M.Sc. Physics
Courses offered

Semester	Subject code	Title of the paper	Hours/week	Credits
I	PP1711	Core I - Classical and Statistical Mechanics	6	4
	PP1712	Core II - Electromagnetic Theory	6	4
	PP1713	Core III – Numerical and Computational methods	6	4
	PP1714 PP1715	Elective I – (a) Experimental techniques/ (b) Photonics	6	5
	PP17P1	Practical I - Advanced Physics Lab – I (General Physics)	6	-
II	PP1721	Core IV – Condensed Matter Physics	6	4
	PP1722	Core V - Mathematical Physics	6	4
	PP1723	Core VI – Quantum Mechanics	6	4
	PP1724 PP1725	Elective II – (a) Crystal Growth Techniques and Thin film Technology (b) Communication Physics	6	5
	PP17P1	Practical I - Advanced Physics Lab – I (General Physics)	-	5
	PP17P2	Practical II - Advanced Physics Lab – II (Programming with C++)	6	5
	LST172	Life Skill Training (LST) – I	-	1
III	PP1731	Core VII - Integrated Electronics	6	4
	PP1732	Core VIII - Microprocessor and Microcontroller	6	4
	PP1733 PP1734	Elective III – (a) Physics of the Cosmos/ (b) Radiation Physics	6	5
	PP17P3	Practical III - Advanced Physics Lab – III (Electronics)	4	-
	PP17P4	Project	8	4
IV	PP1741	Core IX – Material Science	6	4
	PP1742	Core X - Nuclear and Particle Physics	6	4
	PP1743	Core XI - Molecular Spectroscopy	6	4
	PP1744 PP1745	Elective IV – (a) Nano Physics/ (b) Quantum Field Theory	6	5
	PP17P5	Practical III - Advanced Physics Lab – III (Electronics)	-	4
	PP17P6	Practical IV – Advanced Physics Lab – IV (Microprocessor and Micro Controller	6	5
	LST174	Life Skill Training (LST) – II	-	1
	STP171	Summer Training Programme	-	1
		TOTAL	**120**	**90**

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Semester I
Classical and Statistical Mechanics (Core – I)
Subject code: PP1711

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: 1. To have in depth knowledge of classical and quantum statistics.
2. Enable students (i) To link thermodynamics to the micro description used in classical statistical mechanics. (ii) To develop skills in formulating and solving physics problems.

Unit I: Single and many particle systems and central force problems

Mechanics of a particle – Mechanics of a system of particles – conservation laws. Central force problems – Reduction to the equivalent one body problem – the equations of motion and first integral- Kepler's problems – Inverse square law of forces – motion in time in Kelpler's problems.

Unit II: Hamiltonian Formulation:

Hamilton's canonical equations of motion - Deduction of canonical equations from variation principle-principle of least action- canonical or contact transformations – conditions for a transformation to be canonical, Hamilton Jacobi method - Poisson bracket – equations of motion in Poisson bracket form – Jacobi Poisson theorem – Angular momentum and Poisson's bracket.

Unit III: Rigid Body and small Oscillations:

Independent coordinates of a Rigid body – Euler angles – Infinitesimal rotation – Rate of change of a vector – Coriolis force.

Small oscillations: Stable and unstable equilibrium – formulation of the problem – Lagrange's equations of motion for small oscillations – Normal co-ordinates and normal frequencies of vibration – Systems with few degrees of freedom: Parallel pendulum – Linear triatomic molecule.

Unit IV: Statistical mechanics:

The postulate of classical statistical mechanics – Postulate of Equal a Priori probability - Micro canonical ensemble – Derivation of Thermodynamics - Classical Ideal gas – Gibb's paradox - The ideal gases - The Ideal gases in Micro – canonical ensemble – Statistical weight – Entropy – Distribution Law – Maxwell-Boltzmann statistics – Bose-Einstein statistics – Fermi-Dirac statistics – Thermodynamic functions for Boltzmann gas.

Unit V: Ideal Fermi and Bose gases and applications

Ideal Bose gas – Bose Einstein condensation – Thermodynamic behavior when $T<T_c$ - Thermodynamic behavior when $T>T_c$ - Blackbody radiation - The photon gas - Ideal Fermi gas – weakly degenerate and strongly degenerate – Free electron theory of metals.

Text Books

1. Herbert Goldstein Charles Poole John Safko.(1989). Classical mechanics. (2nd Ed.)
   Unit I: Chapter 3: 3.1, 3.2, 3.7, 3.8.
   Unit III: Chapter 4:4.1, 4.4, 4.8, 4.9, 4.10
2. Gupta, S.L., Kumar, V., Sharma Pragati Prakashan H.V., Meerut. (2004-05) Classical Mechanics. (21st Ed.)
   Unit I: Chapter I : 1.3, 1.4
   Unit II Chapter 3: 3.1 - 3.4, 3.7, 3.10 to 3.12, 3.14, 3.15.1, 3.21, 3.22 3.23, 3.24, 3.26
   Unit III: Chapter 8: 8.1 - 8.3, 8.5, 8.6(A), 8.6(D)
3. Kerson Huang. (1986). Statistical mechanics. Wiley Eastern Ltd.
   Unit IV: Chapter 7: 7.1, 7.2, 7.3, 7.5, 7.6
4. Sinha, S.K. (2007). Introduction to Statistical mechanics. New Delhi: Narosa Publishing House Pvt.Ltd.
   Unit IV: Chapter 6: 6.1, 6.4 – 6.6, 6.8, 6.10
   Unit V: Chapter 7: 7.1 – 7.3, Chapter 8: 8.1 – 8.3

Reference Books

1. Gupta, A.B. (2015). Fundamentals of classical mechanics. Books and Allied (P) Ltd.
2. Arul Dhas,G. (2009). Classical mechanics. PHI Learning Private Limited.
3. Narayan Chandra Rana. (2004). Classical mechanics. Pramod Sharad Chandra Joag- Tata Mc- graw- Hill Publishing Company Ltd.
4. Saxena, A.K. (2010). An Introduction to Thermodynamics and Statistical Mechanics. New Delhi: Narosa Publsihing House Pvt.Ltd.

Semester I
Electromagnetic theory (Core – II)
Subject Code: PP1712

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: 1. To provide knowledge on the propagation of electromagnetic radiation.
2. To gain insight into the physical nature of electric and magnetic phenomena.

Unit I: Electrostatic field

Electrostatic field – Divergence and curl of electrostatic field – Gauss law and its applications – Electric potential – Introduction – Poisson's and Laplace equation – Method of Images - Solution of Laplace's equation using separation of variables in Cartesian Coordinates – Electrostatic fields in conductors and dielectrics – induced dipoles and polarizability – Polarization – bound charges - field inside a dielectric – Susceptibility permittivity and dielectric constant – Boundary value problems with linear dielectrics – Electro static energy in dielectric media.

Unit II: Magnetostatic field

Lorentz's force law – cyclotron motion – cycloid motion – continuity equation – Biotsavart's law for a line current, surface current and volume current – divergence and curl of B – Ampere's law - applications of Ampere's law – comparison of magneto statics and electrostatics – magnetic vector potential – Torques and forces on magnetic dipoles – effect of magnetic field on atomic orbits – magnetic susceptibility and permeability in linear media and non-linear media.

Unit III: Electrodynamics

Ohm's law – Electromagnetic induction – Faraday's law – inductance – energy in magnetic fields – Maxwell's equations - Maxwell's equation free space and linear isotropic media – Boundary conditions on the field at interfaces – Integral and differential forms – Boundary conditions – Continuity equation – Poynting theorem – Poynting vector –Conservation of momentum.

Unit IV: Propagation of Electromagnetic waves

Wave equation for E and B monochromatic plane waves – energy and momentum in electromagnetic waves – electromagnetic waves in matter – propagation in linear media – reflection and transmission at normal incidence and oblique incidence – Fresnel's equations – Electromagnetic waves in conductor – skin depth – Reflection at a conducting surface - wave guides – TE waves in rectangular wave guide - Co-axial transmission lines.

Unit V: Relativistic Electrodynamics

Einstein's two postulates – Covariant and contra variant vector – Concept of four vectors – Minkowski force – Covariance of Electrodynamics equations – Maxwell's equations in four vector – Four vector form of Lorentz equations – Relativistic Lagrangian and Hamiltonian force equations for a relativistic charged particle in external electromagnetic field.

Text Books:

1. David J. Griffiths. (2004). *Introduction to Electrodynamics*. III Ed., Prentice Hall of India Private Ltd.
   Unit I: Section 2.1.1 - 2.1.4, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.3, 3.2, 3.3, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.4.1 – 4.4.3
   Unit II: Section 5.1.1, 5.1.2, 5.1.3, 5.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4.1, 5.4.3, 6.1.2, 6.1.3, 6.4.
   Unit III: Section 7.1.1, 7.2.1, 7.2.3, 7.2.4, 7.3.1 – 7.3.6, 8.1.1, 8.1.2, 8.2.3.

Unit IV: Section 9.1.1, 9.1.2, 9.1.3, 9.1.4, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 9.3.2, 9.3.3, 9.4.1, 9.4.2, 9.5.1, 9.5.2., 9.5.3
Unit V: 12.1.1, 12.1.4, 12.2.4, 12.3.5

2. John David Jackson.(1983). *Classical Electro Dynamics.* II Ed., New Delhi: Wiley Eastern Ltd.
Unit V: 11.1, 11.6, 11.9, 12.1

Reference Books:

1. Reitz and others. (1987). *Foundations of Electromagnetic Theory*. III Edition. New Delhi: , Narosa Publishing House.
2. Paul Lorrain and Date Corson. (1986). *Electromagnetic Fields and Waves*. II edn., CBS publications and Distributors.

