentz gauge, Coulomb gauge – Poynting's theorem – Conservation of energy and momentum for a system of charged particles and electromagnetic fields - Transmission lines & waveguides – Dynamics of charged particles in static and uniform electromagnetic fields.

**Unit V: Relativistic Electrodynamics**

Four vectors - Transformation relation for charge and current densities for electromagnetic potentials - Covariant form of inhomogeneous wave equations - Covariance of field equations in terms of four vectors - Covariant form of electric and magnetic field equations - Covariance of electromagnetic field tensor - Covariant form of Lorentz force law.

**Books for Study**

1. K.K. Chopra & G.C. Agarwal, Electromagnetic Theory, Nath & Co., 1984.

2. Gupta, Kumar & Singh, Electrodynamics, Pragati Prakashan, Meerut,1992

3. Satyaprakash, Electromagnetic Theory & Electrodynamics, Kedar Nath Ram Nath & Co., Meerut.

4. J.D. Jackson, Classical Electrodynamics, Wiley India Edition, 3rd Edition, Reprint 2009.

**References**

1. M. Schwartz, Principles of Electrodynamics, Dover Publications, New York,1987.
2. Dale R. Carson & Paul Lorrain, Introduction to EM Fields & Waves, Free man, 1st Edition, 1962.
3. David J. Griffiths, Introduction to Electrodynamics, Pearson International Edition, 4th Edition, 2013.

## QUANTUM MECHANICS

| | |
|---|---|
| Core Course: VI | Semester: II |
| Course Code: 18PPH2CC6 | Max. Marks : 100 |
| Hours / Week: 6 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To learn the approximation methods to study perturbation theory
- ❖ To study the concepts of Angular momentum
- ❖ To understand the basic idea of Dirac formalism in Quantum mechanics

**Unit I: Schrodinger equation and general formulation**

Physical meaning and conditions on the wave function - Schrodinger equation – Expectation values and Ehrenfest's theorem – Hermitian operators and their properties – Commutator relations - Uncertainity relation - Bra and ket vectors - Hilbert space – Schrodinger, Heisenberg and interaction pictures.

**Unit II: Approximate methods**

Time independent perturbation theory in non-degenerate case - Ground state of Helium atom - Degenerate case - Stark effect in hydrogen - Variation method & its application to Hydrogen molecule - WKB approximation.

**Unit III: Time dependent perturbation theory**

Time dependent perturbation theory - First and second order transitions - Transition to continum of states - Fermi Golden rule - Constant and Harmonic perturbation - Transition probabilities - Selection rules for dipole radiation.

**Unit IV: 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 –($J_1=1/2, J_2=1/2$).

**Unit V: Scattering theory & Relativistic Quantum mechanics**

Scattering cross section – Green's function – Born approximation – Partial wave analysis – Klein-Gordon equation for a free particle and in an electromagnetic field – Dirac equation for a free particle – Dirac matrices.

**Books for study**

1**.** Gupta, Kumar & Sharma, Quantum Mechanics, 23rd Edition, 2004
2. P.M. Mathews & K.Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill, New Delhi,
2005L.
3. Ghatak**,** Ajoy**,** Lokanathan, S**.**Quantum Mechanics: Theory and Applications, 2004

**References**

1. I. Schiff, Quantum Mechanics, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2010.
2. Satyaprakash, Quantum Mechanics, Pragati Prakashan.
3. Merzbacher E, Quantum Mechanics, Wiley and Sons, USA, 3rd Edition, 1998.

## PHYSICS PRACTICAL - II
## MICROPROCESSOR AND C PROGRAMMING

| | |
|---|---|
| Core Practical - II | Semester: II |
| Course Code: 18PPH2CP2 | Max. Marks : 100 |
| Hours / Week: 8 | Internal Marks : 40 |
| Credit: 4 | External Marks : 60 |

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

**A. Microprocessor Practicals**

1. 8 bit addition, subtraction, multiplication and division using 8085.
2. 16 bit addition, 2's complement and 1's complement subtraction.
3. Conversion from decimal to octal and hexa systems.
4. Conversion from octal, hexa to decimal systems.
5. Study of ADC interfacing (ADC 0809).
6. Study of DAC interfacing (DAC 0900).
7. Traffic control system using microprocessor interfacing.
8. Control of stepper motor using microprocessor interfacing.
9. Arithmetic programs using microcontroller.
10. Key Interface using microcontroller.

