VINAYAKA MISSION'S RESEARCH FOUNDATION

(Deemed to be University)

Curriculum and Syllabus

For

M.Sc. PHYSICS

(Regular)

Learning Outcome based Curriculum Framework

(LOCF- 2022)

(For the Academic Year starting from 2022-2023 onwards)

OUTCOME-BASED EDUCATION (OBE)

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

OBE is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes.

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability.

Outcome –Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs):

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Some important terminologies repeatedly used in LOCF

Core Courses (CC)

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE) / Generic Elective courses

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

Generic Elective Courses

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

The Ability Enhancement Courses (AEC)
Two compulsory Ability Enhancement Courses with 4 credits is offered for a PG programme by the Department.

Skill Enhancement Courses (SECs)
These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme.

M.Sc. PHYSICS

PROGRAMME OUTCOMES

PO1. Apply the knowledge and skill in the design and development of Electronics circuits to fulfill the needs of Electronic Industry.

PO2. Become professionally trained in the area of electronics, optical communication, nonlinear circuits, materials characterization and lasers.

PO3. Pursue research related to Physics and Materials characterization.

PO4. Demonstrate highest standards of Actuarial ethical conduct and Professional Actuarial behavior, critical, interpersonal and communication skills as well as a commitment to life-long learning.

PO5. Understanding the basic concepts of physics particularly concepts in classical mechanics, quantum mechanics, electrodynamics and electronics to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws.

PO6. Learn to carry out experiments in basic as well as certain advanced areas of physics such as nuclear physics, electronics and lasers.

PO7. A research-oriented learning that develops analytical and integrative problem-solving approaches.

VINAYAKA MISSION'S RESEARCH FOUNDATION DEEMED UNIVERSITY

M.Sc - PHYSICS REGULAR

CURRICULUM - REGULATIONS 2022

DISTRIBUTION OF CREDITS

Sem	Component	Paper Title	Credits	Total
I	CCT - 01	Classical Dynamics and Relativity	4	25
	CCT - 02	Mathematical Physics	4	
	CCT - 03	Medical Physics	4	
	CCP - 01	Practical: General Physics and Electronics-I	3	
	CCP - 02	Practical: General Physics and Electronics-II	3	
	DSE - 01	Solid State Physics (Or) Numerical Method and C++ Programming	4	
	SEC - 01	Experimental Techniques in Physics (Or) Elements of Nano science and Nano Technology	3	
II	CCT - 04	Statistical Mechanics	4	25
	CCT - 05	Methods of Spectroscopy	4	
	CCT - 06	Electromagnetic Theory	4	
	CCP - 03	Practical: General Physics and Electronics-III	3	
	CCP-04	Practical: General Physics and Electronics-IV	3	
	DSE - 02	Crystal Growth and Thin Film Physics (Or) Non-Linear Optics	4	
	SEC - 02	Physics and Our world (Or) Fibre Optics and its Applications	3	
III	CCT - 07	Advanced Electronics	4	26
	CCT - 08	Quantum Mechanics	4	
	CCT - 09	Microprocessor and Micro Controller	4	
	CCP - 05	Practical: Electronics Lab	3	
	CCP - 06	Practical: Microprocessor and Microcontroller Lab	3	
	DSE - 03	Nano Physics (Or) Material Science	4	
	AEC - 01	Human Rights	4	
IV	CCT - 10	Nuclear and Particle Physics	4	24
	DSE – 04	Physics of Non-Conventional Energy (Or) Elementary Biophysics	4	
	DSE - 05	Physics of Solid (Or) Laser and Optics	4	
	AEC -02	Physics for Competitive Exam	4	
	CC - 01	Project and Dissertation	8	

1. Core Course (Theory)-Compulsory-10 Papers -10x4=40
2. Core Course (Practical)-Compulsory-06 Papers -06x3=18
3. Specific Elective Course - 05 Papers -05x4=20

4. Skill enhancement / Generic Elective
   (Interdisciplinary – Theory)- 02 Papers -02x3=06
5. Compulsory Courses - 01 Papers -1 x 8=08
6. Ability enhanced course -02 papers -2 x 4 =08

Total – 26 Papers - 100 Credits

Total Number of Credits: 40+ 18 + 20 + 06 + 06 + 08 = 100 Credits

Total Number of Credits for each semester: 25+25+26+24=100 Credits

M.Sc. PHYSICS			
PROGRAMMESTRUCTURE			
Name	**No of Courses**	**No of Credits**	**Total**
Core Course Theory credit (CC (T))	**10**	**4**	**40**
Core Course Practical Credit (CC (P))	**6**	**3**	**18**
Discipline Specific Elective Credit (DSE)	**5**	**4**	**20**
Ability Enhancement Compulsory Course Credit (AEC)	**2**	**4**	**8**
Skill Enhancement Course Credit (SEC)	**2**	**3**	**6**
Project Work	**1**	**8**	**8**
		Total Credits	**100**

Semester	**Compulsory Core Courses (CC) Theory**	**Compulsory Core Courses (CC) Practical**	**Discipline Specific Elective (DSE/Inter Disciplinary/Generic Electives)**	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Course (SEC)**	**Total Credits**
Sem I	**CC (I,II,III) (3 x 4 credits =12 credits)**	**CC(P) (I,II) (2 x 3 credits =6 credits)**	**DSE - I (1 x 4 credits =4 credits)**		**SEC - I (1 X 3 = 3 Credits)**	**25**
Sem II	**CC (IV,V,VI) (3 x 4 credits =12 credits)**	**CC(P) (III,IV) (2 x 3 credits =6 credits)**	**DSE - II (1 x 4 credits =4 credits)**		**SEC - II (1 X 3 = 3 Credits)**	**25**
Sem III	**CC (VII,VIII,IX) (3 x 4 credits =12 credits)**	**CC(P) (V,VI) (2 x 3 credits =6 credits)**	**DSE – III (1 x 4 credits =4 credits)**	**AEC – I (1 x 4 credits =4 credits)**	**---**	**26**
Sem IV	**CC (X) (1 x 4 credits =4 credits)** **Major Project work (1 x 8 credits =8 credits)**		**DSE – IV, V (2 x 4 credits =8 credits)**	**AEC – II (1 x 4 credits =4 credits)**		**24**
Total	**48**	**18**	**20**	**8**	**6**	**100**

SEM	Subject Code	Subject name	L	T	P	C
I		CCT-01-Classical mechanics and Relativity				4

Objectives

To acquire knowledge of Lagrangian formulations.
To understand the concepts of Hamiltonian formulations.
To study dynamics of rigid bodies.
To understand the concepts of relativity.

Course outcomes:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	understand the Lagrangian and Hamiltonian formulation of classical mechanics.
CO-2	understand Kepler problem, Jacobi differential equation, Lagrangian and Poisson brackets
CO-3	understand the Euler's equations and apply them for rigid body dynamics.
CO-4	evaluate the concepts of Lorentz transformations in real four-dimensional space in relativistic mechanics. Understand the Lagrangian and Hamiltonian formulation of relativistic mechanics
CO-5	know the fundamental postulates of special theory of relativity and apply the relativity theory in daily life

UNIT I: PRINCIPLES AND LAGRANGIAN FORMULATION

Mechanics of a particle and system of particles – conservation laws – constraints - generalised co-ordinates – D'Alembert's principle and Lagrange's equations and Hamilton's principle - Lagrangian equation of motion from Hamilton's principle – conservation theorems and symmetry properties-Invariance & Noether's theorem (without proof)-Applications.

UNIT II: HAMILTONIAN FORMULATIONS

Hamilton's canonical equation – proof of principle of least action – general equations of canonical transformations -Cyclic Co-ordinates- Hamilton – Jacobi differential equation – Legrange brackets and Poisson brackets – Action angle variables – the Kepler problem in action angle variable.

UNIT III: RIGID BODY DYNAMICS

Angular momentum – rotational kinetic energy and moment inertia of a rigid body – Euler's angle – moments and products of inertia – Eulers' equation – Motion of asymmetrical top under the action of gravity. Theory of small oscillations –frequencies of free vibration and normal - coordinates – Linear tri atomic molecules.

UNIT IV: RELATIVISTIC MECHANICS

Lorentz transformations – Lorentz transformations in real four-dimensional spaces – covariant four dimensional formulations – force and energy equations inrelativistic mechanics – Lagrangian and Hamiltonian formulation of relativistic mechanics.

UNIT V: SPECIAL THEORY OF RELATIVITY

Frame of reference; Galilean transformation; Basic postulates of special relativity; Lorentz transformation and its consequences – length contraction, time dilation, velocity addition formula, variation of mass and mass-energy equivalence; Relativistic dynamics; Experimental verification of special relativity

TEXT AND REFERENCE BOOKS:-

1. Rana.N.C & Joag, P.S, Classical Mechanics, Tata McGraw Hill
2. Herbert Goldstein, Classical Mechanics, Narosa Publications
3. Ghatak and Loganathan A.K, Quantum Mechanics, Macmillan
4. Mondal, Classical Mechanic, Prentice Hall of India.
5. Aruldhas, Quantum Mechanics, Prentice Hall of India.
6. Bhatia V.B, Classical Mechanics, Tamil Nadu Book House
7. Mathews P.M and Venkatesan, Quantum Mechanics, Tata Mc Graw Hill

SEM	Subject Code	Subject name	L	T	P	C
I		CCT-02 Mathematical Physics				4

Objective: The foundations to various mathematical techniques and tools like numerical methods, transform techniques and special functions which forms the back bone of all higher physics is introduced.

Course outcomes:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	demonstrate competence with the basic ideas of complex variables including Cauchy-Riemann equations, Analyticity and singularity points, complex integration, Cauchy integral theorem, Stoke's theorem.
CO-2	solve Eigen values and eigen vectors problems
CO-3	understand the properties of Laplace transform, derivative of Laplace transforms and inverse Laplace transform
CO-4	apply and solve the problems using the Fourier transform.
CO-5	understand the special functions such as Bessel function, recurrence formula, Beat and gamma functions.

UNIT I: Complex Variables

Algebra of complex numbers, single and multidimensional functions, Branch points and branch lines, continuity and differentiability of complex functions, Cauchy-Riemann equations, Analyticity and singularity points, complex integration, Cauchy integral theorem, Stoke's theorem, Proof for multiple connected regions, Cauchy's theorem of residues, Simple problems on the above topics.

UNIT II: Matrices and Tensor Analysis

Eigen values and eigen vectors, diagonalization of matrix, Physics laws, space of NBdimensions, coordinate transformation, summation convention, contra-variant and co-variant vectors, Contra variant, covariant and mixed tensors, Kronecker delta, Tensor of higher rank, scalars or invariants, tensor fields, symmetric and skew-symmetric tensors, fundamental operations with tensors (Addition, Subtraction, outer multiplication, contraction, inner multiplication, quotient law, line element of metric tensor, conjugate or reciprocal tensor, associated tensor, Simple problems on the above topics.