Semester I
Numerical and Computational Methods (Core – III)
Subject Code: PP1713

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective: 1. To introduce the numerical methods for solving algebraic, differential and matrix equations and its applications in Physics.
2. To make students able to understand and analyse various mechanical problems that require the use of numerical / computational methods.

Unit I: Interpolation and Extrapolation:

Finite differences – Forward difference – Backward Differences – Central Differences– Newton's formula for Interpolation – Central Difference Interpolation formulae – Guass' Central Difference Formulae – Stirling's Formula – Lagrange's Interpolation Formula – Error in Lagrange's Interpolation Formula – Hermite Interpolation Formula – Divided Differences and their Properties Newton divided difference formula – Interpolation by Iteration.

Unit II: Solution of Algebraic and Transcendental Equations: Zeros of linear and non-linear algebraic equations and transcendental equations: The Bisection method – Newton Raphson method –Ramanujan's Method -Birge – Vieta method.

Solution of simultaneous equations: Direct methods: Gauss elimination – Gauss Jordon Methods –Modification of the Gauss Method to Compute the Inverse – Solution of Linear Systems – Iterative methods: Gauss Seidal and Gauss Jacobi methods.

Unit III: Numerical differentiation and Integration:

Numerical differentiation: Methods based on interpolation: Finite difference and undetermined coefficients – Differentiation using Newton's forward and backward difference formulae – Errors in numerical differentiation.

Numerical Integration: Trapezoidal Rule – Simpson's 1/3 Rule – errors – Simpson's 3/8 rule – Monte Carlo integration – evaluation of simple integrals.

Unit IV: Numerical solutions of ordinary Differential equations:

Solution by Talor's Series - Picard's Method of Successive Approximations - Euler's method – Runge–Kutta Methods – Predictor-Corrector Methods: Adam's – Moulton method and Milne's method – Boundary-value Problems – Finite-difference Method

Unit V: Introduction to MATLAB Programming

Basic of MATLAB –MATLAB windows - On-line help - Input-Output - File types- Platform dependence - General commands- Input – Indexing - Matrix Manipulation - Creating Vectors - Matrices and vectors – Matrix and array operations- Arithmetic operations- Relational operations - Logical operations - Elementary math functions - Matrix functions - Character strings - linear algebra- Solving a linear system- Gaussian elimination - Finding eigenvalues & eigenvectors - Matrix factorizations.

Text Books:

1. Sastry, S.S. (2009). Introductory Methods of Numerical Analysis. (3rd ed.) Prentice Hall of India Ltd.
   UnitI: Chapter 3: 3.3.1 - 3.3.3, 3.6, 3.7: 3.7.1 – 3.7.2, 3.9: 3.9.1 – 3.9.3, 3.10: 3.10.1, 3.10.2.

Unit II: Chapter 2: 2.1, 2.2, 2.5 - 2.6 Chapter 6: 6.3.2, 6.3.3, 6.3.4, 6.4.
Unit III: Chapter 5:5.2, 5.2.1, 5.4, 5.4.1- 5.4.3, 5.4.7
Unit IV: Chapter 7: 7.2 - 7.4, 7.5 - 7.6, 7.10: 7.10.1

2. Jain,M.K., Iyengar, S.R.K., Jain, R.K. (2000). Numerical methods, Wiley Eastern Limited.
   Unit II: Chapter 2: 2.8
   Unit III: Chapter 5:5.2
3. William Press, H., Teakolsky, S.A., Vetterling, W.T., Flannery, B.P. (2002). Numerical Recipes in C++. CambridgeUniversity Press.
   Unit III: Chapter 7: 7.6
4. Rudra Pratap, (2006). 'Getting started with MATLAB 7' (2nd ed.) . Oxford University Press.
   Unit V: Sections 1.6, 3.1, 3.2, 5.1: 5.1.1-5.1.4

Reference Books:

1. Raja Raman, V. (2003). Computer Oriented Numerical Methods . Prentice Hall of India Ltd.
2. Xavier, C. (1996). Fortran 77 and Numerical Methods. New Age International Ltd.

Semester I

a. Experimental Techniques (Elective – I)

Subject Code: PP1714

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective:

1. To provide knowledge on the measurements including error, signal and thermal analysis, nuclear radiation measurement using counters and detectors.
2. To gain insight in different experimental and analytical techniques involving mass spectroscopy, surface and laser spectroscopy, vacuum techniques, diffusion pumps, measuring gauges and sensors.

Unit I: Mathematical techniques and signal analysis:

Error – Types of Error – Error in a series approximation – General Error formula. Curve Fitting : Linear curve fitting law of the types $y=ax^b$, $y=a\ e^{bx}$ – principle of least squares – straight line fitting by LSF method – Signal analysis : Signal to noise ratio – source of noice in instrumental analysis – signal to noise enhancement.

Unit II: Nuclear radiation measurements

Methods of detection of free charge carrier – Ionization chamber – G.M. counter - Semi-conductor detectors – Methods based on light sensing - Scintillation detector – Wilson cloud chamber – Nuclear emission techniques – Solid state nuclear track detectors.

Unit III: Mass spectroscopy and Vacuum techniques

Introduction: Ion production – Volatile – In volatile – Field desorption – Laser desorption – Fast atom bombardment (FAB) - Secondary ions mass spectroscopy (SIMS) – Californium plasma desorption – Ion analysis – Components of mass spectrometers – Resolution – Production and measurements of low pressure. Exhaust pumps – Rotary pumps – Diffusion pumps – Pirani and ionization gauges.

Unit IV: Solid state, surface and Laser spectroscopy

Vibration studies of surfaces – Electron energy loss spectroscopy (EELS) – Electronic spectroscopy of surfaces – Photoelectron spectroscopy (PES) Ultraviolet PES (UPES) – Auger electron spectroscopy (AES) – X-Ray fluorescence (XRF). Helium – neon laser, Semiconductor lasers - Lasers in medicine

Unit V: Thermal analysis, Sensors and transducers

Introduction - Thermal analysis instruments – Types of measurement – Main Techniques – Thermal events – Thermo gravimetry- Differential thermal analysis and Differential scanning calorimetry – Interpretation of DTA and DSC - Application of DTA and DSC - Sensors/transducer specification – Classification of sensors – Displacement and position tensor – Potentiometer – Strain gauges –Capacitive sensor – Linear variable differential transformer – Piezoelectric sensor – Temperature sensor – Resistance temperature detector - Thermistor - photodiode.

Text Books:

Unit I:

1. Sastry, S.S. (2009). Introductory Methods of Numerical Analysis. (3rd ed.). Prentice-Hall of India Ltd.
   Chapter 1: 1.3 – 1.5, Chapter 3: 3.3: 3.3.1 – 3.3.3, 3.6, 3.9: 3.9.1, 3.10: 3.10.1, Chapter 4: 4.2.1, 4.2.2
2. Douglas A. Skoog, James Holler, F., Stanley R. Crouch. (2007). Instrumental Analysis. Cengage Learning

Unit II:

3. Ghoshal. (2002). Nuclear Physics. (1st ed.). Chand and company Ltd reprint
   Chapter 7: 7.1 - 7.3, 7.5 – 7.8, 7.10, 7.11, 7.14, 7.15

Unit III:

4. Dudley H. Williams, Ian Fleming. (1987). Spectroscopic methods in organic chemistry. McGraw Hill.
   (Relevant topics from chapter IV)
5. Gurdeep Chatwal, ShamAnand. (1985). Spectroscopy (Atomic and Molecular). Himalaya Publishing house
   Chapter 10.1 - 10.3, 10.5
6. Verma, K.L. (1965). Properties of matter. S. Nagin& Co.,
   Chapter 11 : 11.8, 11.9, 11.10, 11.11, 11.13, 11.14, 11.15, 11.20, 11.21

Unit IV:

7. Colin N. Banwell, Elaine M. McCash. (1999). Fundamentals of Molecular Spectroscopy. Tata McGraw- Hill Publishing Company Limited
   Chapter 8 - 8.1: 8.1.1, 8.2: 8.2.1, 8.2.2, 8.2.3
8. Thyagarajan, K., Ghatak, A. K. (1982). LASERS. Theory and Applications, Macmillan India Limited.
   Chapter 9: 9.4, 9.8 , Chapter 14: 14.5

Unit V:

9. Micheal E. (2002). Brown. Introduction to Thermal Analysis, Techniques and Applications. Tata McGraw hill.
   Chapter 1, 2, 3
   Chapter 4: 4.1 - 4.3, 4.7, 4.11.
10. Paul P.L. Regtien. (2007). Sensors for Mechatronics. Elsevier- E-book
    Relevant topics

Reference Books:

1. Raja Raman, V. (2003). Computer Oriented Numerical Methods. Prentice – Hall of India Ltd.
2. Svanberg. (2009). Atomic and Molecular Spectroscopy. (4th ed.). Springer.
3. Sawhney, A.K. (2000). A course in Electrical and Electronic Measurements and Instrumentation. Delhi: DhanpatRai & Co.(P) Ltd.
4. Bernhard Wonderlich, Verlag Berlin, Heidelberg. (2005). Thermal Analysis of Polymeric Materials. Springer.

Semester I
b. Photonics (Elective - I)
Subject Code: PP1715

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. To study the optical properties of solid.
2. To introduce the topic of non linear effects of light on matter.

Unit I: Optical properties of solids

Introduction – Classical model-Drude model – Ionic conduction – Optical refractive index and relative dielectric constant – Optical absorption in metals, insulators and semiconductors - Colourcentres – Excitons – luminescence – Maser and laser – Population inversion – Lasers – Properties of laser beam and uses of lasers – Semiconductor lasers – Gas lasers – Liquid lasers – Free electron lasers - Phosphors in fluorescent lights – Application of lasers – Physics of optical fibers – Step-index fibers – graded-index fibers - Holography.