**B. Computer Practicals (By C Language)**

1. Roots of algebraic equations - Newton-Raphson method.
2. Least-squares curve fitting – Straight-line fit.
3. Solution of simultaneous linear algebraic equations – Gauss elimination method.
4. Solution of simultaneous linear algebraic equations – Gauss-Seidal method.
5. Interpolation – Lagrange method.
6. Numerical integration – Composite Trapezoidal rule.
7. Numerical integration – Composite Simpson's rules.
8. Numerical differentiation – Euler method.
9. Solution of ordinary differential equations – Runge-Kutta 2$^{nd}$ order method.
10. Solution of ordinary differential equations – Runge-Kutta 4$^{th}$ order method.

## MICROPROCESSOR AND COMMUNICATION ELECTRONICS

| | |
|---|---|
| Elective Course: I | Semester: II |
| Course Code: 18PPH2EC1 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To understand the hardware components and software programming instructions of INTEL 8085 microprocessor and 8051 microcontroller
- ❖ To understand the concept of interfacing and peripheral devices
- ❖ To study the various functions and applications of optical fibre

**Unit I: Microprocessor Intel 8085**

Pin diagram - Architecture - Organization of Control, data and address buses – Addressing modes - Instruction sets - Timing diagram for opcode fetch, memory read and write cycles – Interrupts - Assembly language programming - Multibyte addition, Multibyte subtraction – Ascending and descending orders – Square and square root of a single byte – Delay routine using single register.

**Unit II: Interfacing Memory and I/O Devices**

Memory mapped I/O – I/O mapped I/O - Data transfer schemes - Programmed and DMA data transfer schemes - Programmable peripheral interface (8255A) - 8253 timer interface - DMA controller - Programmable interrupt controller (8259) – Programmable communication interface (8251).

**Unit III: Microcontroller Intel 8051**

Comparison of Microprocessors and Microcontrollers – Architecture – Memory organization - Pin diagram –Addressing modes – Instruction set – Interrupts - Assembly language programming – 8-bit addition, subtraction, multiplication and division – Sum of the elements in an array – Ascending and descending order.

**Unit IV: Communication Electronics**

Analog and Digital signals – Modulation – Types of Modulation - Amplitude modulation theory – Frequency spectrum of the AM wave – Representation of AM – Power relations in the AM wave – Generation of AM – Basic requirements - Description of frequency and phase modulation – Mathematical representation of FM – Frequency spectrum of the FM wave - Effects of noise on carrier.

**Unit V: Optical Fibres**

Propagation of Light in an Optical Fibre - Acceptance Angle - Numerical aperture - Step and Graded index fibre - Optical fibre as a cylindrical wave guide - Wave guide equations - Wave equations in step index fibres - Fibre losses and dispersion - Applications.

**Books for Study**


1. B.Ram, Fundamentals of Microprocessors and Microcomputers, Dhanapet Rai & Sons, New Delhi, 5$^{th}$ Edition, 2001.
2. P.S. Manoharan, Microprocessors & Microcontrollers, Charulatha Publications, 2013.
3. George Kennedy & Davis, Electronic Communication System, Tata McGraw Hill, 4$^{th}$ Edition, 1999.

**References**

1. Taub Schilling, Principles of Communication Systems, TMH 1986.
2. Carlson, Communication Systems, McGraw Hill, 3rd Edition 1986.
3. Stewart D. Personick, Fibre Optics technology & Applications, Khanna Publishers, Delhi.

## NUMERICAL METHODS AND PROGRAMMING

| | |
|---|---|
| Elective Course: II | Semester: II |
| Course Code: 18PPH2EC2 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To familiarize the students with numerical methods and computer programming using C language
- ❖ To study Numerical Integration using different rules
- ❖ To determine the roots of non-linear equations using Newton-Raphson's method

**Unit I: Introduction to numerical computing**

Process and characteristics of numerical computing - Computational environment - Integer and floating point - Representation of numbers - Computer arithmetic - Errors of arithmetic and computation: Inherent errors, numerical errors, modeling errors, Blunders, Absolute and relative errors, Machine Epsilon - Error propagation - Conditioning and stability - Error estimation.