UNIT III: Laplace Transform

Integral Transforms, Laplace transform: Conditions for L.T., Simple properties of L.T., First and Second shifting theorems, L.T. of derivatives, Derivatives of L.T., L.T. of integrals, integration of L.T., initial and final value theorems, inverse L.T. by partial fractions, Simple problems on the above topics

UNIT IV: Fourier Series and Transforms

Fourier series, Dirichlet's conditions, determination of Fourier co-efficient, F.S. for arbitrary period, half-wave expansions, Fourier integral theorem, Fourier sine and cosine transforms, Fourier Transforms of Dirac Delta function, simple problems.

UNIT V: Differential Equations

Power series solution of differential equations validity of the power series method, Bessel's equation and solutions, Bessel's functions, recurrence formula, orthogonality of Bessel functions, Leguerre's Differential equation, Generating function, orthogonal prosperities, Beta and gamma functions and their properties and inter relationships

TEXT AND REFERENCE BOOKS:

1. Mathematical Methods for Physicists, by G. Arfken
2. Matrices and Tensors of Physicists, by A.W. Joshi
4. Special Functions, by E.D. Rainvile.
5. Special Functions, by W.W. Bell
6. Mathematical Methods for Physicists and Engineers, by K.F. Reily, M.P. Hobson and S.J. Bence
7. Mathematics for Physicists, by Mary L. Boas
8. Mathematical Physics, by B.D. Gupta
9. Mathematical Physics, by H.K. Dass

SEM	Subject Code	Subject name	L	T	P	C
I		CCT-03 Medical Physics				4

Objectives: The course will introduce the students to the rapidly developing field of advanced physics with special focus on the Interacting electron gas, Point –Defects, Mechanism of plastic deformation in solids.

Course Outcomes

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	acquire knowledge about the basic principles of radiation detection and measurements
CO-2	understand the physics behind the radiation therapy instruments
CO-3	acquire knowledge about the medical diagnostic instruments
CO-4	apply and solve the problems using the Fourier transform.
CO-5	understand the principle, working function and applications of MRI imaging

UNIT I - BASICS OF RADIOLOGICAL PHYSICS:

Atomic Structure - Nuclear Transformation - Radioactivity and radioactive decay successive disintegration and equilibrium conditions - Interaction of Radiation with matter; electromagnetic radiation, charged particles and neutrons – Radiation attenuation coefficients - Radiation dosimetric concepts, quantities and units – cavity theories - Principles of Radiation detection and measurements - Radiation dosimeters and Radiation monitors.

UNIT II - RADIATION THERAPY PHYSICS:

Radiotherapy with sealed and unsealed radionuclide – Mechanism of Telecobalt and linear accelerators (LINAC) – Physics of Modern radiotherapy machines - 3D CRT, IMRT, SRS & SRT, IGRT, cyber kinfe and Proton Beam therapy - Radiation Dosimetry protocol (TRS 398), Calibration of teletherapy equipments - Quality Assurance of Radiotherapy machines - Treatment Planning System (TPS) in radiation therapy & Quality assurance of TPS.

UNIT III - DIAGNOSTIC RADIATION PHYSICS:

Basic Physics of diagnostic radiology – Production of X-rays - diagnostic X-ray tube & its electrical circuits- X-ray tube rating - X-ray film, properties & Processing - Intensifying screens - Factors affecting radiographic imaging - fluoroscopy - Tomography - Various diagnostic X-ray tubes and shields – Computer Tomography (CT) and its generations - Quality assurance of diagnostic equipment’s – Digital subtraction angiography (DSA).

UNIT IV - PHYSICS OF ULTRASOUND & IMAGING:

Production & properties of ultrasound - propagation of ultrasound through body tissue - Acoustic impedance and acoustical characteristics in human body - ultrasound dosimetry - piezoelectric transducers - ultrasound scanning modes - Ultrasound cardiography (UCG) – Doppler effect - Double doppler shift – doppler systems - ultrasonic tomography - applications of ultrasound in medicine. .

UNIT V - MRI AND BIO MEDICAL INSTRUMENTATION:

Basic principles of Magnetic resonance imaging (MRI) – Larmor frequency - Resonance - Slice selection - localization within slices – Machanism of relaxation (T1 and T2) - contrast agents – MRI system - Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) - physiological assist devices - pacemaker – defibrillators - heart lung machine - diathermy units – Dialysis units; Hemo & peritonial dialysis - Blood cell counter.

TEXT AND REFERENCE BOOKS:

1. Irving P. Herman, "Physics of Human Body", 1st Edition, Springer, 2007.
2. Paul Davidovits, "Physics in Biology and Medicine", 3rd Edition, Elsevier, 2008.
3. B.H. Brown, "Medical Physics and Biomedical Engineering", 1st Edition, IOP Publishing,1999.
4. A.G. Webb, "An Introduction to Biomedical Imaging", 1st Edition, Wiley, 2003.

SEM	Subject Code	Subject name	L	T	P	C
I		CCP- Practical- General and Electronics-I				3

Objectives:

The course aims at exposing the students to the intricacies of handling sophisticated equipment's, designing electronic circuits, trouble shooting and analysis of results.

Experiments

1. 7 segment display - 2 digit optically controlled counter
2. Op - Amp 741 - Solving Simultaneous Equations
3. Op - Amp 741 - Second order filters
4. "C++" - Language - Introduction III (use of library functions)
5. "C++" - Language - Introduction IV (Numerical methods)
6. MASM - Introduction I (using DOS interrupt 21h)
7. Turbo Debugger - Introduction I (simple programs - Trace mode)
8. Elastic constants of glass - Cornu's method

SEM	Subject Code	Subject name	L	T	P	C
I		CCP-02-Practical- General and Electronics-II				3

Objectives:

The course aims at exposing the students to the intricacies of handling sophisticated equipment's, designing electronic circuits, trouble shooting and analysis of results.

Experiments

1. Dielectric studies
2. Electrical conductivity studies - Four Probe Method
3. GM counter –Feather Analysis.
4. Elastic constants of glass - Cornu's method
5. Iodine absorption spectrum - Spectroscopic constants
6. Arc Spectra - Hartman's Interpolation
7. Susceptibility - Quinke's method
8. Stefan's Constant – determination

SEM	Sub. Code	Title of the paper	L	T	P	C
I		DSE 01-Solid State Physics				4

Objective: This paper aims to give an understanding of the basic theoretical models to study the properties matter from a microscopic point of view.

Course Outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	understand the structure of the crystal and dynamics of lattice
CO-2	acquire knowledge about the type of semiconductor and their carrier concentration
CO-3	understand the transport properties of metal, semiconductor and insulator
CO-4	understand the magnetic properties and types of magnetic materials
CO-5	acquire knowledge about the different types of superconductor and BCS theory

UNIT I: Crystal structure and lattice dynamics

Lattice-- translation symmetry- 3D crystal systems - Bravias lattices - Reciprocal lattice - Miller indices; X Ray Diffraction -- Bragg's law (Vector form) - atomic scattering factor- structure factor- extinction rules for BCC, FCC, ZnS and diamond structure. Lattice vibrations for a linear mono atomic lattice - linear diatomic lattice - acoustical and optical modes extinctions and optical branch in ionic crystals- quantization of lattice vibrations- - lattice dynamics of a BC three dimensional solid - inelastic scattering of phonons.

UNIT II: Theory of metals and semiconductor

Brillouin zones - electrons in periodic potential- Bloch's theorem - Kronig- Penney model - nearly free electro model- effective mass - zone schemes- band model of metal, semiconductor and insulator. Intrinsic semiconductor- carrier concentration- impurity semiconductors (n and p type) - carrier concentration steady state diffusion- pn junction - homogeneous semiconductors.

UNIT III: Transport phenomena and dielectric properties

Thermal conductivity: of lattice - of free electrons - Fermi surface - effect of electric field on Fermi surface effect of magnetic field on Fermi surface - mobility of charge carriers in semiconductors: intrinsic region a impurity range - Hall effect. dipole moment - atomic polarizability - Classius - Mossotti equation - theory of electronic polarization frequency dependent polarisability - ferro electricity

UNIT IV: Magnetism

Larmor diamagnetism - Langerin’s theory of para magnetism - Hund's rules- origin of magnetic interaction molecular field theory of ferromagnetism - failure of independent electron approximation Spin Hamiltonian and Heisenberg model - Magnons and thermal excitation of magnons - domain theory of hysteresis and anti-ferromagnetic magnons- types of magnetic structure.

UNIT V: Superconductivity

Historical survey of superconductivity - critical parameters - Isotope effect- Meissner effect- type I and I superconductors- thermodynamics of superconducting transition - other properties. London's theory - elements of BCS theory - flux quantization - DC and AC Josephson effect - SQUID – High

TEXT AND REFERENCE BOOKS:

1. Introduction to Solid State Physics - C. Kittel, John Wiley (2004)
2. Material Science - M. Arumugam, Anuradha Agencies, (2004)
3. Materials Science and Engineering - Raghavan (2004)
4. Introduction to Solids - Azaroff (2004)
5. Solid State Physics - A.J. Deckker (2004)

SEM	Sub. Code	Title of the paper	L	T	P	C
I		**DSE - 01 Numerical Method and C++ Programming**				4

Objectives: The course will introduce the students to the rapidly developing field Numerical Method and C++ Programming, solution of system of equations and functions and classes in C++

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	solve the numerical differentiation and integration
CO-2	acquire knowledge about the solution of equation using different numerical methods
CO-3	apply the numerical methods in Laplace and Poison equation
CO-4	understand the numerical methods used in scientific computations
CO-5	implement them in the form of computer programs in C++ and solve them using mathematical packages (Matlab/Octave).

Unit I: SOLUTION OF NONLINEAR EQUATIONS

Newton's method – Convergence of Newton's method – Bairstow"s Method for quadratic factors NUMERICAL DIFFERENTIATION AND INTEGRATION: Derivatives from Differences tables – Higher order derivatives – Divided difference, Central-Difference formulas – Composite formula of Trapezoidal rule – Romberg integration – Simpson's rules.

Unit II: SOLUTION OF SYSTEM OF EQUATIONS

The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss Seidal Iteration – Relaxation method – Systems of Nonlinear equations. Taylor series method – Euler and Modified Euler methods – Rungekutta methods – Multistep methods – Milne's method – Adams Moulton method. The shooting method – solution through a set of equations Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

Unit III: NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The Explicit method (ii) The Crank Nicolson method – solving the wave equation by Finite Differences.

Unit IV: FUNCTIONS AND CLASSES IN C++

Procedure Oriented Programming, characteristics of OOP – Function Prototype – Default Arguments – Inline functions – Function overloading – Template functions - Classes – This pointer – Constructors – Destructors – Friend functions – Template classes – New and delete operators – Operator overloading – Static members - Nesting of classes

UNIT V: INHERITANCE AND POLYMORPHISM and INPUT/OUTPUT IN C++

Single inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance – Abstract base class – Virtual functions – Dynamic binding – Polymorphism –

Virtual base classes. Input/Output operations – Overloading the insertion and extraction operators – I/O stream classes – File Input/Output – Exception handling

TEXT AND REFERENCE BOOKS:

1. APPLIED NUMERICAL ANALYSIS' by C.F.Gerald and P.O.Wheatley, Fifth Edition, Addison Wesley, (1998).
1. S.B.Lipmann, "The C++ Primer", Pearson Education, 2000
1. S.C. Chapra and P.C. Raymond: Numerical Methods for Engineers, tata McGraw Hill, New Delhi, (2000)
2. R.L. Burden and J. Douglas Faires: Numerical Analysis, P.W.S.Kent Publishing Company, Boston (1989), Fourth Edition.
3. S.S. Sastry: Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, (1998)
5. E. Balaguruswamy, "Object Oriented Programming with C++", 4 th Edition, Tata
6. McGraw Hill, 2007. Ivor Horton, "Beginning C++", Wrox Press Ltd, 1998.