Unit II: Plasma, optical & reflectance excitons

Dielectric function of a electron gas – Dispersion relation for electromagnetic wave – Transverse optical modes in a plasma – Transparency of alkali metals in the ultra violet – Longitudinal plasmal oscillations – Plasma – Polaritons – LST relation.

Optical reflectance – Kramers – Kronig relations – Example – Frenkelexciton – Alkali halides – Molecular crystals – Moltt – Wannierexcitons – Exciton condensation into electron – Hole drops – Raman effect in crystals.

Unit III: Non-linear interaction of light & matter

Introduction - General classification – Non resonant interactions – Non linear polarization of the medium – Second order effects – Generation of the second Harmonic – Phase matching – Frequency mixing of two monochromatic fields – Pockel’s effects – Electron optical beam deflection – Optical rectification.

Unit IV: Non linear optical spectroscopy

Homogeneous and in homogeneous broadening – Incoherent interaction – Bleaching – Transient absorption – Non – linear transmission – Stimulated emission – Spectral hole burning – General procedure – Steps of analysis – Choice of excitation light intensities – Choice of probe light intensities – Pump and probe light overlap – Light beam parameters – Sample parameters – Possible measuring errors – Conventional absorption measurements – Determination of the cross section – Reference bream method – Cross section of anisotropic particles.

Unit V: New developments in laser optics

Optical cooling and trapping of atoms – Photon recoil – Measurement of recoil shift – Optical cooling by photon recoil – Experimental arrangements – Three dimensional cooling of atoms – Optical trapping of atoms – Optical cooling limits – Bose – Einstein condensation – Evaporative cooling – Application of cooled atoms and molecules.

Text Books:

SPillai, S.O. (2006). Solid state physics. (6thEd.). Chennai: Reprint New age international (P) limited publishers.
Unit I: Chapter: 12

1. Kittel , C. Introduction to solid state physics. (7th Ed)., John Wiley & Sons Inc.,
   Unit II: Chapters: 10 & 11. **(**Relevant sections)
2. Ralf Maenzel . (2004). Photonics. Springer Publication
   Unit III: Chapters: 4.1 to 4.47
3. Ralf Maenzel. (2004). Photonics. Springer Publication.
   Unit IV: Chapter5 : 5.1 to 5.35, Chapter7: 7.1, 7.2 : 7.2.1, 7.2.3.

4. W. Demtroder. (2004). Laser spectroscopy. (3rd Ed), Springer publications.
   Unit V: Chapter 4: 4.1.1 to 4.1.11

Reference Books:

1. Thyagarajan, K., Ghatak, A.K. ,(1981). Lasers: Theory and applications. New York: Plenum Press.
2. Bahaa, E. A., Saleh , Malvin Carl Teich. (2007). Fundamentals of Photonics. (2nd Ed.), Wiley Interscience.

Semester II
Condensed Matter Physics (Core – IV)
Subject Code: PP1721

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective: 1.To enable the students to understand crystal structure, phonons, energy bands, semiconductor crystals, magnetism and superconductivity.
2.To formulate the theory of lattice vibrations and apply it to determine thermal properties of solids.

Unit I: Crystal Structure

Structure of solid matter: The crystal lattice – Point symmetry – Point groups – The significance of symmetry – Simple crystal structure
Reciprocal lattice and determination of crystal structure : Bragg's law – Reciprocal lattice vectors – Construction – Diffraction condition – Laue equations – Brillouin zone – structure factor and atomic form factor – Measurement of diffraction pattern of crystal: The Ewald construction – Rotation method – Powder method – Determination of lattice constants

Unit II: Phonons

Crystal Vibration: Vibration of crystals with mono-atomic basis – Two atoms per primitive basis – quantization of elastic waves – Phonon momentum-Inelastic scattering by Phonons
Thermal Properties: Phonon heat capacity- Planck distribution-Normal mode enumeration-Density of states in one dimension- Density of states in three dimension-Debye model for Density of states-Debye T^3 law

Unit III: Energy Bands and Semiconductor crystals

Electronic band structure of solids - Nearly free electron model – Block functions – Kronig Penny model – Wave equation of electron in a periodic potential – Number of orbitals in a band – Insulators, semiconductors and metals. Band gap – Equations of motion – Effective mass - Physical interpretation of effective mass – Effective mass in semiconductors

Unit IV: Magnetism

Diamagnetism: Langevin diamagnetism equation- Quantum theory of diamagnetism of mononuclear systems- Quantum theory of paramagnetism - Hund rules - Ferromagnetic order - Curie point and the exchange Integral – Temperature Dependence of the Saturation Magnetization - Magnons – Thermal Excitation of Magnons – Ferrimagnetic order – Antiferro magnetic order – Ferro magnetic domains.

Unit V: Superconductivity

Superconductivity: Experimental survey- Occurrence of superconductivity- Destruction of superconductivity by magnetic fields- Meissner effect – Critical temperature –Heat Capacity - Energy gap – Isotope effect - Thermodynamics of the superconducting transitions – London equations – Coherence Length - BCS theory — Flux quantization in a superconducting ring- Duration of persistent currents- Type II super conductors Single Particle Tunneling – DC and AC Josephson effects – High temperature super conductors.

Text Books

1. Kittel, C. (1996). Introduction to solid state physics (8th ed.). John Wiley and Sons.
   Unit I: Chapter 2 (relevant topics)
   Unit II: Chapter 4 and 5 (relevant topics)
   Unit III: Chapter 7 and 8 (relevant topics)
   Unit IV: Chapter 11 and 12 (relevant topics)
   Unit V: Chapter 10 (relevant topics)

2. Ibach, H., Luth, H. (2004). Solid State Physics. Springer.
   Unit I: Sec. 2.1-2.5
3. Srivastava, J.P. (2004). Elements of solid state physics. Printice Hall of India
   Unit I: Sec. 3.8, 3.9
   Unit III: Sec. 8.5, 9.2.3

Reference Books

1. Ali Omer, M., Addison. (2001). Elementary solid state physics. Wesly.
2. Pillai, S.O. (1997). Solid State Physics. New Delhi: New Age International,.
3. Madelung,O. (1978). Introduction to Solid State Theory. Springer.

Semester II
Mathematical Physics (Core – V)
Subject Code: PP1722

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: 1. To emphasize the use of mathematical tools like evaluation of definite integrals of Physics in particular in the field of classical and quantum mechanics.
2. To demonstrate competence with a wide variety of mathematical tools and techniques.

Unit I: Complex Analysis

Analytic functions – Cauchy – Riemann equations in cartesian and polar forms– Harmonic functions - Cauchy's integral theorem – Cauchy's integral formula – Taylor's Series – Laurentz series – Cauchy's residue theorem –Singular points of an Analytic function – Evaluation of residues - application to evaluation of definite integrals – Integration around a unit circle –Jordan's Lemma.

Unit II: Polynomials

Legendre differential equation and Legendre functions – generating functions – Rodrigue's formula – Orthogonal Properties - recurrence formula – Bessel differential equation – Bessel functions of I kind - recurrence formula and generating functions – Hermite differential equations and Hermite polynomials - Generating functions & recurrence formula.

Unit III: Partial Differential equations and Green's function

Solution of Laplace equation in Cartesian coordinates- Solution of heat flow equations – Method of separation of variables – variable linear flow – One and two dimensional heat flow – Green's function for one dimensional case- general proof of symmetry property of Green's function- Eigen function: expansion of Green's function- Green's function for Poisson equation and solution of Poisson equation. Green's function for quantum mechanical scattering problem.

Unit IV: Tensors, Fourier and Laplace transforms

Contravarient and Covarient Tensors -Addition and subtraction – Outer product, inner product of tensors, Contraction of a tensor, Symmetric and anti-symmetric tensors – The Kronecker delta – Fourier transform- properties of Fourier transform - Fourier transform of a derivative – Laplace transform- properties of Laplace transform- Laplace transforms of the derivative of a function

Unit V: Group theory

Group postulates – abelian group – Cyclic group – Group multiplication table – Rearrangement theorem – Subgroups – Isomorphism and Homomorphism – Symmetry elements and symmetry operations – Reducible and irreducible representations - the great orthogonality theorem - character table for C_{2V}& C_{3V} point groups.

Text Books

1. Pipes, Harwell. (1976). Mathematics for Physicists and Engineers. McGraw Hill International Book company.

   Unit I: Chapter 1 Sections 1.1 to 1.10, 1.12, 1.14, 1.15.

2. Satya Prakash. (2005). Mathematical Physics. (4^{th} ed.) New Delhi: S. Chand & Company Pvt. Ltd.
   Unit II: Chapter 6, Sections 6.7 to 6.11, 6.17, 6.21, 6.22, 6.29, 6.30, 6.31
   Unit III: Chapter 8, Sections 8.2, 8.7, 8.10, Chapter 10, Sections 10.3-10.7
   Unit IV: Chapter 9, Sections 9.2-9.5, 9.9-9.11
   Unit V: Chapter 12, Sections 12.1, 12.2, 12.4, 12.5, 12.6, 12.7, 12.13, 12.19, 12.21.
3. Joshi, A.W. (1995). Matrices and Tensors for Physicists. New Age International Publishers Limited.
   Unit IV: Chapter 15, Sections 15.3 to 15.5. Chapter 16, Sections 16.2 to 16.7

Reference Books

1. Eugene Butkov. (1978). Mathematical Physics. New York, NY: Addison Wesley Publishing.
2. Courant, D. Hilbert. (1978). Methods of Mathematical Physics. New Delhi: Wiley Eastern Limited.
3. Arfken, Weber. (2001). Mathematical Methods for Physicists. (5^{th} ed.) San Diego. Elsevier Academic press.