**Unit II: Numerical integration**

Newton cotes formula - Trapezoidal rule - Simpsons 1/3 rule - Simpsons 3/8 rule - Booles rule - Gaussian quadrature method - (2 point and 3 point formulae) – Giraffe's root square method for solving algebraic equation.

**Unit III: Numerical solutions of ordinary differential equations**

$N^{th}$ order ordinary differential equations – Power series approximation – Pointwise method – Solutions of Taylor series – Euler's method – Improved Euler's method – Runge-Kutta method: second and fourth order – Runge-Kutta method for solving first order differential equations – C program for solving ordinary differential equations using RK method.

**Unit IV: 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 – Newton's interpolation formula for unequal intervals – C programming for Lagrange's interpolation.

**Unit V: Solution of Linear & Nonlinear Equations**

Need and scope of simultaneous linear equations - Existence of solutions - Solution by elimination - Gauss elimination method with and without pivoting - Applications to electrical networks - C program for implementing Gauss elimination method with pivoting.

Roots of nonlinear equations: Newton-Raphson's method for a single nonlinear equation - Extension to a system of nonlinear equations - Finding multiple roots by deflation and synthetic division - Program in C for Newton-Raphson method for finding the roots of a single nonlinear equation.

**Books for Study**

1. T.Veerarajan, T.Ramachandran, Numerical Methods With Programs in C, Tata Mc Graw Hill Publishing
Company,New Delhi,2008.
2. E. Balagurusamy, Numerical Methods, Tata Mc Graw Hill Publishing Company, New Delhi, 1999.

**References**

1. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., Madras, 1996.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall, 2005.
3. S. Rajasekaran, Numerical Methods in Science and Engineering, S. Chand Limited, 2003.

## STATISTICAL MECHANICS

| | |
|---|---|
| Core Course: VII | Semester: III |
| Course Code: 18PPH3CC7 | Max. Marks : 100 |
| Hours / Week: 6 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To review the fundamental concepts of thermodynamics in order to understand Statistical mechanics
- ❖ To understand the fundamental principles of Statistical mechanics
- ❖ To apply the quantum mechanical ideas to Statistical mechanics

**Unit I: Thermodynamics and radiation**

Laws of thermodynamics - Entropy and second law of thermodynamics – Principle of increase of entropy - Thermodynamic Potential and Reciprocity relation – Enthalpy, Helmholtz and Gibb's functions – Clausius Clapeyron's equation.

**Unit II: Classical statistical mechanics**

Phase space and ensembles – Types of ensembles: Microcanonical, canonical & grand canonical - Liouville's theorem – Statistical equilibrium – Thermal equilibrium - Elementary ideas of partition functions - Connection between statistical and thermodynamical quantities - Micro and macro states - Maxwell-Boltzmann distribution law - Distribution of energy and velocity - Principle of equipartition of energy - Boltzmann's entropy relation.

**Unit III: Bose Einstein Statistics**

Quantum statistics of identical particles – Density matrix – Bose-Einstein distribution law – Black body radiation – Planck's radiation law – Specific heat of solids – Einstein's theory – Debye's theory.

**Unit IV: Fermi Dirac statistics**

Fermi-Dirac distribution law – Ideal Fermi-Dirac gas – Fermi energy – Degeneracy: weak degeneracy, strong degeneracy – Electron gas in metals – Thermionic emission of electrons – Specific heat of gases – Variation with temperature: Monoatomic, diatomic and polyatomic gases.

**Unit V: Phase transition**

Phase transition- Phase transition of first and second kind - Critical exponent – Yang and Lee theory - Phase transitions of second kind: The Ising model - Bragg Williams approximation- one dimensional Ising model

**Books for study**

1. Gupta & Kumar, Statistical Mechanics, Pragati Prakashan, Meerut, 24$^{th}$ edition, 2011.
2. Satya Prakash, J.P. Agarwal, Statistical Mechanics, Kedar Nath Ram Nath & Co., Meerut, 2005.