SEM	Sub. Code	Title of the paper	L	T	P	C
I		**SEC-01 Elements of Nanoscience and Nano Technology**				3

Objectives: The course will introduce the students to the rapidly developing field of nanoscience and technology with special focus on the methods of synthesis, characterization techniques and applications of nanomaterials with interdisciplinary approach involving Physics and Chemistry.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	know the fundamental principles of nanoscience and technology and their applications in field of energy and storage, medical, agriculture, space and defense.
CO-2	acquire knowledge about the different types of nanostructured materials
CO-3	know the synthesis of different types of nanomaterials
CO-4	know the characterization techniques of nanomaterials
CO-5	acquire knowledge about the applications of nanostructured materials in different fields

Unit I: Fundamentals of Nanoscale Science

Properties of materials & nanomaterials, role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells, conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state

Unit II: Classification of nanoparticles and its properties

Metal Nanoparticles: Size control of metal nanoparticles, Structural, Surface, electronic and opticalproperties. Semiconductor Nanoparticles: solid state phase transformation, Excitons, Quantum confinement effect, Semiconductor quantum dots (SQDs), Correlation of properties with size, Quantum Well, Quantum Wires,Super lattices band and Band offsets, Quantum dot lasers. Magnetic nanomaterials: Fundamentals of magnetic materials, Dia, Para, Ferro, Ferric, and Superparamagnetic materials, Nanostructured Magnetism. Semiconductor Nanocomposites: Types of Nanocomposites (Metal oxides, ceramic and Glass), Core – Shell nanoparticles - Types of systems - properties of nanocomposites. Carbon Nanostructures: Introduction, Fullerenes, C60, CNT, mechanical, optical and properties.

Unit III: Synthesis of Nanomaterials

Chemical precipitation and coprecipitation; Metal nanocrystals by reduction, Sol-gel synthesis; Microemulsions or reverse micelles; Solvothermal synthesis; Thermolysis routes, Microwave heating synthesis; Sonochemical synthesis; Electrochemical synthesis; , Photochemical synthesis, Synthesis in supercritical fluids

Unit IV: Characterization Techniques

Powder X - Ray Diffraction, scanning electron microscope (SEM), Transmission electron microscope (TEM), Scanning tunnelling microscope (STM), Atomic force microscope (AFM), Scanning probe microscopy (SPM), UV - Visible absorption, Impedance measurement, V - I characteristics, Vibrating sample magnetometer (VSM). Brunauer -

Emmett - Teller (BET) Surface Area Analysis, Energy dispersive X - ray (EDX), X – ray photoelectron spectroscopy (XPS) and Photoluminescence.

Unit V: Applications of Nanomaterials

ID, 2D, 3D Photonic crystals, Couplers, Waveguides, Photonic crystal fibres, Optical data storage systems and Quantum computing Imaging of cancer cells, Biological tags and Targeted nano drug delivery system. Sensors based on physical properties - Electrochemical sensors, Sensors for aerospace, defense and Biosensors. Solar cells, LEDs and Photovoltaic device applications. Photocatalytic applications: Air purification, Water purifications and Volatile organic pollution degradation. Field emission, Fuel cells and Display devices.

TEXT AND REFERENCE BOOKS:

1. Structure and properties of solid state materials by B. Viswanathan, 2nd Edition, Alpha Science
International, (2006).
2. Nano - The essentials by T.Pradeep, Tata McGraw - Hill publishing company limited (2007).
3. Nanocomposite Science and Technology by Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, John Wiley & Sons, (2006)

SEM	Sub. Code	Title of the paper	L	T	P	C
I		**SEC-01 EXPERIMENTAL TECHNIQUES IN PHYSICS**				3

Objectives

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	describe and explain the working principles of the various techniques and convert the SI unit to CGS units
CO-2	acquire knowledge about mechanical skill such as casting, machining and welding
CO-3	know the common machine tools
CO-4	easily operate the fundamental electronic equipments
CO-5	acquire knowledge about the applications of prime movers in different fields

Unit I: **Introduction**

Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet. Use of Sextant to measure height of buildings, mountains.

Unit II: Mechanical Skill

Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing.

Unit III: Introduction to common machine tools

Like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

Unit IV: Electrical and Electronic Skill

Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

Unit V: Introduction to prime movers

Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

Text and Reference Books:

1. A text book in Electrical Technology - B L Theraja – S. Chand and Company.
2. Performance and design of AC machines – M.G. Say, ELBS Edn.
3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newness [ISBN: 0750660732]

SEM	Sub. Code	Title of the paper	L	T	P	C
II		CCT-04- Statistical Mechanics and Thermodynamics				4

Objectives

1. To understand the basics of thermodynamics and Statistical systems.
2. To understand the various laws of thermodynamics.
3. To acquire the knowledge of various statistical distributions.
4. To comprehend the concepts of enthalpy, phase transitions and thermodynamic functions.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	acquire the knowledge of different laws of thermodynamics.
CO-2	understand about diverse thermodynamic potentials and their importance to deduce reciprocity relations and Bragg-William's approximation
CO-3	apply the Knowledge about Liouville's theorem and its importance, MB distribution law, BE and FD distribution law.
CO-4	evaluate and check the knowledge from phase transitions of first andsecond type
CO-5	apply and analyze the statistical laws to study transport phenomena

UNIT I: BASIC ELEMENTS OF STATISTICAL MECHANICS

Foundations of statistical mechanics-Bridging microscopic and macroscopic behavior - Contact between statistics and thermodynamics-Free energy-Partition function of an ideal monatomic gas -Partition function of a diatomic molecule- Classical ideal gas- Entropy of mixing and Gibb's paradox-Sackur Tetrode equation-The semi-classical perfect gas- Specific heat of solids -Saha's ionization formula.

UNIT II: THEORY OF ENSEMBLES

Ensembles- Microcannonical ensemble-Phase space- Trajectories and density of states-Liouville's theorem-Canonical ensemble -Thermodynamic properties of the canonical ensemble-Evaluation of the total partition function-Partition function in the presence of interactions-Fluctuation of the assembly energy in a canonical ensemble Grand canonical ensemble-The grand partition function and its evaluation Fluctuations in the number of systems-The chemical potentials in the equilibrium state.

UNIT III: STATISTICAL DISTRIBUTIONS AND APPLICATIONS

Maxwell-Boltzmann distribution- Determination of undetermined multipliers ß and α-equipartition of energy- Bose-Einstein statistics-Bose-Einstein condensation-FermiDirac statistics-The electron gas-White dwarfs and their limiting mass,statistical (Thomas - Fermi) model of atom-Comparison of the 3 statistics.

UNIT IV: LAWS OF THERMODYNAMICS AND THERMODYNAMIC PROCESSES

Ideal gases-Equation of state- Internal energy- Specific heats -Entropy- isothermal and adiabatic processes-Compressibility and expansion coefficient - Real gases Deviation from the ideal gas equation-Zeroth and first law of thermodynamics Reversible and irreversible processes- Carnot theorem- Second law of thermodynamics-Clausius inequality- Entropy changes in reversible and irreversible processes- Temperature-entropy diagrams-Unavailable energy-Thermal death of the universe.

UNIT V: THERMODYNAMIC POTENTIALS AND PHASE TRANSITIONS

Thermodynamic potentials: Enthalpy- Gibbs and Helmholtz functions- Maxwell relations and their applications- Magnetic work- Magnetic cooling by adiabatic demagnetization-Approach to absolute zero-Change of phase-Equilibrium between a liquid and its vapour- Clausius-clapeyron- Phase transitions-Landau theory of phase transition-Equilibrium between phases-Pomeranchuk cooling.

Text and Reference Books

1. Richard E. Sonntag, Gordon J. Van Wylen, Introduction to Thermodynamics, Classical and Statistical, 3rd Edition, 2008.
2. Pathria R.K., Statistical Mechanics, 2nd Edition, Elsevier, 2000.
3. Statistical and thermal physics, By F. Reif.
4. Statistical Mechanics, By K Huang.
5. Statistical Mechanics, By R K Patharia.
6. Statistical Mechanics, By R. Kubo.
7. Statistical Physics, B Landau and Lifshitz

SEM	Sub. Code	Title of the paper	L	T	P	C
II		**CCT-05 Methods of Spectroscopy**				**4**

Objective: To understand in detail the structure of atoms and molecules.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	acquire knowledge and understand the aspects of various spectroscopic methods like rotational spectroscopy and its techniques
CO-2	explain the theory and principles of vibrational spectroscopy and itstechniques
CO-3	perceive the theory and principles of electronic and X-ray spectroscopyand apply them to describe fluorescence and phosphorescence
CO-4	comprehend the basics of Raman spectroscopy and evaluate and examine the molecular and atomic structure of different advanced materials.
CO-5	understand the physics behind NMR and ESR spectroscopy, Mossbauer spectroscopic techniques and apply it examine new materials and to make novel drugs in the field of medicine

Unit – I: Atomic Spectra

Quantum states of electron in atoms – hydrogen atom spectrum – electron spin – SternGerlach Experiment – spin-orbit interaction – Lande interval rule – two electron systems – LS-JJ coupling schemes – fine structure – spectroscopic terms and selection rules – hyperfine structure – exchange symmetry of wave function – Pauli's exclusion principle – periodic table.

Unit – II: Atoms in External Fields and Resonance Spectroscopy

Zeeman and Paschen Back Effect of one and two electron systems – selection rules – Stark effect – inner shell vacancy – X-ray – Auger transitions – Compton Effect – NMR – basic principles – classical and quantum mechanical description – spin-spin and spin-lattice relaxation times – magnetic dipole coupling – chemical shift – Knight shift – ESR – basic principles – nuclear interaction and hyperfine structure – g-factor – zero field splitting.

Unit – III: Microwave Spectroscopy and IR Spectroscopy

Rotational spectra of diatomic molecules – rigid rotator – effect of isotropic substitution – non-rigid rotator – rotation spectra of polyatomic molecules – linear, symmetric top and asymmetric top molecules – experimental techniques – diatomic vibrating rotator – linear, symmetric top molecule – analysis by infrared techniques – characteristic and group frequencies.

Unit – IV: Raman Spectroscopy

Raman effect – quantum theory of Raman effect – rotational Raman spectra – vibrational Raman apectra – Raman spectra of polyatomic molecules – Raman spectrometer – hyperRaman effect – experimental techniques.

Unit – V: Electronic Spectroscopy

Electronic spectra of diatomic molecules – Frank-Condon principle – dissociation energy and dissociation products – rotational fine structure of electronic vibration transitions – Fortrat Diagram – predissociation.