Semester II
Quantum Mechanics (Core - VI)
Subject Code: PP1723

Number of hours per week	No of credits	Total number of hours	Marks
6	4	90	100

Objective: 1. To introduce the concepts of quantum mechanics and study their applications.
2. To use quantum mechanical principles to analyze advanced Physical phenomena of nature.

Unit I: Schrodinger Equations

Wave packet – Time dependent Schrödinger equation – Interpretation of the wave function – Time independent Schrödinger equation – Stationary states – Admissibility conditions on the wave function – Eigen functions and eigen values – Hermitian operator – Postulates of quantum mechanics – Simultaneous measurability of observables – General uncertainty relation – Dirac's notation – Equations of motion – Momentum representation – Linear Harmonic oscillator – Operator method.

Unit II: Angular Momentum

Angular momentum operators – Angular momentum commutation relations – Eigen values and eigen functions of L^2 and L_z– General angular momentum – Eigen values of J^2 and J_z – Angular momentum matrices – Spin angular momentum – Spin vectors for spin-(1/2) System – Addition of angular momentum : Clebsch-Gordon coeffiecients – Stern Gerlach Experiment.

Unit III: Approximation methods

Time independent perturbation theory: Basic concepts – Non-degenerate energy levels – Anharmonic oscillator – First-order correction – Effect of electric field on the ground state of hydrogen.

Variation method :Variational principle – Ground state of Helium

WKB Approximation : WKB method – Connection formula – Barrier penetration – Alpha emission

Time dependent perturbation theory: First order perturbation – Harmonic perturbation – Transition to continuum states – Absorption and Emission of radiation – Einstein's A and B coefficients – Selection rules.

Unit IV: Scattering theory

Scattering cross-section – Scattering amplitude – Partial waves – Scattering by a central potential: Partial wave analysis – Scattering by an attractive square-well potential – Scattering length – Expression for phase shifts – Integral equation – The Born approximation – Scattering by screened coulomb potential – validity of Born approximation.

Unit V: Relativistic Theory

Klein – Gordon Equation – Interpretation of the Klein-Gordon equation – Particle in a Coulomb field – Dirac's equation for a free particle – Dirac matrices – Plane wave solution – Negative energy states – Spin of the Dirac particle – Magnetic moment of the electron – Spin-orbit interaction.

Text Books:

1. Aruldhas, G. (2005). Quantum Mechanics. New Delhi: Prentice-Hall of India.
Unit I : Chapter 2.4 - 2.6, 2.8 – 2.10, 3.3 – 3.10, 4.8
Unit II : Chapter 8 : 8.1-8.9
Chapter 1 : 1.14

Unit III : Chapter 9 : 9.1 – 9.3, 9.5
Chapter 10 : 10.1, 10.5
Chapter 11 : 11.1 – 11.2, 11.4-11.5
Chapter 12 : 12.2 - 12.7
Unit IV : Chapter 14 : 14.1-14.4,14.6, 14.8-14.13
Unit V : Chapter 15: 15.1-15.5, 15.9-15.12

Reference Books:

1. AjoyGhatak, Lokanathan, S. (2007). Quantum Mechanics : Theory and Applications. New Delhi: Macmillan India Ltd.
2. Mathews, P.M., Venkatesan, K. (2008). A text book of Quantum Mechanics. Delhi: Tata McGraw – Hill Publishing Company Ltd.

Semester II

a. Crystal Growth Techniques and Thin Films Technology (Elective II)

Subject Code: PP1724

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective: 1. To study the various theory of crystal growth crystal growth process and the preparation of thin films through various techniques.

2.To gain insight involved in crystal growth and thin film technology and apply the techniques in the field of research.

Unit I: Crystal growth theories

Introduction - Nucleation – Theories of nucleation – Classical theory of nucleation - Kinetics of Crystal Growth: Introduction – Singular and rough faces – Models on surface roughness - The Kossel Stranski Volmer (KSV) theory – The Burton Cabrera Frank (BCF) theory.

Unit II: Solution growth

Low temperature solution growth: Introduction – Solution, solubility and super solubility – Expression for super saturation – Methods of crystallization.

Crystal Growth System: Classification – Constant temperature bath – Crystallizer – Attraction assembly – Seed, seed mount platform and crystal revolution unit -

High temperature solution growth: Introduction – Principles of flux growth

Gel Growth: Introduction – Principle of gel growth – Various types of gel – Structure of gel – Growth of crystals in gels – Experimental procedure – Biological crystallization.

Unit III: Hydro thermal and melt growth

Hydrothermal Growth: Introduction – Design aspects of autoclave.

Melt growth: Growth from the melt – The Bridgman and related techniques – Crystal pulling – Convection in melts.

Unit IV : Thin Film technology

Introduction – Nature of film – Deposition technology – Resistance heating – Electron beam method – Cathodic sputtering - Chemical vapour deposition – Epitaxial deposition - Chemical deposition – Spray pyrolysis process - Film thickness and its control – Substrate cleanng.

Unit V : Conduction in thin films and some applications

Conduction in continous film – Conduction in discontinuous metal film – Semiconducting film – Intrinsic semiconductor – Extrinsic semiconductor – Impurity energy level – Conduction in insulator film – Technological applications.

Text Books

1. Santhana Raghavan, P. and Ramasamy, P. (2004). Crystal growth processes and Methods. Chennai: KRV publications.
   Unit I: Chapter 2: 2.1 – 2.3.5 (solution growth not included)
   Unit II: Chapter 4: 4.1, 4.2, 4.8, 4.8.1, 5.4.1 – 5.4.7.3
   Unit III: Chapter 5: 5.2, 5.2.1 – 5.2.1.8, 3.1 – 3.5.2
2. Goswami, A.(2006). Thin film Fundamentals. New Age publishers .
   Unit – IV: Chapter 1: 1 – 11 (Pg 1- 13, 18 – 47).
   Unit V: Chapter 7: 1 – 3 (Pg 214 – 220) 4, 4.1 (Pg 235 – 239) Chapter 8 : 1-4 (Pg 248 – 259 ,Chapter 9: 4, 4.1 – 4.3 (Pg 314 – 319, Chapter 14: 1 – 7 (Pg 519 – 533)
3. Kasturi Lal Chopra, Suhit Renjan Das. Thin Film solar Cells. New York & London: Plenum press.
   Unit IV: Chapter 5: 5.2.2, 5.2.2.1 – 5.2.2.3, 5.3.1 – 5.3.1.1 – 5.3.1.3,

Reference Books

1. Pamplin, B.R. (1980).Crystal Growth. Oxford: Pergamon.
2. Brice,J.C. (1986).Crystal Growth Processes. New York: John Wiley and Sons.
3. Henisch, H.K. (1988). Crystals in gels and Liesegang Rings. Cambridge: Cambridge University Press.
4. Mullin, J.W. (1993). Crystallization. Oxford: Butterworth – Heine man
5. Bunshah, R.F. (1982). Deposition Techniques for films and coatings – Developments and Applications. New Jersey: Noyer publications

Semester II

b. Communication Physics (Elective - II)

Subject Code: PP1725

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective: 1. To provide an introduction to the various modulation techniques used for telecommunication.

2.To gain insight in digital, wireless, satellite communication which provide future employability and progress of students.

Unit I: Modulation techniques

Amplitude modulation index – Average power of sinusoidal AM – Double sided suppressed carrier modulation (DSBSC) – Amplitude modulator circuits – Amplitude demodulator circuits – Amplitude modulated transmitters – AM receiver using phase locked loop (PL) – Single sideband principles – Single balanced modulators – Frequency modulation – Sinusoidal FM – Frequency spectrum for sinusoidal spectrum - Average power in sinusoidal FM

Unit II: Digital communication

Introduction – Synchronization – Asynchronous transmission – Probability of bit error in base band transmission – Eye diagrams – Digital carrier systems – Carrier recovery circuits – Differential phase shift keying (DPSK) – Hard and soft decision decoders.

Unit III: Fibre optic communication

Principles of light – Transmission in a fiber – Modes of propagation – Losses in fibres – light sources for fiber optics – photo detectors – Connectors and splices – Fiber optic communication link.

Unit IV: Wireless communication

Cellular Technology : Definition of cellular radio - The cellular concept - Cellular system objectives - Fundamental wireless system components: The mobile phone - The cell base station - The Backhaul network - The mobile switching center (MSC) - Interconnection to the public switched telephone network (PSTN) and the internet - Cell ase station : Overview - Criteria and methods for cell placement - Selecting cell base station locations - Cell base station deployment - Microcells - Picocells and Nanocells - Radio frequency operation and techniques: Wireless frequency bands - System interference - Cochannel interference - Adjacent-Channel interference - Intermodulation interference (IM) - Bluetooth - Ultra-Wideband wireless (UWB) - UWB Drivers - 3G Communication: 3G Systems and IMT 2000 - Universal mobile telecommunications system (UMTS) - UMTS Network architecture - The UMTS core network - 3G Applications

Unit V: Satellite communication

Kepler's first law – Kepler's second law – Kepler's third law – Orbits – Geostationary orbit – Power systems – Altitude control – Satellite station keeping – Antenna lock angles – Limits of visibility – Frequency plans and polarization – Transponders – Uplink power budget calculations – Downlink power budget calculations – Overall link budget calculations – Digital transmission – Multipole – Access methods.

Text Books:

1. Dennis Roddy & John Coolen . (2008). *Electronic communication.* (4th ed) . India: Pearson Education Pvt. Ltd.

.Unit I: Chapter 8: 81. – 8.4, 8.6, 8.9, 8.10, 8.11, 8.12, 8.13.Chapter 9: 9.2, 9.Chapter 10: 10.2 - 10.5

Unit II: Chapter 12: 12.1-12.4, 12.8 - 12.12

.Unit III: Chapter 20: 20.1 - 20.3, 20.5 – 20.8.