**References**

1. B.K. Agarwal and M. Eisner, Statistical Mechanics, New Age International Publishers, 2$^{nd}$ Edition, 1998, Reprint 2005.
2. B.B. Laud, Fundamentals of Statistical Mechanics –New Age International Publishers, New Delhi, 2$^{nd}$ Edition 2012.
3. Kerson Huang, Statistical Mechanics, John Wiley & Sons, New Delhi, 2$^{nd}$ Edition, 1983, Reprint 2009.

4. F. Reif, Fundamentals of Statistical and Thermal physics, Waveland Press, Illinois, 2009.
5. F. W. Sears, G. L. Salinger, Thermodynamics, Kinetic theory & Statistical Thermodynamics, Narosa
Publishing House, New Delhi, 3rd Edition, Reprint 2013.

## SOLID STATE PHYSICS

| | |
|---|---|
| Core Course: VIII | Semester: III |
| Course Code: 18PPH3CC8 | Max. Marks : 100 |
| Hours / Week: 6 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To know how to interpret the results obtained from the X-ray diffraction
- ❖ To understand the energy bands in metals, semiconductors and insulators
- ❖ To know the recent developments in high temperature superconductivity

**Unit I**: **States of matter**

Crystalline and amorphous - Unit cell - Bravais lattices - Symmetry point groups – Space groups – Reciprocal lattice (definition and properties) - Reciprocal lattice of SC, BCC, FCC and HCP lattices - Miller indices - Atomic scattering factor – Diffraction – Structure factor - X-ray diffraction - Laue equations - Interpretation of Bragg's equation - Ewald construction.

**Unit II**: **Lattice Vibrations and Thermal Properties**

Vibration of monatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons – Lattice heat capacity – Einstein model – Density of modes in one-dimension and three-dimension – Debye model of the lattice heat capacity – Free electron Fermi gas: Drude model – Electrical conductivity, electronic heat capacity - Hall effect & thermionic power – Electron motion in periodic potential: energy bands in solids, metals, semiconductors and insulators.

**Unit III: Dielectrics**

Defects and dislocations – Dielectrics: Internal electric field – Polarizability – Clausius mosotti equation -Ferroelectric crystals and their types – Polarization catastrophe – Landau theory of phase transition: First and second order – Antiferro, pyro and piezoelectric crystals.

**Unit IV: Magnetism**

Langevin theory of para magnetism - Quantum theory of para magnetism - Curie law – Ferromagnetism - Weiss molecular field theory - Domain theory - Anti ferromagnetism - Neel theory – Ferrimagnetism - Ferrites-spin waves - Experimental techniques to study magnetic properties.

**Unit V: Superconductivity**

Occurrence of Superconductivity – Meissner effect – Thermodynamics of superconducting transition – London equation – Coherence length – BCS theory – Flux quantization – Type I and Type II Superconductors – Josephson superconductor tunneling – DC and AC Josephson effect – SQUID – Recent developments in high temperature superconductivity – Application of superconductors.

**Books for Study:**

1. C. Kittel, Introduction to Solid State Physics, Wiley India Edition, New Delhi, 7$^{th}$ Edition, Reprint 2008.
2. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2006.

**References:**

1. B.S. Saxena, R.C. Gupta & P.N. Saxena, Solid State Physics, Pragati Prakashan, Meerut.

2. J.P. Srivastava, Elements of Solid state physics, Prentice-Hall of India Pvt Ltd, New Delhi, Second Edition,
2006.
3. S.L. Kupta and V. Kumar, Solid State Physics, K. Naths Educational Publishers, Meerut, 2006.