Text Books and References

1. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill, New York (2004).
2. G. Aruldhas, Molecular Structure and Spectroscopy, Prientice Hall of India, NewDelhi (2002).
3. Manas Chanda, Atomic Structure and Chemical Bond, Tata McGraw-Hill, New Delhi (2003).
4. Arthur Beiser, Concepts of Modern Physics, 6th edition, Tata McGraw-Hill, New Delhi (2003).
5. B.P. Straughan & S. Walker, Spectroscopy: Vol. I, Chapmen and Hall (1976).
6. G.M Barrow, Introduction to Molecular Spectroscopy, McGraw Hill (1986).

Sem	Sub. Code	Title of the paper	L	T	P	C
II		CCT-06-Electro Magnetic Theory				4

OBJECTIVES

1. To make the student understand the principles of electrostatics and magnetostatics.
2. To enable the student to explore the field of electrodynamics.
3. To make the student understand the basic concepts in Electromagnetic wave and radiation.
4. To allow the student to have a deep knowledge of the fundamentals of Electromagnetism.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	impart and describe the knowledge on the concepts in electrostatics, magnetostatics, field equations and electromagnetic waves.
CO-2	explain the boundary conditions in electrostatics and magnetostatics, Poynting theorem, propagation of electromagnetic waves.
CO-3	apply and analyze the knowledge to solve image problems, magnetic field and potential problems, boundary conditions and radiation reaction.
CO-4	compare and summarize TE, TM, TEM waves, normal and obliqueincidences for conductors.
CO-5	relate and check the knowledge from symmetry problems, Gauss law and Biot-Savart's law.

UNIT I: ELECTROSTATICS

Coulomb's Law - Electric Field- Gauss's law of electrostatics - Sphere- Shell- Planeline- Electrostatic Potential-Multipole expansion- Work and energy in electrostaticsPoisson's Equation - Laplace equation- Boundary condition and uniqueness theoremMethod of Images- Classic image problem- Induced Surface charge- Separation of variables - Electrostatics in matter -Polarization- Free charges - Bound charges - Linear isotropic homogenous medium.

UNIT II: MAGNETOSTATICS

Lorentz force law-Biot-Savart law-Divergence and curl of B-Magnetic field of steady currents - Ampere's law -Magnetic field of a straight wire - Magnetic field of a solenoid- Comparison of electrostatics and magneto statics- Magnetic potential - Magnetization- Fields of a magnetized object- Bound currents- Physical interpretation of bound currents- Magnetic field inside a matter.

UNIT III: ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES

Electromotive force- Ohm's law- Electromagnetic induction - Faraday's law – Lenz law- Maxwell's equations -Displacement current- Electromagnetic waves-In vacuumIn dielectric media-Skin depth-Poynting vector-Boundary conditions- reflection and transmission at normal incidence-Reflection and transmission at oblique incidence - Fresnel's equations - Perpendicular polarization - Parallel polarization.

UNIT IV: POTENTIALS AND RADIATION

Continuous distribution - Retarded scalar and vector potentials-Jefimenko's potential - Point charges -Lienard-Wiechert potentials for a moving point charge-Electric and magnetic fields

of a moving point charge-Electric dipole radiation-Magnetic dipole radiation - Power radiated by a point charge - Radiation reaction -The physical basic of a radiation reaction.

UNIT V: RELATIVISTIC ELECTRODYNAMICS

Potential formulation of electrodynamics - Gauge transformations-Coulomb gauge and Lorentz gauge- Introduction to special theory of relativity - Magnetism as a relativistic phenomenon- Field transformation- Field Tensor- Electrodynamics in Tensor notation - Relativistic potentials -The four potential of a moving charge –The invariance of the equations of electrodynamics.

TEXT and Refernce Books

1. Griffith D.J, Introduction to Electrodynamics, 4 thEdition, Prentice Hall of India, 2012.
2. Murugeshan.R, Electricity and Magnetism, 7 th Revised Edition, S. Chand, 2008.
3. Laud B.B, Electromagnetics. 2ndEdition, New Age International Publication, 2005.
4. John David Jackson, Classical Electrodynamics, 3rdEdition, John Wiley &Sons Ltd, 1998.

SEM	Sub. Code	Title of the paper	L	T	P	C
II		CCP-03-GENERAL AND ELECTROCNICS-III				4

Objective: To have enhanced knowledge on digital electronics

1.Transistorised Amplifier-RC coupled
2.Deign of Gates-transistor (NOT, AND, OR, NAND)
3.A/D converter-Parallel conversion using LM339
4.7 segment display-2 digit optically controlled counter
5.555 Timer-Astable Multivibrator
6.555Timer-Temp. control (thermistor)
7.Op-Amp 741-Introduction (basic functionality)
8.Op-Amp 741-Solving Simultaneous Equations
9.Op-Amp 741-Second order filters
10.Op-Amp 741-Astable Multivibrator

SEM	Sub. Code	Title of the paper	L	T	P	C
II		CCP-04-GENERAL AND ELECTROCNICS-IV				4

Objective: To have enhanced knowledge on digital electronics
1.Voltage Controlled Oscillator
2. Op - Amp Arithmetic Operations
3. Op - Amp Square, Ramp Generator and Wien Bridge Oscillator
4. Op - Amp Precision Full Wave Rectifier
5. Multiplexer and De multiplexer
6. Regulated Power Supply using IC 72315
7. UJT – Characteristics of Relaxation Oscillator
8. Logarithmic and Anti - logarithmic A amplifier

SEM	Sub. Code	Title of the paper	L	T	P	C
II		DSE-02 Crystal Growth and Thin film Physics				4

Objectives

To understand the geometry of crystals, steoreographic projection, diffraction, crystal symmetry, chemical methods of thin film deposition

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	acquire the knowledge about the geometry of crystalline materials
CO-2	understand the X- ray diffraction and its role in crystallography
CO-3	know the symmetry of Bravais lattice
CO-4	evaluate the merits and demerits of different growth techniques and design a new growth approach to overcome the existing demerits.
CO-5	acquire knowledge about the growth mechanism and film measuring techniques

UNIT I: GEOMETRY OF CRYSTALS

Introduction – lattice – crystal systems – symmetry – primitive and non primitive cells– lattice directions and planes –unit cells of hcp and ccp structures – constructing crystals – interstitial structures – some simple ionic and covalent structures - Representing crystals in projection – crystal planes stacking faults and twins – steoreographic projection.

UNIT II: DIFFRACTION AND X- RAYS

Diffraction – braggs law – diffraction methods – scattering by electrons, atoms, unit cell - Introduction to X-rays – electromagnetic radiation – continuous spectrum – characteristic spectrum – absorption – filters – production of X-rays – detection of Xrays – safety precautions – Contributions of Laue, Bragg and Ewald to X-ray diffraction.

UNIT III: CRYSTAL SYMMETRY

Symmetry of the fourteen Bravais lattices – coordination of Bravais lattice points – space filling polyhedra -– thiry two crystal classes – centres and inversion axes of symmetry – crystal symmetry and properties – translation symmetry elements – space groups – Bravais lattices, space groups and crystal structures – Quasiperiodic crystals or crystalloids

UNIT IV: CHEMICAL METHODS OF THIN FILM DEPOSITION

Electrodepostion - Electrolytic deposition - Electroless deposition - Anoidic oxidation - Spray pyrolysis - Spin and Dip coating - Chemical vapour deposition – chemical decomposition(Pyrolysis) - Hydrogen reduction- Halide disproportionation- Transfer reactions - CVD Processes and systems - Low pressure CVD - Laser enhanced CVD - Metalorganic CVD (MOCVD).

UNIT IV: FILM GROWTH MECHANISM & THICKNESS MEASUREMENT TECHNIQUES

Introduction- Nucleation and early stages of film growth - Three dimensional

nucleation and growth - Two dimensional Nucleation and Growth - Stranski-Krastanov Nucleation and Growth - Capillarity theory. Thickness Measurement- Electrical methods - Microbalance monitors - Quartz crystal monitor - Mechanical method (Stylus) - Optical interference methods – Interference fringes.

TEXT and References BOOKS

1. Kittel.C, Introduction to Solid state physics, 7th Edition., Wiley India, New Delhi 2004.
2. Santhana Raghavan P.and Ramasamy P., Crystal Growth Processes and Methods, KRU Publications, 2001.
3. Heinz K. Henisch, Crystals in Gels and Liesegang Rings, Cambridge University Press , 2005.
7. Suryanarayana .C, Norton. M.G., X-ray diffraction – A practical approach, Plenum press, 1998.
8 Rointan F. Bunshah, Handbook of Deposition Technologies for Films and Coatings, Science, Technology and Applications, Noyes Publications, 1994
9. Kasturi L. Chopra, Thin Film Phenomena, Robert E. Krieger Publishing Company, 1979

SEM	Sub. Code	Title of the paper	L	T	P	C
II		DSE-02 Non Linear Optics				4

Objectives

1. To understand of the non-linear optical susceptibility
2. To understand the wave equation and intensity, refractive index

Course Outcome

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	acquire the knowledge about the nonlinear optical susceptibility and Kramers-Kronig relations in linear and nonlinear optics
CO-2	understand the wave equation for nonlinear optical media and second harmonic generation
CO-3	know the intensity dependent refractive index, semiconductor nonlinearity and semiempirical models of the nonlinear optical susceptibility
CO-4	know the basic principle of electrooptic and photorefractive effect
CO-5	acquire knowledge about the optical processes and ultrafast nonlinear optics

UNIT I: NONLINEAR OPTICAL SUSCEPTIBILITY

Introduction to Nonlinear Optics - Descriptions of Nonlinear Optical Processes - Definition of the Nonlinear Susceptibility - Nonlinear Susceptibility of a Classical Anharmonic Oscillator - Properties of the Nonlinear Susceptibility -Time-Domain Description of Optical Nonlinearities - Kramers-Kronig Relations in Linear and Nonlinear Optics - Schrödinger Calculation of Nonlinear Optical Susceptibility.

UNIT II: WAVE EQUATION FOR NONLINEAR OPTICAL MEDIA

The Coupled Wave Equations for Sum Frequency Generation - Phase Matching -Quasi Phase Matching - The Manley Rowe Relations - Sum Frequency Generation - Second Harmonic Generation - Difference Frequency Generation and Parametric Amplification - Optical Parametric Oscillators - Nonlinear Optical Interactions with Focused Gaussian Beams - Nonlinear Optics at an Interface.

UNIT III: INTENSITY-DEPENDENT REFRACTIVE INDEX

Descriptions of the Intensity-Dependent Refractive Index - Tensor Nature of the Third-Order Susceptibility - Nonresonant Electronic Nonlinearities - Nonlinearities Due to Molecular Orientation - Thermal Nonlinear Optical Effects – Semiconductor Nonlinearities - Nonlinear Susceptibilities Calculated Using Time-Independent Perturbation Theory-Semiempirical Models of the Nonlinear Optical Susceptibility.

UNIT IV: SCATTERING, ELECTROOPTIC AND PHOTOREFRACTIVE EFFECTS

Spontaneous Raman Effect - Spontaneous versus Stimulated Raman Scattering - Stimulated Raman Scattering Described by the Nonlinear Polarization - Stokes-AntiStokes Coupling in Stimulated- Raman Scattering - Coherent Anti-Stokes Raman Scattering - Stimulated Rayleigh-Wing Scattering - Introduction to the Electrooptic Effect - Linear Electrooptic

Effect- Electrooptic Modulators - Introduction to the Photorefractive Effect - Two-Beam Coupling in Photorefractive Materials .