2. Paul Bedell . (2005). Wireless *Crash Course*. (2nd ed). NewDelhi: The McGraw-Hill Companies

Unit IV: Chapter 1: 1.1, 1.2, Ch 2: 2.6
Chapter 3: 3.1 – 3.4, 3.8, 3.9
Chapter 4: 4.3, 4.6, 4.8, 4.9
Chapter 7: 7.1, 7.2.1, 7.2.2, 7.7
Unit V: Chapter 19: 19.1 – 19.18

Reference Books:

1.Leon W. Couch II (1988). *Modern communication systems,* (4th ed). India: Prentice Hall Pvt.

2. Killen H.B. (1988). *Digital Communications with Fiber Optic and Satellite Applications*. (1 st ed). India: Prentice Hall International Edition.

Semester III
Core VII: Integrated Electronics
Subject Code: PP1731

Number of hours per week	No of credits	Total number of hours	Marks
6	4	90	100

Objectives: 1. To provide knowledge in the basic structure and working concepts of electronic devices.
2. To acquire application skills involving digital integrated circuit.

Unit I: Electronic Devices

FET – Types – JFET – Principle and working - Salient features – Important Terms and parameters – JFET connections – Practical JFET – JFET applications – MOSFET – Types – Circuit operation – D-MOSFET – EMOSFET – SCR – Working – Equivalent circuit – SCR as a switch – Application of SCR – Triac – Construction – Operation – Characteristics - Applications – Applications of Diac.

Unit II: Digital Logic circuits and Flip Flops

Digital IC characteristics – Diodes and transistors in logic circuits – DTL type – AND, OR, NAND and NOR – RTL and TTL type NAND – ECL and I^2L circuits – Flip flops – NAND Latch – SR flip –flop, D flip – flop, JK flip flop – JK master – Slave flip flop – T-flip flop.

Unit III: Registers and Counters

Shift register – Ring counter – Shift counter (Johnson's counter) – Asynchronous counter / Ripple counter – Mod counters – 4-bit binary down counters – 4 Bit up/down counters – BCD using decoding gates – Synchronous counters – Design – Mod 3 counter – Random Sequence generator – Synchronous BCD counter.

Unit IV: Op-Amp Circuits

Characteristics and parameters –Op-amp comparator- Schmitt Trigger – Inverting and non-inverting amplifier –Voltage follower – summing and difference amplifier - Differentiator and Integrator – Current to voltage converter - Solution of Differential equation and simultaneous equation using op-amp - Instrumentation Amplifier using Transducer Bridge - Temperature indicator and controller –Light intensity meter – Measurement of flow and thermal conductivity –Analog weight scale – Differential input and output amplifier -Voltage to current converter –Very high impedence circuit - sample and hold system.

Unit V: Filter circuits and 555 Timer

Active filters – First order Low pass Butterworth filter – Filter design - frequency scaling – Second order Low pass Butterworth filter - First order and Second order High pass Butterworth filter – Higher order filters - Band pass filter –Wide and Narrow Band pass filter – Wide and Narrow Band Rejection filter -All pass Filter - 555 Timer - internal structure – Schmitt Trigger – Astable and Monostable multivibrators.

Text Books:

1. Mehta V.K., Rohit Mehta. (2016). *Principles of Electronics*. New Delhi: S.Chand and Company.
   Unit I: 19.1 – 19.13, 19.27 – 19.38, 20.1 – 20.8, 20.12, 21.2 – 21.6, 21.8, 21.9, 21.10
2. Vijayendran.V., Viswanathan.S. (2011). *Introduction to Integrated Electronics Digital and Analog*. (1st ed.).Chennai: (printers and Publishers) Pvt. Ltd.
   UnitII: 11.1 – 11.7, 11.8, 9.1 – 9.6
   Unit III: 10.1 – 10.7
   Unit IV: 13.3, 13.4, 14.1 – 14.13.
   Unit V: 17.1 – 17.4
3. Thomas L.Floyd. (1999). *Digital Fundamentals*.(3rd ed.). New Delhi: UBS- Publishers Distributers LTD.

Unit II: A – 8

4. Ramakant.A.Gayakwad. (2012). *Op-amps and linear Integrated circuits*. (4th ed.).New Delhi: Eastern and Economy Edition PH1 learning private Limited.
   Unit IV: 6.6.1 , 6.6.1(a-e) 6.6.7,6.9,6.11, 8.15
   Unit V: 7.1 – 7.10

Reference Books:

1. Millman J. Halkias, C.C. (1991). *Integrated Electronics*. New Delhi: Tata McGraw-Hill Publishing Company Limited.
2. Ryder, J.D. (2004). *Electronics: Fundamentals and Applications*. United States: Prentice Hall International, INC., Englewood Cliffs.
3. Salivahanan, S., Kumar, N.S. (2012). *Electronic Devices and Circuits*. (3rd ed.). New Delhi: Tata McGraw-Hill Publishing Company Limited.
4. Donald .P. Leach, Albert Paul Malvino, Goutam suba. (2006). *Digital Principles and Applications.* New Delhi: Tata, Mc Graw Hill publishing company, Ltd..
5. Malvino A.P. and Brown J.A. (1997). *Digital Computer Electronics*. (3rd ed.). NewDelhi: Tata McGraw Hill Publishing Company.

Semester III

Core VIII: Microprocessor and Microcontroller

Subject Code: PP1732

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: **1.** To provide knowledge on the hardware, programming and applications of 8085 microprocessor and 8051 microcontroller.

2. To gain hands on experience in interfacing peripherals to the microprocessor.

Unit I: Evolution and architecture of microprocessor 8085

Evolution of microprocessors – Intel 8085 microprocessor – Architecture – ALU – Timing and control unit – Registers (general purpose & special purpose registers) – Flags – Data and address bus – Pin configuration – 8085-based microcomputer – 8085 machine cycles and bus timings – Memory interfacing –Peripheral I/O – Memory mapped I/O

Unit II: Introduction to assembly language programming

Intel 8085 instructions – Opcode and operands – Instruction word size – Instruction set of Intel 8085 – Instruction and data formats – Addressing modes – Stack – Subroutines – Examples of assembly language programs: addition of two 8-bit numbers – 8-bit subtraction – One's compliment – Two's compliment – Square of a number – Largest number in an array – Ascending or descending order – Smallest number in an array

Unit III: (a) Data transfer schemes – Interrupts – Interfacing

Address space partitioning – Memory and I/O interfacing – Data transfer schemes – Programmed data transfer schemes – DMA data transfer scheme – Interrupts of Intel 8085 – Hardware and software interrupts – Interrupt call locations – RST 7.5, 6.5 and 5.5 – Interfacing I/O devices – I/O ports: non programmable I/O port Intel 8212, Programmable Peripheral Interface (PPI) Intel 8255

(b) Microprocessor based data acquisition system

Analog to digital converter – Sample and hold circuit – Analog multiplexer – ADC 0800 – Interfacing of A/D converter ADC 0800 – Interfacing of ADC 0800 and analog multiplexer AM 3705 – Interfacing of ADC 0800, analog multiplexer and sample and hold circuit

Unit IV: Microprocessor applications

Delay subroutine – 7 Segment LED display – Display of decimal numbers – Display of alphanumeric characters – Formation of codes for alphanumeric characters – Generation of square wave or pulse – 8-bit multiplication – 8-bit division – Measurement of electrical quantities – Frequency measurement – Resistance measurement – Measurement of physical quantities – Temperature measurement and control – Measurement and display of speed of a motor – Microprocessor based traffic control

Unit V: The 8051 Microcontroller

Inside the 8051 – Introduction to 8051 assembly programming – Assembling and running an 8051 program – The program counter and ROM space in the 8051 – Data types and directives – 8051 Flag bits and the PSW register – 8051 register banks and stack – Pin description of 8051 – I/O programming – Bit Manipulation. Arithmetic Instructions: Addition of unsigned numbers, Addition of Individual bytes – Subtraction of unsigned numbers – Addition of Individual bytes – Subtraction of unsigned numbers – Unsigned multiplication and division.

Text Books:

1. Ramesh Goankar. (2013). *Microprocessor Architecture*. Programming and Applications with the 8085. (6th ed.). India: Penram International Publishing Pvt.Ltd. **Unit I:** Chapter 4: 4.2, 4.3
   Chapter 5: 5.1 (5.1.1, 5.1.2), 5.4 (5.4.1, 5.4.3)

2. Ram, B. and Sanjay Kumar. (2013). *Fundamentals of Microprocessors and Microcontroller*. (7th ed.). India: DhanpatRai Publications (P) Ltd.
3. **Unit I:** Chapter 1: 1.1, 1.2
   Chapter 3: 3.1.3 – 3.1.5
   Unit II: Chapter 3: 3.1.6 – 3.1.8
   Chapter 4: 4.1 - 4.3, 4.6
   Chapter 5: 5.5, 5.6
   Chapter 6: 6.1 – 6.6, 6.9, 6.11, 6.19, 6.21 (only), 6.22.1, 6.24 (only)
   Unit III: Chapter 7: 7.1, 7.2, 7.3, 7.4, 7.4.1 – 7.4.4, 7.5, 7.5.1 – 7.5.3, 7.6, 7.6.1, 7.7, 7.7.1 – 7.7.4
   Chapter 8: 8.1, 8.2, 8.4, 8.5, 8.6, 8.6.1 – 8.6.3
   Unit IV: Chapter 6: 6.29, 6.30
   Chapter 9: 9.2, 9.3, 9.3.3 – 9.3.5, 9.5, 9.5.1, 9.5.5, 9.6, 9.6.1, 9.6.5, 9.8, 9.9

4. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin, D. Makinlay. (2009). *The 8051 Microcontroller and Embedded Systems.* (2nd ed.).New Delhi: Pearson Education
5. **Unit V:** Chapter 2: 2.1 – 2.6
   Chapter 4: 4.1 – 4.2
   Chapter 6: 6.1 (Relevant topics)

Reference Books:

1. NagoorKani. (2004). *Microprocessor and its Applications.* (1st ed.). Chennai: RBA Publications.
2. Douglas. V. Hall. (1999). *Microprocessors and Interfacing – Programming and Hardware.* (2nd ed.). India: McGraw Hill.
3. Kenneth J. Ayala. (2004). *The 8051 Microcontroller – Architecture, Programming & Applications.* (2nd ed.). India: Penram International.