## PHYSICS PRACTICAL - III
## LIQUID STATE AND SOLID STATE PHYSICS PRACTICAL

| | |
|---|---|
| Core Practical - III | Semester: III |
| Course Code: 18PPH3CP3 | Max. Marks : 100 |
| Hours / Week: 8 | Internal Marks : 40 |
| Credit: 4 | External Marks : 60 |

Any **TWELVE** only

1. Four probe method – Determination of resistivity of powdered samples.
2. Determination of carrier concentration and Hall coefficients in semiconductors.
3. Determination of magnetic susceptibility of liquid by Guoys method.
4. Determination of magnetic susceptibility of liquids by Quincke's method.
5. Determination of dielectric constant of a liquid by RF oscillator method.
6. Determination of wavelength and thickness of a film by using Michelson's interferometer.
7. Brass spectrum – Determination of composition.
8. Charge of an electron by spectrometer.
9. Polarizability of liquids by finding the refractive indices at different wavelengths.
10. Determination of wavelength of monochromatic source using biprism.
11. Determination of refractive index of liquids using biprism (by scale & telescope method).
12. Determination of specific rotatory power of a liquid using polarimeter.
13. Rydberg's constant using spectrometer.
14. Determination of coefficient of coupling by AC bridge method.
15. Magnetoresistance of powder samples using CE bridge.
16. Forbe's method of determining thermal conductivity.
17. Particle size determination using He-Ne Laser.
18. Laser diode characteristics.
19. Determination of dielectric loss using CRO.

# CRYSTAL GROWTH AND THIN FILM PHYSICS

| | |
|---|---|
| Elective Course: III | Semester: III |
| Course Code: 18PPH3EC3 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To understand the nucleation parameters
- ❖ To know about the different techniques of crystal growth and thin films
- ❖ To know the characterization techniques relating to the structural, molecular and optical phenomenon

**Unit I: Nucleation**

Introduction - Kinds of nucleation - Equilibrium stability and meta stable state - Classical theory of nucleation -Effect of soluble impurities on nucleation - Determination of solubility - Methods of induction period measurements - Steady state nucleation rate - Nucleation parameters.

**Unit II: Low temperature growth techniques**

**Solution Growth Technique:** Low temperature solution growth: 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 technique:** Bridgman technique - Basic process – Various crucibles design - Thermal consideration – Vertical Bridgman technique - Czochralski technique: Experimental arrangement – Growth process.

**Vapour technique:** Vacuum technology - Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical vapour transport.

**Unit IV: Preparative techniques of thin film**

Physical methods: Vacuum evaporation, Sputtering - Chemical methods: Spray pyrolysis, Electrochemical method - Types of electrodes: Counter, Working, Reference electrode - Electro and electroless coating – Sol-gel method: Dip coating - Spin coating.

**Unit V: Characterization techniques**

Structural: XRD: Single and Powder – Molecular: FTIR Spectroscopy – Functional group analysis – Optical: UV-Vis-NIR spectroscopy – optical constants: film thickness measurements- Electrical: Four probe technique Dielectric: dielectric constant and dielectric loss.

**Books for Study**

1. Brice J. C., Crystal Growth Process, John Wiley and Sons, New York, 1986.
2. P. Santhana Raghavan and P. Ramasamy, Crystal Growth, KRU Publications, 1$^{st}$ Edition.
3. A. Goswami, Thin Film Fundamentals, New Age International Publishers, 2008

**References**

1. Brice J.C., The growth of crystals from liquids, North Holland Publishing Company, Amsterdam, 1973.
2. Henisch H.K., Crystals in gels and Liesegang rings, Cambridge Univ. Press, USA, 1988.
3. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Thin Film Fundamentals, CBS, Publishers and Distributors, New Delhi.
4. Kasturi L. Chopra, Thin film Phenomena, Mc Graw Hill Book Company, 1969.
5. Smith Donald. L, Thin Film Deposition, Mc Graw Hill, London, 1995.

## NONLINEAR OPTICS

| | |
|---|---|
| Elective Course: IV | Semester: III |
| Course Code: 18PPH3EC4 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To know about the properties of laser to understand the non-linear optics
- ❖ To understand the pulse propagation in fibers
- ❖ To prepare students for research in optics-related topics

**Unit I: Lasers for Nonlinear Optics**

LASER – Properties of Lasers - Optical resonator – Laser modes: Axial and transverse – Nonlinear optics: Definition – Wave propagation in linear and nonlinear media - Nonlinear optical materials - Linear & nonlinear optical susceptibilities (focusing on $\chi^{(2)}$ and $\chi^{(3)}$)

**Unit II: Second-order nonlinear optical effects**

Second harmonic generation and phase matching technology – Sum and difference frequency generation - Parametric amplification and oscillation – Stimulated Raman scattering – Applications of short wavelength lasers.