UNIT V: OPTICAL PROCESSES AND ULTRAFAST NONLINEAR OPTICS

Introduction to Optical Damage - Avalanche-Breakdown Model - Influence of Laser Pulse Duration - Direct Photoionization - Multiphoton Absorption and Multiphoton Ionization - Ultrashort Pulse Propagation Equation - Interpretation of the UltrashortPulse Propagation Equation - Intense-Field Nonlinear Optics - Motion of a Free Electron in a Laser Field - High-Harmonic Generation - Nonlinear Optics of Plasmas and Relativistic Nonlinear Optics.

TEXT and Reference BOOKS

1. Laud B.B., Lasers and Nonlinear Optics, 2nd Edition, New Age International (P) Ltd., 1991.
2. Robert W. Boyd, Nonlinear Optics, 2nd Edition, Academic Press, 2003.
3. Govind P. Agarwal, Fiber-Optics Communication Systems, 3rd Edition, John Wiley & Sons, 2003.

SEM	Sub. Code	Title of the paper	L	T	P	C
II		SEC -02-Fibre Optics and its Applications				4

Objectives

(1) To develop the understanding of elements of an optical fiber transmission link, block diagram, advantages of optical fiber communication,

(2) To develop a knowledge and understanding of the Ray theory of transmission, total internal reflection, acceptance angle, numerical aperture, meridional and skew rays,

(3) Understanding Modes, electromagnetic mode theory and propagation.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	Analyze fiber optics and optical detectors components associated with fiber optics systems
CO-2	Distinguish internal reflection, acceptance angle, numerical aperture and skew rays
CO-3	Identify difference between Coherent and non-coherent sources, quantum efficiency, modulation capability of optical sources,
CO-4	Explain bending losses, modal dispersion, waveguide dispersion and pulse broadening,
CO-5	Apply the skills necessary to solve practical and design problems for fiber optic communication systems.

Unit I: Ray Theory of Transmission

Introduction, optical Fiber and its Importance, Propagation of Light in Different Media, Basic Structure of an Optical Fiber, and Propagation of light through it, Acceptance Angle and Acceptance Cone of a fiber, Numerical Aperture (General), Numerical Aperture of a Graded index fibre, Modes of Propagation, Meridional and Skew Rays, Number of Modes and Cut-Off Parameters of Fibres, Comparison of Step and Graded Index Fibres, Applications of fibers. Classification of Fibers: Stepped Index Fibre, Stepped-Index MonomodeFiber, Disadvantages of Monomodefibre, Graded Index Multimode Fibre, Plastic Fibers, Numerical Problems .

Unit II: Fiber Fabrication Techniques

Introduction, Preparation of optical fibers, Vapor-Phase deposition techniques: Outside vapor- phase oxidation process, Vapor axial deposition (VAD), Modified chemical vapor deposition, Plasma- activated chemical vapor deposition, Fibre Drawing and Coating, Double Crucible Method, ROD-IN –TUBE Method.

Unit III: Fibre Losses

Attenuation in Optic Fibers, Materials or Impurity Losses, Rayleigh Scattering Losses, Absorption Loss, Leaky Modes, Bending Losses, Radiation Induced Losses, Inherent Defect Losses, Inverse Square law losses, Transmission Losses, 16 Temperature Dependence of Fiber Losses, Core and Cladding Losses, Numerical Problems.

Unit IV: Communication Systems and Modulation

Communication Systems: Introduction: The p-i-n photodiode, Avalanche photodiode, Transmitter for Fiber Optic Communication, High Performance Transmitter Circuit (LED Digital Transmitter), LED Analog Transmitter, Comparison between Analog and Digital Transmitter, LASER Transmitter, Digital Laser Transmitter, Analog Laser Transmitter, Analog Laser Transmitter With A/D Conversion And Digital Multiplexing, Transmitter Design, Bit Stuffing, Fiber Optic Receiver, A High Performance Receiver, Design of a fibre optic Receiver, Repeaters, Fiber-Based Modems: Transreceiver. Modulation: Introduction, LED Analog Modulation, Digital Modulation, Laser Modulator, Pulse Code Modulation (PCM), Intensity Modulation (IM).

Unit V: Optical Fiber Communication & Measurements on Optical Fibers

Optical Fiber Communication Systems: Introduction, Important Applications of Integrated Optic Fiber Communication Technology, Long-Haul Communication, Coherent Optical Fibre Communication, Principle of Coherent Detection. Measurements on Optical Fibers: Introduction, Measurements of Numerical Aperture (NA), Optical Time-Domain Reflectometer (OTDR), Measurement of fibre Attenuation, Measurements of Dispersion Losses, Measurements of Refractive Index, Cut-Off Wavelength Measurement, Measurements of Mode Field Diameter (MFD).

Text and Reference Books

1. Optical Fiber and Fiber Optic Communication Systems, S.K. Sarkar (S. Chand and Comp., Ltd New Delhi 2010) Reference Books:
2. Optical Fiber Communications: Principles and Practice- J M Senior (PHI) 2nd Ed (2007)
3. Optical Fiber Communication- G. Keiser (Mc Graw Hill) Third Edition
4. Fundamentals of Fiber Optics in Telecommunication and Sensor Systems, Edited By B. P. Pal, New Age International Publisher, New Delhi, 1st Edition (2006)
5. Introduction to Fibre Optics- A. Ghatak and Thyagrajan (Cambridge University Press)

SEM	Sub. Code	Title of the paper	L	T	P	C
II		SEC-02 Physics and Our World				2

Objective

This is a course that assumes no quantitative background and is meant as an introduction to a physicists' way of understanding the world we inhabit. It is a survey of the hierarchical structuring of the universe in categories of space, time, matter and energy, from the very small to the gigantic. Rather than providing a simplified treatment of the subjects and categories by which the physicists seeks to understand the physical universe the course seeks to take the participant on a path that provides a glimpse of the process by which this understanding is sought.

Course Outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	know the space and time relationship
CO-2	understand the matter and energy. Also, able to relate the theories to nature
CO-3	Understand the Kepler's laws of planetary motion
CO-4	Know the waves and oscillation theories
CO-5	understand conceptualization in physics

Unit-I

Space and Time: A discussion on length scales and dimensions, Galaxies, The solar system and Planet Earth, Rotation and revolution of the Earth, Seasons, Calendars in history and the recording of time. Laws of nature – a discussion of principles, theories and models, Gravitation, Planetary motion and Kepler's laws, The laws of motion in the eyes of Galileo and Newton.

Unit-II

The relationship between space and time: A basic account of the theory of relativity, Does nature differentiate between Left and Right?- The notion of Parity Is there an ―arrow‖ of time? Entropy and the laws of thermodynamics The size of the universe - Is the universe expanding?

Unit-III

Matter and Energy Discrete and continuous matter- a brief historical survey, Atoms and molecules: Structure of atoms, the nucleus, Elementary particles, Unification of forces Equivalence of matter and energy, nuclear energy and thermonuclear power. The Periodic table of elements, Chemical bonds and molecules, Large molecules and living matter.

Unit-IV

Waves and oscillations, Electromagnetic radiation and spectrum, Propagation of waves Energy in the atmosphere- Wind and solar energy, Weather predictability and chaos, Indeterminacy

Unit-V

The quantum world -- an introduction, Debates on the conceptualisation of physical realities – is nature unreasonably mathematical?

Text and References Books

1. The Evolution of Physics- Einstein and L. Infeld, Toughstone 1967.
2. The Ascent of Man- J. Bronowski, Liffle and Brown Company, 1976.
3.Cosmos- Carl Sagan, McDonald and Company, 2003.
4. In search of Schrodinger's Cat- John Gribbin, Random House, 2012
5. Chaos- James Gleick, Viking Penguin, 1987
6. Doubt And Certainty – Tony Rothman and George Sudarshan (Helix books, Cambridge, 1998)

SEM		Sub. Code	Title of the paper	L	T	
III			CCT-07 Advanced Electronics			

Objective:

1. To impart a diversified knowledge on circuit analysis, the semiconductor devices, FETs, operational amplifiers and digital circuits and their applications.

Course Outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	know the fundamental principles of circuit theorems and different types of diodes.
CO-2	understand the biasing characteristics of junction transistor
CO-3	understand the working function of oscillators
CO-4	analyze the unique properties of operational Amplifiers
CO-5	know the different types of flip-flops

Unit – I: Circuit Theorems and Special Diodes

Kirchoff's laws for current and voltage – Thevenin's and Norton's theorems, superposition and reciprocity theorems with examples – p-n junction diodes – Zener diode – tunnel diode – Schottky barrier diode – varactor diode-photodiode – solar cell – photodiodes and transistors – light emitting diode – semiconductor laser – UJT – opto-couplers.

Unit – II: Bipolar Transistor Amplifiers and FETs

Biasing characteristics of junction transistors – analysis using re model-fixed bias-voltage divider bias-emitter bias – direct coupled transistor amplifiers – single stage transistor amplifier – frequency response – feed back in amplifiers – effect of negative feedback in amplifiers – FETs – different types-low and high frequency FETs, frequency response of FET – applications

Unit-III: Oscillators

Oscillator principle – oscillator types – frequency stability, RC oscillators – phase shift oscillator – Wein bridge oscillator – LC tunable oscillators – limitations – multivibrators – monostable and astable – 555 IC timer – sine wave and triangular wave generation – crystal oscillators and their applications.

Unit – IV: Operational Amplifiers

Basis of operational amplifier – characteristics – CMRR – inverting and non-inverting modes- sum and difference amplifiers – integrating and differentiating circuits – feedback types – current to voltage (ICVS) and voltage to current (VCIS) conversion — op-amp application – instrumentation amplifiers – low pass and high pass active filters.

Unit – V: Digital Circuits

Logic gates: De Morgan's law, binary adder, comparators, decoders, multiplexers. Flipflops: RS flip-flop, JK flip- flop, JK master-slave flip-flops, T flip-flop, D flip-flop. Shift registers – synchronous and asynchronous counters – registers – A/D and D/A conversion.

Text Books and Reference Books

1. J. Milman and C.C. Halkias, Electronic Devices and Circuits, McGraw-Hill (1981).
2. Albert Malvino, David J Bates, Electronics Principles, Tata McGraw-Hill (2007).
3. R.J. Higgins, Electronics with Digital and Analogue Integrated Circuits, Prentice Hall (1983).
4. R. L. Boylsted and L. Nashelsky, Electronic Device and Circuits, Pearson Education (2003).
5. C.L Wadhwa, Network Analysis and Synthesis, New Age International Publishers, (2007).
6. G.B. Calyton, Operation Amplifiers, ELBS (1980)

SEM	Sub. Code	Title of the paper	L	T	P	C
III		CCT-08-Quantum Mechanics				4

OBJECTIVES

1. To illustrate the inadequacy of classical theories and the need for a quantum theory.
2. To explain the basic principles of quantum mechanics.
3. To develop solid and systematic problem-solving skills.
4. To apply quantum mechanics to simple systems occurring in atomic and solid-state physics.