Semester III

Elective III (a): Physics of the Cosmos

Subject Code: PP1733

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. The course enables the students to understand and realize the historical evolution of Universe and principles involved in Astrophysics

2. The topics included are Solar system, Comets, Galaxy, Cosmology and Astronomical Instruments which play a key role in the future employability and global progress of students.

Unit I: Solar system

Components of the solar system - The Sun - The Planet - Two types of planets-Satellites - Asteroids and Comets - Composition differences between the Inner and Outer planets - Bode's law: The search for order - Density as a measure of a planet's composition - Age of solar system - Origin of solar system - Interstellar cloud - Formation of the solar Nebula - Condensation in solar Nebula - Accretion and Planetesimals - Formation of Planets - Formation of Moons - Final stages of Planet formation - Formation of Atmospheres - Cleaning up the solar system

Unit II: Stars

Binary and multiple stars: Introduction – Visual Binary – Spectroscopic Binary – Eclipsing Binary – Multiple stars – Origin of Binary stars – Stellar masses and mass Luminosity Relation – Mass transfer in close Binary systems.

Neutron stars and Black holes: Discovery of pulsars – Rotating Neutron star model of pulsars – Period distribution and loss of rotational energy – Test of rotating neutron star model of pulsars Gold's model of pulsars, Black holes.

Unit III: Galaxies Discovering

Galaxies - early observations of Galaxies - Types of Galaxies - Differences in Stellar and Gas content of Galaxies - The cause of Galaxy types - Galaxy collisions and Mergers - Measuring properties of Galaxies - Galaxy distances - using Cepheid Variables - The Red shift and Hubble Law - Measuring the diameter of a Galaxy -Measuring the Mass of a Galaxy - Dark Matter-Quasars as probes of Intergalactic Space -Gravitational Lenses-Galaxy clusters - The local group-Rich and Poor Galaxy clusters -Super clusters

Unit IV: Cosmology

Introduction – Red shift and the expansion of the universe – Matter Density in the universe and Declaration parameter – Perfect cosmological principle – Fundamental equation of cosmology. The current theories – Some important models of the universe – Observational tests of cosmological models.

Unit V: Astronomical Instruments

Light and its properties – Earth atmosphere and the electromagnetic radiation – Optical telescopes – Radio telescopes – Hubble space telescopes – Astronomical spectrographs – Photoelectric photometry – Spectrophotometry – Detectors and Image processing.

Text Books:

1. Thomas T., Arny. (1996). *Explorations –An Introduction to Astronomy*, (1st ed.). California: Mosby Version publications.
   Unit I: Chapter 6 Unit III: Chapter 15, Section 15.1 - 15.3,15.5,15.6
2. Baidyanath Basu. (2006). *An introduction to Astrophysics.* (1st ed.). New Delhi: Prentile Hall of India PVT Lt publications.
   Unit II: Chapter 7, Sections 7.1 – 7.7 and 15.1 - 15.5, 15.8
   Unit IV: Chapter 21, Sections 21.1 – 21.7
   Unit V: Chapter 1, Sections 1.1 – 1.10

Reference Books:

1. Narlikar, J.V. (1995). *Structure of the Universe.* (1st ed.). New York: Oxford University George O., Abell. (1986). *Exploration of the universe*. (1st ed.). New Delhi: Saunder's college publishing.
2. Frark, H., Shu. (1982). *The Physical Universe An Introduction to Astronomy*. (1st ed.). California: University science books, Mill valley.
3. Abhyankar, K.D. (1989). *Astrophysics – Stars and Galaxies*. (1st ed.). New Delhi: Tata – McGraw Hill Publications.

Semester III
Elective III (b): Radiation Physics
Subject Code: PP1734

No of hours per week	Credit	Total No of Hours	Marks
6	5	75	100

Objective: 1. To inculcate the knowledge on Radiation sources and its detection, Diagnostic Radiology, and Radiation Dosimetry.
2. To develop the skill in industrial applications of radiation.

Unit I: Radiation Sources and its interaction with matter

Units and definitions-Fast electron sources-Heavy charged particle sources-Sources of electromagnetic radiation-neutron sources-Interactions of fast electron –Interaction of Heavy charged particle- Interaction of gamma rays-Interaction of neutrons

Unit II: Radiation Detection

General properties of Radiation detectors-Simplified Detector model-Modes of Detector operation-Ionization Chambers-Design and Operation of DC Ion Chambers- Proportional Counters-Design Features and its Performance-Geiger-Muller Counter- Geiger CountingPlateau-Design Features-Counting efficiency-Scintillation Detector Principles- Organic and Inorganic Scintillators.

Unit III: Accelarators for Radiation therapy and Diagnostic Radiology

Accelarators: Production of X-Rays and Accelarator beams- Medical and Industrial accelarators

Diagnostic Radiology: Physical principles of x-ray diagnosis, density, contrast, detail and definition of radiograph, choice of kV, mA, filtration, FSD, Screens, films, grids, contrast media, concept of modular transfer function and its applications, Radiographic techniques, Special procedure: Myelography, Tomography, Fluoroscopy, Pelvimetry, Film Processing, Image intensifiers and television monitoring, reduction of patient dose, quality assurance in diagnostic radiology.

Unit IV: Radiation Dosimetry

Dosimetry Fundamentals-Simple Dosimeter model in terms of cavity theory-Integrating Dosimeters-Thermoluminescence Dosimetry- Photographic Dosimetry-Chemical Dosimetry-Calorimetric Dosimetry-Scintillation Dosimetry-Semiconductor Detectors for Dosimetry

Unit V: Industrial applications of radiation and Hazard evaluation

Scientific and industrial applications of gamma rays- Based on gamma ray backscatter and on X-ray Fluorescence- Scientific and industrial applications of beta particles and electrons-Scientific and industrial applications of neutrons- Scientific and industrial applications of gamma rays- Scientific and industrial applications of protons and alpha particles. Application of tracer technology to industry and the environment- Tracer applications in the field.

Hazard evaluation by calculation, methods of calculation, area monitoring,and personal monitoring. Detection and measurement of contamination on work surface and person.

Text Books:

1. Knoll. G F**,** (1989), *'Radiation Detection and Measurement'*,(2 nd ed) NewYork:Wiley
2. Foldiak G**, (**1986).*'Industrial applications of radioisotopes' (1st ed)* NewYork: Elsevier Science Publishing Company.
3. Frank Herbert Attix, (2004*)"Introduction to Radiological Physics and Radiation Dosimetry" (1st ed)* Weinheim: WILEY-VCH Verlag Gmbh & Co. kGaA.
4. John R Lamarsh, (1983)**,** *'Introduction to Nuclear Engineering'*,(2nded)New York: Addison Wesley Publishing Company
5. G.C Lowenthal & P.L. Airey, (2001*), 'Practical applications of Radioactivity and Nuclear Radiations'* (1st ed.). Cambridge : Cambridge University Press.

Reference Books:

1. Kenneth R Kase, Bjarngard B E and Attix F H, (1985), *The Dosimetry of ionising radiation*‟, Vol I (1st ed.). Orlando, Florida: Academic Press
2. Kenneth R Kase, Bjarngard B E and Attix F H, (1987), *The Dosimetry of ionising radiation*‟, Vol II (1st ed.). Orlando, Florida: Academic Press
3. Glasstone S and Sesonske A, (1986), *Nuclear Reactor Engineering (* 4th ed) Delhi: CBS.
4. Erich J Hall, (1988). *'Radiology for the Radiologists' (*3rd ed) **.** New York: J B Lippincott Company.
5. Faiz M.Khan, (2003), *The Physics of Radiation therapy*, (3rd ed.). Philadelphia, USA: Lippincott Williams & Wilkins.

Semester IV

Core IX: Materials Science
Subject Code: PP1741

o. of hours per week	No. of credits	Total no. of hours	Marks
6	4	90	100

Objectives: 1. To provide a clear idea on the properties, of functional materials.
2. To understand the fabrication and application of materials.

Unit I: Phase transformation

Phase rule- Single component systems- Binary Phase diagrams- Microstructural Changes during Cooling- The lever rule- Applications of phase diagrams- Phase transformations- Time scale for phase changes- The growth and the overall transformation kinetics of nucleation– Applications.

Unit II: Elastic Behaviour & Imperfections

Atomic model of elastic behavior- The modulus as a parameter in Design- Rubber-like elasticity- Anelastic behavior: Relaxation Processes- Viscoelastic behavior: Spring-Dashpot models- Crystal imperfections-Point imperfections- The geometry of dislocations- other properties of dislocations- surface imperfections.

Unit III: Oxidation, Corrosion and other deformation

Mechanisms of oxidation-oxidation resistant materials- the principles of corrosion-protection against corrosion- plastic deformation- the tensile stress- stress-strain curve- plastic deformation by slip creep- mechanisms of creep-creep resistant materials- Ductile fracture-Brittle fracture- Methods of protection against fracture.

Unit IV: Synthesis, fabrication and processing

Fabrication of metals- forming operations-casting- powder metallurgy- thermal processing of materials- annealing processes- heat treatment of steels- fabrication of ceramic materials-fabrication and processing of glasses- fabrication of clay products- powder pressing-tape casting- polymer additives- forming techniques for plastics.