**Unit III: Third-order nonlinear optical effects**

Four wave mixing and optical phase conjugation – Intensity dependent refractive index: Optical Kerr effect, self-focusing/defocusing, selfphase modulation - Nonlinear Optical Absorption: Two-photon absorption, saturable absorption and reverse saturable absorption - Electro-optic, photorefractive effects – Optical limiters.

**Unit IV: Ultrasfast lasers and ultrafast NLO process**

Pulsed optics: short pulse propagation in linear and nonlinear media, chirped pulse, group-velocity-dispersion, optical elements - Femtosecond laser pulse generation and mode-locking method - Pulse amplification, compression, and measurement - Experimental techniques: pump probe, ultrafast optical Kerr gate, fluorescence up-conversion and streak camera.

**Unit V: Nonlinear fiber optics**

Pulse propagation in fibers – Pulse propagation in a linear and non-linear medium – Optical Solitons – Solitons in optical fibers – Long distance Soliton transmission system – Polarization effects – Nonlinear fiber materials.

**Books for Study:**

1. B.B. Laud, Lasers and Nonlinear optics, 2$^{nd}$ Edition, New Age International (P) Ltd., 2004.
2. R. L. Sutherland, Handbook for Nonlinear Optics, Second Edition, Marcel Dekker Inc., 2003.

**References**

1. Robert W. Boyd, Nonlinear Optics, Academic Press, INC., 1992.
2. Geoffrey New, Introduction to Nonlinear Optics, Cambridge University Press, 2011.
3. Govind P. Agarwal, Nonlinear Fiber Optics, Fifth edition, Academic Press, 2013.

## NUCLEAR AND PARTICLE PHYSICS

| | |
|---|---|
| Core Course: IX | Semester: IV |
| Course Code: 18PPH4CC9 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 5 | External Marks : 75 |

**Objectives:**

- ❖ To understand the basic structure and properties of the nucleus
- ❖ To study about nuclear radioactivity and reactions
- ❖ To study about the properties of elementary particles

**Unit I: Basic Nuclear Properties**

Nuclear size, shape, mass – Charge distribution – Spin and parity – Binding energy – Semi empirical mass formula – Nuclear stability – Mass parabola - Nature of nuclear forces – Ground state of deuteron – Magnetic dipole moment of deuteron – Proton-neutron scattering at low energies, Scattering length, phase shift – Exchange forces – Meson theory.

**Unit II: Radioactive Decays**

Alpha emission – Geiger-Nuttal law – Gamow theory – Neutrino hypothesis – Fermi theory of beta decay – Selection rules – Non-conservation of parity – Gamma emission – Selection rules - Interaction of charged particles and X-rays with matter – Basic principles of particle detectors – Ionization chamber – Proportional counter and G.M counters – Solid state detectors – Scintillation and semiconductor detectors.

**Unit III: Nuclear Reactions and Nuclear models**

Q-values and kinematics of nuclear cross sections – Energy and angular dependence – Reciprocity theorem – Breit-Wigner formula – Compound nucleus – Resonance theory – Optical model – Shell model – Liquid drop model – Collective model.

**Unit IV: Accelerators and Reactors**

Cyclotron – Synchrocyclotron – Betatron – Synchrotron – Linear accelerators - Characteristics of fission – Mass distribution of fragments – Radioactive decay processes – Fission cross section – Energy in fission – Bohr-Wheeler's theory of nuclear fission – Fission reactors – Thermal reactors – Homogeneous reactors – Heterogeneous reactors – Basic fusion processes - Characteristics of fusion – Solar fusion – Controlled fusion reactors.

**Unit V: Particle Physics**

Production of new particles in high energy reaction - Classification of elementary particles - Fundamental interaction - Quantum numbers – Anti particles - Resonances - Law in production and decay process – Symmetry and conservation laws - Special symmetric groups – Gell-Mann Nishijima theory - Quark model - SU3 symmetry - Unification of fundamental interactions - CPT invariance and applications of symmetry arguments to particle reaction - Parity non conservation in weak interaction - Relativistic kinematics.