Course Outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	describe the principles and methods of wave mechanics and matrix mechanics based on Dirac notation.
CO-2	apply the quantum theory to 1D potentials, 3D potentials, rotation & addition of angular momenta, stationary states and time- dependent systems.
CO-3	analyse various properties using the quantum theory and compare itwith the results of classical physics.
CO-4	evaluate and summarize the methods and properties of variousquantum mechanical systems.
CO-5	understand relativistic quantum mechanics

UNIT I: GENERAL FORMALISM

Postulates of quantum mechanics - Wave function and its Physical InterpretationSchrödinger equation-Time-independent Schrödinger equation -Dynamical variables and operators-Commutation relations of operators- Hermitian operators- Expansion in Eigen functions-Heisenberg Uncertainty relation-Time evolution operatorSchrödinger and Heisenberg pictures of time evolution- Time variation of expectation values.

UNIT II: DISCRETE EIGENVALUE PROBLEMS

Harmonic oscillator in one dimension - Analytic method -Abstract operator methodSchrödinger equation in three dimensions - Spherical polar coordinate form- Angular momentum eigen functions and eigen values- Total angular momentum and Spherical harmonics- Radial equation- Hydrogen atom wave functions and their discussion.

UNIT III: PERTURBATION THEORY

Time independent perturbation theory for discrete levels - Non-degenerate cases and degenerate cases- Removal of degeneracy- Spin-Orbit coupling- Fine Structure of Hydrogen-Variational method- Time-dependent perturbation theory - constant and periodic perturbations - Fermi Golden rule - WKB approximation - sudden and adiabatic approximations.

UNIT IV: IDENTICAL PARTICLES AND SCATTERING THEORY

Mutual scattering of two particles -Schrödinger equation in laboratory and center of mass frames-System of identical particles -Symmetric and anti symmetric wave functions- Two

electron atoms - Exchange interactions- Spin half particles in a box - Fermi gas- Band structure- Quantum Scattering theory - Differential and total cross sections- Scattering amplitude- Formal expression for scattering amplitude - Green's functions- Born approximation - Application to spherically symmetric potentials.

UNIT V: RELATIVISTIC QUANTUM MECHANICS

The Klein-Gordon (KG) equation - Charged particle in an electromagnetic field, Interpretation of the KG equation- Dirac equation- free particle solution – Negative energy states-Equation of continuity-Plane wave solutions of the Dirac EquationNon-relativistic limit of the Dirac equation - Fine structure of Hydrogen-Dirac equation in Electromagnetic field.

Text And Reference Books

1. David J. Griffiths, Introduction to Quantum Mechanics, 2 ndEdition, Pearson, 2009. 2. Mathews P.M. and Venkatesan.K., Quantum Mechanics, 2ndEdition, McGraw Hill, 2010.
2. Bransden.B.H. and Joachain C.J., Quantum Mechanics, 2ndEdition, Pearson, 2007.
3. Yoav Peleg, Reuven Pnini, Elyahu Zaarur, and Eugene Hecht, Schaum's Outline of Quantum Mechanics, 2 ndEdition, McGraw Hill, 2010.
4. Leonard I Schiff, Quantum mechanics, 3rdEdition, McGraw Hill BookCompany, 1968.
5. Satya Prakash, Advanced Quantum mechanics, Revised Edition, PragathiPrakashan Publishing Limited, 2008.
6. Gupta, Kumar and Sharma, Quantum Mechanics, 29thEdition, Jai PrakashNath & Co, 2010.

SEM	Sub. Code	Title of the paper	L	T	P	C
III		CCT-09 Microprocessors and Microcontrollers				4

Objectives

1.To Understand the architecture of 8085, 8086 and 8051.
2. To Impart the knowledge about the instruction set.
3. To Understand the basic idea about the data transfer schemes and its applications.
4. To develop skill in writing simple program for 8085, 8086 and 8051 and its applications

Course Outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	Assess and solve basic binary math operations using the microprocessor and explain the microprocessors and microcontrollers internal architecture and its operation within the area of manufacturing and performance.
CO-2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
CO-3	Compare accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performance requirements.
CO-4	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
CO-5	Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.

UNIT I: ARCHITECTURE AND PROGRAMMING OF 8085

Architecture of 8085-Organization of 8085- Control - Data and Address buses registers in 8085-Addressing modes in 8085- Pin configuration of 8085. Instruction set of 8085-Instruction types (based on number of bytes, operation), data transfer – Arithmetic-Logical-Branching-Stack and I/O instructions- Timing and sequencing instruction cycles-Machine cycle of weight state-timing diagram of opcode fetch Memory read and memory write cycles-Assembly language programming-Simple programs using arithmetic and logical operations-interrupts-Maskable-Non maskable -Hardware and multilevel interrupts.

UNIT II: DATA TRANSFER SCHEMES AND APPLICATIONS

Programmed data transfer scheme-Synchronous and Asynchronous and serial data transfer schemes-Interfacing Devices-Types of interfacing devices- Programmable Peripheral Interface (PPI- 8255)- Communication interfacing device (Universal Synchronous Asynchronous Receiver Transmitter (USART- 8251)- Programmable Direct Memory Access (DMA) controller (8257).

UNIT III: ARCHITECTURE AND PROGRAMMING OF 8086

Architecture-Memory organization-Input and output structure-Programmable hard ware resistors-Addressing modes-Minimum and maximum modes-Systems bus timing-Interrupts and interrupts service routines- Assembler instruction format- data transfer instructions-

Arithmetic and logical instructions-Branch instructions-processor control instructions-String operator instructions-Simple programs.

UNIT IV: ARCHITECTURE OF MICROCONTROLLER 8051

Introduction -Comparison between microprocessor and microcontroller-architecture of 8051-Key features of 8051-Memory organization-Data and program memory-Internal RAM organization- Internal ROM organization -Special function registersAccumulator-Data pointer-Control registers-I/O port Counters and timers-Interrupt structures.

UNIT V: PROGRAMMING THE MICROCONTROLLER 8051

Instruction set of 8051-Arithmetic-Logical-Data movable-Jump and call instructions Addressing modes-Immediate-Register-Direct and indirect addressing modes Assembly language programming-Simple program to illustrate arithmetic and logical operations -Sum of numbers-Biggest and smallest numbers in an array-Software time delay system.

TEXT and reference BOOKS

1. Ramesh S Goankar, Micro Processor Architecture, Programming and Applications with the 8085, 6
thEdition, Penram International Publishing (India) Pvt. Ltd., 2011.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3 rdEdition , Publisher Cengage Learning, 2007.

SEM	Sub. Code	Title of the paper	L	T	P	C
III		CCP-05- Electronics Lab				4

Objective: To enrich the knowledge in further application of electronics and application

1. Operational Amplifier parameters
2. Design and Construction of Wien Bridge Oscillator
3. Design and Construction of phase shift oscillator
4. Design and Construction of Astable Multivibrator
5. Design and Construction of Monostable Multivibrator
6. Schmitt Trigger circuit and its use as a zero crossing detector and squaring circuit
7. Voltage Regulator
8. Constant Current Source
9. Design and Construction of DC differential amplifier using op-amps
10. Design and Construction of Function generator
11. Design and construction of Negative nonlinear resistor
12. J. K. flip-flop counter: Scale of 16 and 10 using IC
13. Adder and Subtractor Circuits

Sem	Sub. Code	Title of the paper	L	T	P	C
III		CCP-06-MICROPROCESSOR AND MICRO CONTROLLER				4

Objective: To know data structural inbuilt nature of microprocessor applications

1. Microprocessor 8085-Introduction I (arithmetic-immediate mode)
2. Microprocessor 8085-Introduction II (arithmetic and logical-all modes)
3. Microprocessor 8085-Introduction III (code conversions and arrays)
4. Microprocessor 8085-Solving equations
5. Microprocessor 8085-Subroutines
6. Microprocessor 8085-Subroutines (display results)
7. Microprocessor 8085-Interface I (LEDs)
8. Microprocessor 8085-Interface II (LEDs & switches)
9. Microprocessor 8085-Interface III (Freq. generation)
10. Microprocessor 8085-Interface IV (Waveform generation)
11. Microprocessor 8085-Interface V (Traffic lights simulation)
12. Microprocessor Z80-Introduction (use of advanced instructions w.r.t. 8085)
13. Microprocessor 8086-Introduction I (simple programs-all modes of addr.)
14. Microprocessor 8086-Introduction II (equations and arrays)

SEM	Sub. Code	Title of the paper	L	T	P	C
III		DSE-03 Material Science				4

OBJECTIVES

1. To acquire basic understanding of advanced materials, their functions and properties for technological applications
2. To emphasize the significance of materials selection in the design process
3. To understand the principal classes of bio-materials and their functionalities in modern medical science
4. To get familiarize with the new concepts of Nano Science and Technology
5. To educate the students in the basics of instrumentation, measurement, data acquisition, interpretation and analysis

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	acquire the knowledge and discuss about super capacitor materials, polymer and composite materials, and phase transitions of materials.
CO-2	understand and apply the concepts of alloys and composites
CO-3	identify and discuss the supercapacitor and its applications.
CO-4	identify and analyze different energy conversion materials forconversion process
CO-5	Categorize and Test different materials for storage device

UNIT I–ELECTRONIC AND PHOTONIC MATERIALS

Electronic Materials: Fermi energy and Fermi - Dirac distribution function - Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors - Hall effect - Dilute Magnetic Semiconductors (DMS) and their applications Superconducting Materials: Normal and High temperature superconductivity - Applications. Photonic Materials: LED – LCD - Photo conducting materials – Photo detectors - Photonic crystals and applications - Elementary ideas of Nonlinear optical materials and their applications.

UNIT II– MAGNETIC AND DIELECTRIC MATERIALS

Magnetic Materials: Classification of magnetic materials based on spin - Hard and soft magnetic materials - Ferrites, garnets and magnetoplumbites - Magnetic bubbles and their applications - Magnetic thin films – Spintronics and devices (Giant magneto resistance, Tunnel magneto resistance and Colossal magneto resistance) Dielectric Materials: Polarization mechanisms in dielectrics – Frequency and temperature dependence of polarization mechanism - Dielectric loss - Dielectric waveguide and dielectric resonator antenna - Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT III– MODERN ENGINEERING AND BIOMATERIALS

Modern Engineering Materials: Smart materials - Shape memory alloys - Chromic materials (Thermo, Photo and Electro) - Rheological fluids - Metallic glasses - Advanced ceramics - Composites. Bio-materials: Classification of bio-materials (based on tissue response) - Comparison of properties of some common biomaterials - Metallic implant materials

(stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) -Tissue replacement implants - Tissue engineering - Biosensor.

UNIT IV– INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

Basic concepts of Nanoscience and Nanotechnology - Quantum wire - Quantum well - Quantum dot - fullerenes - Graphene - Carbon nanotubes - Material processing by chemical vapor deposition and physical vapor deposition - Principle of SEM, TEM, AFM, Scanning near-field optical microscopy (SNOM) - Scanning ion-conducting microscopy (SCIM)- Potential uses of nanomaterials in electronics, robotics, computers, sensors, sports equipment, mobile electronic devices, vehicles and transportation Medical applications of nanomaterials.