Unit V: Composites

Particle-reinforced composites- large-particle composites- dispersion-strengthened composites- fiber-reinforced composites- influence of fiber length- influence of fiber orientation and concentration- the fiber phase- the matrix phase- Polymer –Matrix composites- metal-matrix composites- ceramic-matrix composites -carbon-carbon-composites- hybrid composites-Processing of fiber-reinforced composites : Pultrusion- Prepreg production processes- Filament winding.

Text Books:

1. Raghavan, V. (2007). *Materials Science and Engineering*. (5th ed.). New Delhi: Prentice-Hall of India Limited.
   Unit I: Chapter 7: 7.1, 7.2,7.3,7.4, 7.5, 7.7.
   Chapter 9:9.1,9.3.
   Unit II: Chapter 10: 10.1,10.2,10.3,10.4,10.5
   Chapter 6:6.1, 6.2, 6.3, 6.4
   Unit III: Chapter 13: 13.1,13.2,13.3,13.4
   Chapter 11:11.1, 11.2,11.3,11.12,11.13
   Chapter 12: 12.1,12.2,12.6

2. William D. Callister, Jr. (2001). *Fundamentals of Materials Science and Engineering, An*

Interactive e-Text. (5th ed.). USA: John Wiley & Sons.
Unit IV: Chapter 14: 14.1-14.10, 14.12,14.13.
Unit V: Chapter 15:15.1 – 15.13.

Reference Books:

1. Wahab, M.A. (2015). *Solid State Physics- Structure and Properties of Materials*. (3rd ed.). New Delhi: Narosa Publishing House Pvt. Ltd.
2. Philip Philips. (2014). *Advanced Solid State Physics.* (2nd ed.). UK:Cambridge University Press.
3. Luigi Nicolais. & Gianfranco Carotenuto. (2014). *Nanocomposites – In Situ synthesis of polymer-embedded nanostructures.* USA:John Wiley & Sons.

Semester IV
Core X: Nuclear and Particle Physics
Subject Code: PP1742

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: 1. To provide knowledge about the nuclear force in the nucleus, the nuclear models, the nuclear radiations and the elementary particles.
2. To acquire working knowledge of the applications of nuclear and particle Physics.

Unit I: Nuclear forces

Exchange forces – Meson theory of nuclear forces – n-p and p-p scattering – Scattering length – Spin dependence of nuclear forces – Charge independence of nuclear forces - Ground state of deuteron – Properties of ground state of deuteron – Tensor forces – Excited state of deuteron – Magnetic moment and quadrapole moment of deuteron.

Unit II: Nuclear model

Liquid drop model: Weizsacker's mass formula - Equation of mass parabolas for Isobaric nuclei – Mass stability – Deformation of liquid drop - Bohr and Wheeler's theory of nuclear fission - Nuclear shell model – Evidence for the existence of magic numbers – Extreme single particle model – (square well of infinite depth, harmonic oscillator potential – spin orbit potential) - Predictions of nuclear shell model – Angular momenta and parities of nuclear ground states, magnetic moments – Schmidt lines.

Unit III: Radioactivity

Alpha decay: Properties of alpha particles and α decay – Velocity and energy of alpha particles – Gamow's theory of alpha decay – Geiger Nuttal law.

Beta decay: Properties of beta particles - General features of beta spectrum – Fermi theory of beta decay – Fermi and Gamow – Teller selection rule – Neutrino hypothesis – Properties of neutrino – Kurie Plot.

Gamma emission: Multi-pole radiation – Selection rules – Internal conversion and nuclear isomerism.

Unit IV: Nuclear reactions

Kinds of nuclear reactions, conservation laws, nuclear reaction kinematics – Compound nuclear theory - Reciprocity theorem - Breit Wigner dispersion formula - Neutron sources – Classification of neutrons as to energy - Neutron diffusion - Neutrons current density – Neutron leakage rate – Fast neutron diffusion and Fermi age equation – Four factor formula – Nuclear chain reaction – Critical size of a reactor - General aspect of reactor design.

Unit V:Elementary particles

Classification of elementary particles – Particle interactions – Symmetries and conservation laws – Invariance under charge, parity – Charge conjugation – Time reversal, Combined Inversion of C.P.T. - isospin – srangeness –- hyperons – leptons – Classification of hadrons .

Text Books :

1. Tayal, D.C. (1982). *Nuclear Physics*. (4th ed.). Mumbai: Himalaya Publishing House.
   Unit I: Chapter 8: 8.1, 8.4, 8.5, 8.7 (A alone), 8.10
   Unit II: Chapter 9: 9.3, 9.4 (1 and 2 only)
   Chapter 13: 13.1 (F) – (Quantum Effects not included)

Unit III: Chapter 5: 5.3, 5.5, 5.6
Chapter 6: 6.1, 6.2 (Beta spectrum alone), 6.3, 6.5, 6.6
Chapter 7: 7.1, 7.3, 7.4, 7.6
Unit IV: Chapter 10: 10.1 - 10.3, 10.11, 10.14
Chapter 12: 12.1, 12.2, 12.5, 12.9
Chapter 15: 15.1, 15.2 (different shapes of reactors not included), 15.3.
Unit V: Chapter 16: 16.1, 16.2, 16.3, 16.4 – 16.10, 16.13 (only basic properties of elementary particles)

2. Roy, R.R. and Nigam, B.P. (1983). *Nuclear Physics*. (1st ed.). USA: New age International Ltd.
Unit I: Chapter 3: 3.2 – 3.7
Unit IV: Chapter 6: 6.4

3. SatyaPrakash. (2005). *Nuclear Physics and Particle Physics*. (1st ed.). New Delhi: Sultan Chand & Sons.
Unit I: Chapter 2: 2.14 – 2.16
Unit II: Chapter 7: 7.4, 7.8 (1& 2 only)

Reference Books:

1. Bernard L. Cohen. (1971). *Concepts of nuclear Physics*. (1st ed.). New Delhi: Tata McGraw Hill
2 . Herald Enge. (1971). *Introduction to Nuclear Physics*. (1st ed.). New Delhi: AddisionWesly Publishing Company.

Semester IV
Core XI: Molecular Spectroscopy
Subject code: PP1743

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: 1. To provide knowledge in the basic understanding of spectroscopy.
2. To gain insight ideas on instrumentation tools and its applications.

Unit I: Microwave spectroscopy

Classification of molecules - Interaction of radiation with rotating molecule – Rotational spectra of rigid diatomic molecules – Isotope effects in rotational spectra – Intensity of rotational lines – Non-rigid rotator – Vibrational excitation effects – Symmetric top molecules –Microwave spectrometer – Information derived from rotational spectra.

Unit II: Infrared spectroscopy

Vibrational energy of a diatomic molecule – Infrared spectra – Infrared selection rules – Vibrating diatomic molecule – Diatomic vibrating rotator – Asymmetry of rotation – Vibration band – Vibrations of polyatomic molecules – Rotation vibration spectra of polyatomic molecules – IR spectrophotometer – Instrumentation - Sample handling techniques – Fourier transform infrared spectroscopy – Applications (any two)

Unit III: Raman spectroscopy

Theory of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra – Mutual exclusion principle – Raman spectrometer – Polarization of Raman scattered light - Structure determination using IR and Raman spectroscopy.

Unit IV: Electronic spectroscopy

Introduction – Vibrational coarse structure – Vibrational analysis of band systems – progressions and sequences – Information derived from vibrational analysis – Frank – Condon principle – Intensity of vibrational electronic spectra – Roatational fine structure of electronic – Vibration spectra – The Fortrat parabolae – Dissociation – Predissociation.

Unit V: Resonance spectroscopy

Nuclear magnetic Resonance (NMR): Magnetic properties of nuclei – Resonance condition – NMR instrumentation – Relaxation processes – Bloch equations – Chemical shift – Nuclear quadrupole effects.

Electron Spin resonance (ESR): Introduction – Principle of ESR – ESR spectrometer – Total Hamiltonian - Hyperfine structure.

Nuclear quadrupole resonance (NQR): The quadrupole nucleus – Principle of nuclear quadrupole resonance – Transition for axially symmetric systems - NQR instrumentation.

Text Book

Aruldhas. G. (2005) . *Molecular structure and spectroscopy.* **(**2nd ed). New Delhi: Prentice-Hall of India private Ltd.

Unit I : Chapter 6: 6.1 – 6.7, 6.9, 6.13, 6.14
Unit II : Chapter 7: 7.1 – 7.7, 7.11, 7.15 – 7.18
Unit III: Chapter 8: 8.1 – 8.6, 8.8, 8.10
Unit IV: Chapter 9: 9.1 – 9.10
Unit V: Chapter 10: 10.1 – 10.5, 10.7, 10.15,
Chapter 11: 11.1 – 11.5
Chapter12: 12.1 – 12.3, 12.5

Reference Books

1. Banwell . C.N. (1997). *Fundamentals of Molecular Spectroscopy*. (3rd ed). New Delhi: Tata Mc Graw Hill Publishing Company Ltd.
2. Herzberz Van Nastrand G. (1989) .*Molecular spectra and molecular structure* (2nd ed). Germany: Krieger publishing company Ltd.

Semester IV
Elective IV (a) : Nano Physics
Subject code: PP1744

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. To understand the theoretical aspects of low dimensional semiconductor systems.
2. To provide an idea on the synthesis and applications of nanomaterials.