**Books for study**

1. D.C. Tayal, Nuclear Physics, Himalaya Publishing House, Mumbai, 2004.
2. M.L. Pandya and R.P.S. Yadav, Elements of Nuclear Physics, Kedar Nath Ram Nath, 2004.

**References**

1. K. S. Krane, Introductory Nuclear Physics, John-Wiley, New York, 1987.

2. V. Devanathan, Nuclear Physics, Naroso Publishing House, 2006.
3. S. B. Patel, Nuclear Physics: An Introduction, Wiley-Eastern, New Delhi, 1991.
4. Bernard L. Cohen - Concepts of Nuclear Physics, Tata McGraw Hill Publishing Co., New Delhi.

## ADVANCED PHYSICS

Core Course: X | Semester: IV
Course Code: 18PPH4CC10 | Max. Marks : 100
Hours / Week: 5 | Internal Marks : 25
Credit: 5 | External Marks : 75

**Objective:**

- ❖ To learn the basics and the advanced applications of physics in the fields of astrophysics
- ❖ To know about the Indian remote sensing programme
- ❖ To understand the data communication through wireless technology

**Unit I: Astrophysics and Radio Astronomy**

**Astrophysics:** Physical properties of stars - Life cycle of a star - End products of stellar evolution – Structure of Milky way - Expanding universe – Gravitational waves – LIGO - Future prospects.

**Radio Astronomy (RA):** Radio telescopes - Synchrotron radiation - Spectral lines in RA - Major discoveries in RA - RA in India - Hot big bang cosmology.

**Unit II: Gravitation & Relativity**

Theories of Gravitation - Conflict between Newtonian gravitation and special relativity - General theory of relativity - Mach's principle - The action principle - Einstein equations of gravitation-a heuristic derivation - Newtonian approximation - The experimental tests of the general theory of relativity - The gravitational red shift - Planetary motion - Strong Gravitational Fields - Equilibrium of massive spherical objects - Binding energy - Gravitational collapse of a homogeneous dust ball - Black holes - Detection of Black holes.

**Unit III: India's Space Programme**

Overview - Methodological issues in cost beneficial analysis of space programme - The INSAT system - Broadcasting - Telecommunication - Meteorology - Indian remote sensing programme – Geoinformatics (basic idea only) - The launching programme.

**Unit IV: Biomedical Instruments**

Ear and hearing aids: Basic measurements of ear function - Air and bone conduction - Masking - Middle ear impedance audiometry - Oto-acoustic emission - Types of hearing aids and Cochlear implants - Sensory substitution aids - Electrophysiology: Source of biological potentials - Signal size and electrodes - Functions - Features of ECG, EEG and EMG - Cardiac and blood related devices: Pacemakers - Electromagnetic compatibility – Defibrillators - Artificial heart valves - Cardiopulmonary bypass - Haemodialysis.

**Unit V: Wireless Communication Technology**

Cellular Radio: IMTS, AMPS control system - Security and privacy - Cellular telephone specifications and operations - Cell site equipments - Fax and data communication using cellular phones and CDPD - Digital cellular systems. Personal Communication Systems (PCS): Differences between CS and PCS, IS-1 36 TDMA PCS, GSM, IS-95 CDMA PCS - Comparison of modulation schemes - Data communication with PCS.

**Books for Study**

1. A.W. Joshi, Horizons of Physics, Wiley Eastern Ltd, New Delhi, 2000.

2. R.D. Begamure (Ed.), Scientific Truths About Our Universe: Know Your Universe: Part I & II, Pune, 2002.
3. Lectures on Gravitation and cosmology, J.V.Narlikar, Macmillan co.1978.
4. An Introduction to General relativity, S.K.Bose, Wiley Eastern, 1980.
5. U. Shankar, The Economics of India's Space Programme, An Exploratory Analysis, Oxford University Press,
Delhi, 2nd reprint, 2007.
6. Mohan Sundar Rajan, Space Today, National Book Trust, India, New Delhi, 5th revised reprint, 2012.
7. B.H. Brown, Medical Physics and Biomedical Engineering, Overseas Press, New Delhi, 2005.
8. R. Blake, Wireless Communication Technology, DELMAR, New Delhi, 2001.