UNIT V– MATERIALS CHARACTERIZATION

X-ray diffraction, Neutron diffraction and Electron diffraction - X-ray fluorescence spectroscopy - Fourier transform Infrared spectroscopy (FTIR) - Ultraviolet and visible spectroscopy (UV-Vis) - Thermogravimetric Analysis (TGA) - Differential Thermal Analysis (DTA) - Differential Scanning Calorimetry (DSC).

SEM	Sub. Code	Title of the paper	L	T	P	C
III		DSE-03 Nano Physics				4

Objectives
1.To understand the basics of Nano Structural Materials.
2. To understand the various characterizations of nanomaterials

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	know the fundamental principles of nanoscience and technology and their applications in field of energy and storage, medical, agriculture, space and defense.
CO-2	understand the methods of fabrication of nanostructures and characterization tools for study the properties of nanostructures.
CO-3	apply physics concepts to the nano-scale materials and discuss the applications of nanomaterials.
CO-4	analyze the unique properties of nanomaterials to the reduce dimensionality of the material and evaluate its impact on energy harvesting and storage, medical, agriculture and defense
CO-5	design new printed circuits by applying the nanofabrication methods like lithography, micro contact printing and Replica molding.

Unit I
Free electron theory (qualitative idea) and its features, Idea of band structure, Metals, insulators and semiconductors, Density of states in bands, Variation of density of states with energy, Variation of density of states and band gap with size of crystal.

Unit II
Electron confinement in infinitely deep square well, confinement in two and one dimensional well, Idea of quantum well structure, Quantum dots, Quantum wires.

Unit III
Determination of particle size, Increase in width of XRD peaks of nanoparticles, Shift in photoluminescence peaks, Variations in Raman spectra of nanomaterials.

Unit IV
Different methods of preparation of nanomaterials, Bottom up : Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and Top down : Ball Milling.

Unit V :
Definition and properties of nanostructured materials. Methods of synthesis of nanostructured materials. Special experimeental techniques for characterization nanostructured materials.Quantum size effect and its applications

Text and Reference Books :
1.Nanotechnology Molecularly designed matrials by Gan -Moog Chow, Kenneth E. Gonsalves, American Chemical Society

2.Quantum dot heterostructures by D. Bimerg, M. Grundmann and N.N. Ledenstov, John Wiley & Sons, 1988.
3.Nano technology : :molecular speculations on global abundance by B.C. Crandall, MIT Press 1996.
4.Physics of low dimensional semiconductors by John H. Davies, Cambridge Univ. Press 1997.
5.Physics of Semiconductors nano structures by K.P. Jain, Narosa 1997.
Nano fabrication and bio system : Integrating materials science engineering science and biology by Harvey C. Hoch, Harold G. Craighead and Lynn Jelinskii, Cambridge Univ. Press 1996.
6.Nano particles and nano structured films ; Preparation characterization and applications Ed. J.H. Fendler, John Wiley & Sons 1998.

SEM	Sub. Code	Title of the paper	L	T	P	C
III		AEC-01 Human Rights				4

Objective

To understand the Foundational Aspects of Human Rights, Evolution of the Concept of Human Rights, Difficulties in the Promotion of Human Rights

Unit - 1 Foundational Aspects

Meaning and Concept of Human Rights, Notion and Classification of Rights : Natural, Moral and Legal Rights, Three Generations of Human Rights (Civil and Political Rights, Economic, Social and Cultural Rights; Collective/Solidarity Rights)

Unit - 2 Evolution of the Concept of Human Rights

Journey from Magna Carta to the Universal Declaration of Human Rights (Magna carta; The united States Declaration of Independence; The French Declaration of the Rights of Man and the Citizen; United States Bill of Rights; Geneva Convention of 1864; Universal Declaration of HumanRights, 1948. International Bill of Rights (Significance of Universal Declaration of Human Rights, International Covenant on Civil and Political Rights; and the International Covenant on Economic, Social and Cultural Rights)

Unit-3 : Deprivation and Denial of Human Rights

Difficulties rooted in Social, Economic, Political and Legal System of the Country Apathy and Lack of Social Auditing, Criminal Justice System {Police Behaviour and and Judicial System. Rights of the Accused (Protection from Arbitrary Arrest, Fair and Speedy Trial)

Unit-4 : International Actions For the Protection of Human Rights

International Convention on Elimination of All Forms of Racial Discrimination ; Declaration on the Elimination of All Forms of Intolerance and Discrimination Based on Religion or Belief International Concerns Regarding Self-Rule and the Rights of Self Determination

Unit-5 : Development, Social Justice and Human Rights

Social Justice in the Discourse of Development and Human Rights State, Solidarity Rights and the Human Rights Movements

Text and References Books

1.Amartya Sen, the Idea Justice, New Delhi: Penguin Books, 2009
2.Conor Greaty and Adam Tomkins (Eds).Understanding HumanRights, London: Manshell, 1996.
3. David Beetham, Politics and Human Rights, Oxford: Blackwell, 1995
4.Gurpreet Mahajan Ed., Democracy, Difference and Social Justice, New Delhi: Oxford University Press, 1998
5. S.N. Chaudhary, Human rights and poverty in India: theoretical issues, Delhi: Concepts, 2005

SEM	Sub. Code	Title of the paper	L	T	P	C
IV		CCT-10- Nuclear and Particle Physics				4

Objectives:

1. Introduce students to the fundamentals of nuclear and particle physics.
2. To understand the applications of nuclear and particle physics.

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	understand the nuclear properties and forces
CO-2	Apply knowledge and demonstrate the nuclear models such as liquid drop model, shell model
CO-3	understand the radioactivity and radioactivity measurement devices
CO-4	understand the nuclear reactions such as fission and fusion fundamentals
CO-5	know the elementary particles and their interactions

Unit – I: Nuclear Properties and Forces

Nuclear radius and charge distribution – angular momentum – parity – electromagnetic moments-isospin – binding energy – nature of the nuclear force – Yukawa's hypothesis – Deuteron and its properties – properties of nuclear forces – spin dependence – internucleon potential – charge independence and charge symmetry-polarization.

Unit – II: Nuclear Models

Liquid drop model – semi empirical mass formula – shell model – experimental evidence – magic numbers – spin-orbit coupling – angular momentum of the energy states – magnetic moments and Schmidt lines – electric quadrupole moments – excited states – collective model – nuclear vibration and rotation.

Unit – III: Radioactivity

Measurements of lifetimes – multipole moments – theoretical prediction of decay constants – selection rules – angular correlations – internal conversion – Geiger-Nuttel law – barrier penetrations applied to alpha, decay and beta decay – simple theory – Kurie plots – comparative half life – selection rules – internal conversion.

Unit – IV: Nuclear Reactions

Reaction dynamics – Q-equation – theory of nuclear reaction – reaction cross sections Rutherford cross section – compound nucleus reactions– direct reactions – resonance reaction – fission process – energy in fission and absorption cross section – neutron sources–fusion fundamentals – Lawson criterion – solar fusion.

Unit – V: Elementary Particles

Classification of elementary particles – types of interactions – conservation laws – momentum-parity and spin – isospin – baryon and lepton numbers – Gell-Mann-Nishijima relationship – mesons and baryons – CPT invariance – detection and properties of neutrino – concept of antiparticles – tau-theta puzzle – neutral kaon – quark model.

Text Books and References

1. Kenneth S. Krane, Introductory Nuclear Physics, John Wiley & Sons, New York (1988).
2. D. Griffiths, Introduction to Elementary Particles, Harper and Row, New York (1987).
3. B. L. Cohen, Concepts of Nuclear Physics, Mc-Graw Hill, New York (1971).
4. I. Kaplan, Nuclear Physics, Addison-Wesley, London (1977).
5. D. H. Perkins, Particle Astrophysics, Oxford University Press, New York (2003)
6. Samuel S. M. Wong, Introductory Nuclear Physics, Wiley, Weinheim (2004).

Sem	Sub. Code	Title of the paper	L	T	P	C
IV		DSE-04 Physics of Non-Conventional energy				4

Objective:
It introduces solar energy its radiation, collection, storage and application. It also introduces the Wind energy, Biomass energy, Geothermal energy and ocean energy as alternative energy sources.

Course Outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	demonstrate the generation of electricity from various non-conventional sources of energy, have a working knowledge on types of fuel cells.
CO-2	estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to
CO-3	Explore the concepts involved in wind energy conversion system by studying its components, types and performance. .
CO-4	evaluate and summarize the methods and properties of variousquantum mechanical systems.
CO-5	Acquire the knowledge on bioenergy

UNIT – I PRINCIPLES OF SOLAR RADIATION:
Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II SOLAR ENERGY COLLECTION:
Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III SOLAR ENERGY STORAGE AND APPLICATIONS:
Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT-IV WIND ENERGY:
Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

UNIT-V BIO-MASS:
Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

TEXT and REFERENCE BOOKS:

1. Non-Conventional Energy Sources /G.D. Rai
2. Renewable Energy Technologies /Ramesh & Kumar /Narosa
1. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
2. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
3. Non-Conventional Energy Systems / K Mittal /Wheeler

SEM	Sub. Code	Title of the paper	L	T	P	C
IV		DSE-04- Elementary Biophysics				4

Objectives

1. To acquire the basic knowledge on Cell and Molecular Biology
2. To acquire the knowledge of Structure and function of Proteins
3. To acquire the knowledge of Structure and function of Nucleic acid
4. To comprehend the concepts of Molecular Modeling and Experimental technique

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	recall and describe the structure of cell membrane, membrane transport systems and membrane potential
CO-2	relate and differentiate various biopotential measuring instruments
CO-3	recall and explain the techniques and underlying theory of UV- Visible, IR, NMR and Raman, AAS, XRD and mass spectroscopy
CO-4	Identify and differentiate working principle, instrumentation and applications of various bio-analytical instruments
CO-5	Categorize and test the membrane and molecular modelling

UNIT I: BASIC CONCEPTS IN BIOPHYSICS

Cell as the Basic Structural Unit-Origin and Organization of Prokaryotic and Eukaryotic Cell- Cell Size and Shape-Fine Structure of Prokaryotic and Eukaryotic cell Organization-Bacteria- Cyanobacteria- Plant and Animal cell-Elementary ideas about the DNA Structure-Sugar-Phosphate Backbone-Nucleosides and NucleotideThree Dimensional-DNA Structure-RNA-Proteins-Primary, Secondary, Tertiary and Quaternary Structures-Enzymes and their Catalytic Activity-DNA-Protein Folding-DNA Denaturation, Replication-Mutation- Intercalation- Neurotransmitters- Membranes.

UNIT II: STRUCTURE AND CONFORMATION OF PROTEINS

Twenty Amino Acids-Structure and Function-The Peptide Bond-Primary Structure of a Protein-Methods of Sequence Determination- Forces Determining Protein StructureSecondary Structure of a Protein-Helix - Sheet - Turns - Super Secondary and Domains-Quaternary Structure of a Protein-Macromolecular Assemblies- Domains and Domain Swapping-Membrane Proteins- Purification Methods-Studies of Proteins with MALDI-TOF-Enzymes and Enzyme Kinetics-G-Proteins and G-Protein Coupled Receptors(GPCRs)- Proteins as Targets for Rational Structure Based Drug Design.