Unit I : Nanomaterials Synthesis and Characterization

Nano structures – Synthesis of nanoparticles : Sol-gel processing – Arrested precipitaiton – Biosynthesis of nanomaterials using plants – Carbon nanotubes - Electronic structure of carbon nanotubes - Types of carbon nanotubes - Synthesis of carbon nanotubes: Laser method- CVD (Pyrolysis of Hydrocarbons) – CVD method on flat surfaces - Solar production of carbon nanotubes – Properties - Applications – Fullerene – Properties of Fullerene. Structural characterisation: XRD – Scanning Tunnelling Microscope (STM) – Atomic Force Microscope (AFM) – Properties of nanomaterials. Structural characterisation: XRD – FTIR

Unit II: Quantum hetrostructures

Novel phenomena - Heterostructure – Growth of heterostructure – Molecular Beam Epitaxy –Band alignment – Quantum well – Superlattice - Doped Heterostructures – Quantum wells in heterostructures – Effective mass theory in heterostructures – Application of effective mass theory in quantum wells in heterostructures –Applications of heterostructures.

UNIT – III: Quantum well, quantum wires & quantum dots

Preparation of Quantum nanostructures - Size effects - Fermi gas and density of states - Calculation of the density of states – Quantum wire – Production, structure and uses – Quantum dot : production, epitaxially self assembled quantum dots – Electronic energy states – Application – Quantum well infrared detector – Quantum well and quantum cascade laser – Quantum dot laser.

Unit – IV : Magneto electronics and applications of nanotechnology

Nano crystalline soft magnetic materials – Permanent magnet materials – Preparation of magnetic nanomaterials - Super paramagnetism - Coulomb blockade – Single electron transistor - Spintronics - Giant magnetoresistance - Quantum Hall effect - Quantum spin Hall effect - Fractional quantum Hall effect - Applications of nanotechnology.

Unit V: Applications of Nanomaterials

Nanoelectronics – Introduction – Sensors – MEMS/NEMS – Solar cells – Displays – Optical switches – Graphene electronics – Biosensors – Biomarkers and Bioimaging – Targeted drug delivery – Nanorobots.

Text Book:

1. Dr. Sr. Gerardin Jayam (2009). *Nano Physics*, (1st ed.). Nagercoil: Department of Physics, Holy Cross College.
   UNIT : I to IV
2. Mohankumar G., (2016) *Nanotechnology-Nanomaterials and Devices* , (1st ed.).New Delhi: Narosa publishing house.
   UNIT: V: 4.1,4.3, 4.7, 5.4, 5.6, 5.7, 5.9, 7.2, 7.3, 7.5, 7.7

Reference Books:

1. Charles P. Poole Jr, Frank J. Owens, (2008). *Introduction to Nanotechnology*, (1^{st} ed.). Germany: Wiley publications.
2. K. Goser, P. Glosekotter and J. Dienstuhl, (2005).*Nanoelectronics and nanosystems*, (1^{st} ed.). Germany: Springer Verlag publications.
3. W.R. Fahrner , (2008). *Nanotechnology and nanoelectronics*, (1^{st} ed.). Germany: Springer Verlag publications.
4. Manasi Karkare, (2008). *Nanotechnology – Fundamentals and applications*, (1^{st} ed.). Mumbai:I.K. International publications.

Semester IV

Elective IV (b) : Quantum Field Theory

Subject Code: PP1745

No of hours per eek	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. To demonstrate an understanding of field quantisation and the expansion of the scattering matrix.

2.To understand and be able to do simple calculations in the standard model of elementary particle physics.

Unit : I Classical fields theory

The dynamics of fields – The Klein – Gordon equation – First order Lagrangians – Maxwell's equations – Locality – Lorentz Invariance – Symmetries – Noether's theorem – Internal symmetries – Hamiltonian formalism

Unit : II Free fields

Canonical quantization – The simple harmonic oscillator – The free scalar field – Relativistic normalization - Complex scalar fiedls. – The Heisenberg picture – Causality – Propagators: The Feynman propagator – Green's functions.

Unit : III Interacting fields

The interaction picture – Dyson's formula – Wick's theorem – Nucleon scattering – Feynman diagrams – Feynman rules – Examples of scattering amplitudes – Mandelstam variables – The Yukawa potential - Φ^4 theory.

Unit IV : The Dirac equation

Spinor representation - Spinors – The dirac equation – Symmetries and conserved currents – Plane wave solutions - Fermionic quantization – Fermi – dirac statistics – Dirac's hole interpretation – Yukawa theory – Nucleon scattering..

Unit V : Quantum electrodynamics

Maxwell' s equations – Gauge symmetry – The quantization of the electromagnetic field – Coulomb Gauge – Lorentz Gauge – QED – Naïve Feynman rules – Feynman rules - Charged scalars – Scattering in QED – The coulomb potential.

Text Book:

Dr. David Tong, (2007). Quantum field theory (lecture notes) (part –III). Universtiy of Cambridge, Mathematical Tripos. Available at : http:// www/damtp.cam.ac.uk/user/tong/qft.html

Reference Book

1. Peskin,M.E. and and Schroeder, D.V. (1995). An Introduction to Quantum Field Theory, Addison – Wesley Publication.
2. Srednicki, M. (2007). Quantum Field Theory, Cambridge University Press.

Practical – I
Advanced Physics Lab – I (General Physics)
Subject Code: PP17P1

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: **1.** To acquire knowledge about basic concepts of physics and to calculated the related physical parameters.

2. To Provide the students with different practical, intellectual and transferable skills.

Any twelve

1. Ultrasonic diffraction
2. Spectrophotometer Kit: Determination of Rydberg's Constant – Hydrogen and solar Spectrum – Mirror and telescope method
3. LASER Experiment: Thickness of insulation of a wire by Diffraction method
4. Guoy's Method: Magnetic Susceptibility measurement
5. Spectrophotometer Kit: Absorption and Transmission coefficients of solutions.
6. Magneto resistance Kit: Determination of Magnetic resistance.
7. Ultrasonic Interferometer Kit: Determination of velocity
8. Quincke's method: Determination of Susceptibility
9. Band Gap measurement
10. Hall effect Kit: Measurement of Hall voltage, current & Hall Coefficient.
11. LCR circuit: Determination of Dielectric constant of Liquids.
12. Four probe Kit: Conductivity measurements
13. Michelson Interferometer: Determination of wave length and thickness of the given mica sheet.
14. Electrolytic tank.Equi-potential plot.
15. Fibre Optical communication.
16. Indexing an X- ray Powder diffraction pattern and lattice parameter determination
17. Debye – Waller factor determination using X – Ray intensity data.
18. Conductivity – Two probe method – dielectric crystals (Kit)
19. Dielectric constant of crystals – Parallel plate capacitor method
20. B.G. Variation of coefficient of mutual induction with distance and angle.

Practical – II
Advanced Physics Lab - II (Programming with Computer – C++)
Subject Code: PP17P2

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. To enable the students to solve problems in C++ using different numerical methods.
2.To make the mathematical calculations simpler.

Any twelve experiments:

1. Curve fitting to straight line and data interpolation (Cauchy's constants)
2. Currents in a Wheatstone's bridge – Gauss elimination method
3. Solution of radioactive decay problem – RungeKutta method
4. Computer simulation (frequency response of a series LCR resonance circuit)
5. Inverse and determinant of a matrix
6. Matrix multiplication (application – rotation matrices)
7. Solution of a physical problem – Newton Raphson method
8. Newton's forward/backward interpolation for table of points
9. Numerical differentiation – Compute the value of derivative for the function y = f(x) (whose tabular values are given) at a given value of x using Newton's forward/backward difference formula
10. Numerical integration – Simpson's 1/3 and $3/8^{th}$ rule
11. a) Pseudo random number generation b) Monte Carlo method of estimating the value of π
12. Monte Carlo integration – estimating the area of an ellipse or a simple integral
13. Differential equation – Newton's law of cooling by Euler's method
14. Boundary value problem – solution to Poisson's equation

Practical – III
Advanced Physics Lab – III (Electronics)
Subject Code: PP17P3

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: 1. To understand and analyze the working of electronic devices.
2. To acquire skills in designing electronic circuits.

Any fourteen

1. Code converters – BCD to Gray, Gray to BCD
2. Darlington pair amplifier
3. FET: Characteristics
4. FET : Amplifier
5. Push – Pull Amplifier
6. Amplitude modulated circuits
7. UJT - Characteristics and saw toothwave generator
8. Phototransistor – Comparison of illumination
9. Schmidt trigger usingIC 555 and IC 741
10. Counters: up, down ring and mod counters
11. Operational Amplifier – A/D converter
12. Operational Amplifer – sine, square, triangular and pulse wave generators
13. Binary adder and subtractor.
14. Operational Amplifier – analog computation
15. Modulus counter – IC7490
16. Multiplexer, Demultiplexer, karnaugh map
17. SCR – Characteristics.
18. BCD to excess 3, excess 3 adder

Practical – IV
Advanced Physics Lab – IV (Microprocessor and Micro controller)
Subject Code: PP17P4

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. To become familiar with the instruction set of Intel 8085 microprocessor and microcontroller.
2. To provide practical hands on experience with Assembly Language Programming and interfacing with 8085 microprocessor.

Any fourteen

1. Assembly language program for Block move and logical operations
2. Assembly language program for Addition, Subtraction, Multiplication, and Division.
3. Arranging an array of data in Ascending and descending orders.
4. Finding the largest, smallest and search for any number of an array using micro processor
5. Factorial of given Number.
6. Sum of series of even numbers and odd numbers from the list of numbers.
7. Fibonaci series.
8. Counters using microprocessor
9. Waveform generation using microprocessor
10. Display of any character (Rolling display)
11. Code conversion using microprocessor
12. AD/DA converters using microprocessor
13. Number of zeros, positive, negative numbers and square of a number using 8085 microprocessor
14. Interfacing – Stepper motor using microprocessor
15. Interfacing – Traffic Control
16. Microcontroller – Logic operations, 1’s and 2’s compliment
17. Microcontroller - Addition, Subtraction, Multiplication, and Division