## PHYSICS PRACTICAL - IV
## ANALOG AND DIGITAL ELECTRONICS LAB

| | |
|---|---|
| Core Practical - IV | Semester: IV |
| Course Code: 18PPH4CP4 | Max. Marks : 100 |
| Hours / Week: 8 | Internal Marks : 40 |
| Credit: 4 | External Marks : 60 |

Any TWELVE only

1. Logic gates – Universality of NAND / NOR gates Using IC's
2. Verification of Demorgan's theorems and Boolean Expressions
3. Astable and monostable multivibrator using IC 555
4. FET amplifier (CD and CS configuration)
5. Phase shift network and Oscillator using IC 741
6. Construction of dual regulated power supply
7. Half and Full wave precision rectifier using IC 741
8. Characteristics of LDR
9. Digital to analog converter - R-2R method and Weighted method
10. Study the function of multiplexer and demultiplexer
11. Study the function of decoder and encoder
12. Flip flops
13. Half adder and Full adder (using only NAND & NOR gates)
14. Half subtractor and Full Subtractor (using only NAND & NOR gates)
15. Digital comparator using XOR and NAND gates
16. BCD to seven segment display
17. Study of counter using IC 7490 (0-9 and 00-99)

## NANOSCIENCE AND NANOTECHNOLOGY

| | |
|---|---|
| Elective Course: V | Semester: IV |
| Course Code: 18PPH4EC5 | Max. Marks : 100 |
| Hours / Week: 5 | Internal Marks : 25 |
| Credit: 4 | External Marks : 75 |

**Objectives:**

- ❖ To understand the classification of nanomaterials based on their dimension
- ❖ To know the background of nanomaterials and their various synthesis process
- ❖ To have an idea about the characterization techniques of nanomaterials and its applications

**Unit I: Background and types of nanomaterials**

Historical perspective of nanomaterials - Scientific revolution – Emergence of Nanotechnology - Challenges in Nanotechnology - Types of nanomaterials: One Dimensional (1D), Two Dimensional (2D), Three Dimensional (3D) nanostructured materials - Quantum dots - Quantum wire.

**Unit II: Synthesis of nanomaterials**

Ball milling – Sol-gel and precipitation - RF plasma – Pulsed laser method - Thermolysis – Combustion synthesis – Hydrothermal / Solvothermal – Microemulsion - Gas phase condensation.

**Unit III: Characterization of nanomaterials**

Working principle, Instrumentation and Application of: X-ray diffraction: Debye-Scherer formula, Electron microscopes: Scanning Electron Microscope (SEM), FESEM, Transmission Electron Microscope (TEM), HRTEM - Atomic Force Microscope (AFM) - Scanning Tunneling Microscope (STM) - Photo luminescence.

**Unit IV: Nanomaterials and their properties**

Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides ($TiO_2$, $CeO_2$, ZnO) - Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites - Dilute magnetic semiconductor - Biological system - DNA and RNA - Lipids - Size dependent properties - Mechanical, Physical and Chemical properties of nanomaterials.

**Unit V: Applications**

Solar energy conversion and catalysis - Nano electronics: MEMS, NEMS - Polymers with a special architecture - Liquid crystalline systems: Applications in displays and other devices - Advanced organic materials for data storage, Photonics, Plasmonics, Chemical and biosensors - Medical applications: Drug delivery, Cancer – Nanomaterials for water purification: Elimination of pollutants.

**Books for study:**

1. M. A. Shah, Tokeer Ahmad, Principles of Nanoscience and Nanotechnology, Narosa Publishing House, New
Delhi, 2010.
2. G. Cao, Nanostructures and Nanomaterials, Imperial College Press, UK, 2004.
3. Phani Kumar, Principles of Nanotechnology, Scitech Publication, India Pvt. Ltd., India, 2012.

**References**

1. A.G. Brecket, A Hand book on Nanotechnology, Dominant Publishers and Distributors, New Delhi, 1st Edition, 2008.
2. P.K. Sharma, Origin and Development of Nanotechnology, Vista International Publishing House, New Delhi, 1st Edition, 2008.
3. K.P. Mathur, Nano Science and Nano Technology, Rajat Publications, New Delhi, 1st Edition, 2007.
4. Hari Singh Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, 2002.