UNIT III: PRINCIPLES OF NUCLEIC ACID STRUCTURE

Nucleotide Structure and Properties-Introduction to DNA-RNA- Bases- SugarsPhosphates-Structure of Nucleotide- Nucleosides and Polynucleotides and their Nomenclature Scheme-Tautomerisation and Ionization- Genetic CodeStereochemistry-Nucleoside- Torsion Angles-Sugar Confirmation- NMR Study- DNA Structure-Different types of DNA and their

Structure- DNA motifs- DNA Repeats and their Significance- Function and Stability- Spectroscopic-RNA Structure and Properties- Different forms of RNA and their Significance- Alkaline Hydrolysis of RNAHow it differs from DNA-Role of 2'OH Group- Structure of Phenylalanine-tRNA Enzymes Involved in Molecular Biology.

UNIT IV: MEMBRANE AND MOLECULAR MODELING

Lipid Structure and their Organization-Comparison of Different Membrane ModelsDiffusion and Permeability-Different Types of Transport Systems Across MembranesLiposome and its Applications-Basic Principles of Modeling-Modeling by Energy Minimization Technique-Concept of Rotation About Bonds-Energy Minimization by Basic Technique for Small Molecules- Ramachandran Plot-Torsional Space Minimization-Energy Minimization in Cartesian Space- Molecular Mechanics-Basic Principle-Molecular Dynamics Basic Principles.

UNIT V: EXPERIMENTAL TECHNIQUES

Introduction to Spectroscopy-Basic Principles- Instrumentation and Applications of UV-VIS Absorption-Infrared- Raman- Atomic Absorption - Fluorescence – Circular Dichroism - Laser Spectroscopy- Nuclear Magnetic Resonance-Electron Spin Resonance - Acoustic Spectroscopy- Solvent Perturbation-Difference SpectroscopyFourier Transform Techniques-Nuclear - Magnetic Resonance- Interaction of UV Radiation with DNA - Photodimerizatio-Photodynamic action.

TEXT and References BOOKS

1. Narayanan.P, Essentials of Biophysics, New Age International Publishers, 2008.
2. Phillip Sheeler and Donald Bianchi.E, Cell and Molecular Biology, Wiley Publications, 3 rdEdition,2009.
3. Lehninger.A.L, Nelson.D.L and M.M. Cox, Principles of Biochemistry, CBS Publishers, 1993.
4. Stryer.L, Biochemistry,W.H. Freeman and Co.1997.
5. Vasantha Pattabhi and Gautham.N, Biophysics, Narosa Publishmg House, 2002.
6. Schule G.E. and Schirmer R.H. Principles of protein structure, Springer Verlag, 1984

SEM	Sub. Code	Title of the paper	L	T	P	C
IV		DSE-05 Physics of Solids				4

Objective

To provide the knowledge on crystal structure, electron transport and Classification of solids

To Explain mechanical properties of solid matter, and connect these to bond type.

Course outcome:

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	know the fundamental of crystal structure and bonding.
CO-2	Understand how electrons and holes behave in semiconductors, and explain how they conduct current.
CO-3	understand the lattice dynamics
CO-4	understand the periodic potentials and energy gap
CO-5	acquire knowledge about the semiconductors and super conductors

UNIT I CRYSTAL STRUCTURE AND BONDING

Crystalline solids - crystal systems - Bravais lattices –corordination number – packing factors – cubic, hexagonal, diamond structures – lattice planes – Miller indices – interpalanar distances – directions. Types of bonding - lattice energy – Madelung constants – Born Haber cycle – cohesive energy.

UNIT II FREE ELECTRON THEORY

Drude theory – Wiedemann-Franz Law and Lorentz number – free electron statistics (Fermi-Dirac) – density of states - Sommerfeld theory – concentration, chemical potential, Fermi energy and specific heat of free electrons – Boltzmann transport theory – electrical and thermal conductivity of electrons.

UNIT III LATTICE DYNAMICS

Mono atomic and diatomic lattices – harmonic approximation - phonon frequencies and density of states – Einstein and Debye theories of lattice energies and phonon dispersion curves – anharmonic effects - thermal expansion - thermal conductivity - normal and Umklapp processes - scattering experiments.

UNIT IV PERIODIC POTENTIALS AND ENERGY BANDS

Bloch’s theorem - nearly free electron approximation - formation of energy bands and gaps - Brillouin zones and boundaries - effective mass of electrons and concept of holes - classification into insulators, conductors, semiconductors and semimetals - Fermi surface - Cyclotron resonance

UNIT V PHYSICS OF SEMICONDUCTORS AND SEPERCONDUCTIVITY

Semiconductors – direct and indirect gaps – carrier statistics (intrinsic and extrinsic) – law of mass action and chemical potential of semiconductors – electrical conductivity and its temperature variation - III - V and II – VI compound semiconductors – excitons and polarons. Superconductivity – critical parameters – anomalous characteristics – isotope effect, Meissner effect – type I and II superconductors - BCS theory (elementary) - Josephson junctions and tunneling – SQUID - High temperature
superconductors - applications.

TEXT and REFERENCES Books

1. Harald Ibach and Hans Lueth, Solid State Physics, 2nd edition Springer (1996)
2. H.P.Myers, Introductory Solid State Physics, 2nd edition, Viva Books Pvt. Ltd (1998)
3. M.Ali Omar, Elementary Solid State Physics, revised printing Pearson Education (2000)
4. M.S. Rogalski and S.B. Palmer, Solid Statae Physics, Gordon Breach Science
Publishers (2000)
5. Y.K. Lim, Problems and solutions on Solid State Physics, Sarat Book Publishers (2002)
6. N.W. Ashcroft and N.D. Mermin Solid State Physics, Thomson Brrooks/Cole
(1976)
7. A.J Dekker, Solid State Physics, Prentice Hall (1957).

SEM	Sub. Code	Title of the paper	L	T	P	C
IV		DSE-05- LASER and OPTICS				4

Objectives

1.To understand the basics of lasers.

2. To understand the theory of diffraction and crystal optics

CO No.	CO-Statements
	On the successful completion of the course, student will be able to
CO-1	understand the propagation of laser and vectorial nature
CO-2	Apply knowledge and demonstrate the diffraction theory and crystal optics
CO-3	understand the different types of lasers
CO-4	understand the holography and fibre Optics
CO-5	know the advances in optical fiber systems

UNIT I: Light Propagation and Vectorial Nature

Electromagnetic wave propagation, Harmonic waves, phase velocity, group velocity, energy flow – Poynting vector. Different polarizations –Matrix representation, Jones calculus. Ray vectors and ray matrices. Theory of partial coherence-visibility of fringes coherence time and coherence length-coherence line width-temporal and spatial coherence-multiple beam interference- fabry perot interferometer - theory of multi layer films-applications

UNIT II : Theory of Diffraction & Crystal Optics

Kirchoff's theory of diffraction-Fresnel -Kirchoffs formulae-Fresnel diffraction at a straight edge-Babinets principle-Fraunhoffer diffraction at single , multiple and circular aperture-resolution of patterns -Fourier transform in diffraction theory-Frauhnhoffer diffraction - apodization-spatial frequencies and spatial filtering. Propagation of light in isotropic dielectric media-dispersion -Sellmeir's formulae-propagation of light in crystalsray velocity-wave vector surface-susceptibility tensor of an optically active medium Nonlinear polarization and nonlinear wave equation. Second harmonic generation and phase matching

UNIT III :Laser Optics

Laser action: absorption, spontaneous and stimulated emission; Einstein A and B coefficients – amplification of light – threshold condition, three- and four-level rate equation analysis, line broadening. Laser media and laser systems; solid-state lasers, gas lasers, dye lasers, semiconductor lasers, fibre lasers. Theory of laser resonators and modes. Q switching and Mode locking (Qualitative ideas)

UNIT IV :Holography and Fibre Optics

Theory of holography, reconstruction of images. Volume holograms- off-axis holograms. Fourier holograms. theory of cylindrical wave guides, modes-step index fibre-graded index fibre- Ray theory of transmission-acceptance angle-numerical aperture –single mode fibres-cut-off wavelength. Transmission characteristics in optical fibres,attenuation and scattering loses-non-linear loses-optimum wavelength for transmission. Material dispersion-wave guide dispersion- intermodal dispersion. Optical communication (General ideas)

UNIT V: ADVANCES IN OPTICAL FIBER SYSTEMS

Semiconductor optical Amplifier- EDFA- Raman Amplifier- Wideband Optical Amplifiers -Principles of Wavelength Division multiplexing (WDM)- Dense Wavelength Division multiplexing (DWDM)- Telecommunications and broadband application- SONET/SDH- MUX-Analog and Digital broadband- Optical switching.

Tex and References

1. Introduction to Modern Optics- G R Fowles
2. Quantum Electronics-A Yariv
3. Optical Electronics-Ghatak & Thyagarajan
4. Modern Optics-R d Guenther
5. Laser Fundamentals-W T Silfvast

SEM	Subject Code	Subject name	L	T	P	C
IV		AEC-I - HUMAN RIGHTS				4

CO	Human rights' as an emblem of modernity, good governance, and globalization. Its universal nature with reference to the dignity of every human being brings forward dreams of freedom as well as worries about foreign influence. It refers to actually existing international law and associated legal and political mechanisms as well as processes of far-reaching social and cultural change. This programme offers courses in human rights in both theory and practice from legal, historical, philosophical, political and social science-based perspectives.

UNIT-I : Introduction To Human Rights12 HOURS

Human rights: Meaning-origin and growth of human rights in the world- Need and Types of human rights- UNHRC (United Nations Human Rights Commission) – Human Rights in India

UNIT-II: Classification of human rights 12 HOURS

Rights to liberty – Rights to life – Rights to equality-Rights to Dignity- Right against Exploitation- Educational Rights- Cultural rights – Economical Rights –Political Rights-Social Rights.

UNIT-III: Rights of Women and Children12 HOURS

Rights of Women- Female feticide and infanticide and selective abortion- Physical assault and sexual harassment-Domestic violence-violence at work place- Remedial measures.

Rights of children-Protection right- survival Rights – Participation Rights-Development Rights-Role of UN on convention on Rights of children.

UNIT –IV Multi – Dimensional aspects of human Rights12 HOURS

Labor Rights –Bonded Labour- Child Labour- Contract labour- Migrant Labour- Domestic Women labour-Gender equity –Rights ethic refugees- Problems and Remedies- Role of trade union in protecting the unorganized labour.

UNIT –V Grievances and Redressal Mechanism12 HOURS

Redressal Mechanisms at national and international levels-structure and function of National and state level human rights commission- Constitutional remedies and directive principles of state policy.

REFERENCES BOOKS:

1. Baradot Sergio and Swarojali Ghosh Teaching of human Rights: Dominant Publishers and Distributors New Delhi,2009.

2. Roy A.N Human Rights Achievement and challenges: vista imitational Publishing house, Delhi, 2005.

3. Asish Kumar das and PeasantKumar Mohanty: Human Rights in India: Sarup and sons New Delhi, 2007.

4. Velan, G . Human Rights and Development issues: The associated Publishers Ambalacannt, 2008.

SEM	Subject Code	Subject name	L	T	P	C
IV		AEC-02-PHYSICS FOR COMPETITIVE EXAMINATIONS				4

Course outcome:

CO No.	CO- Statements
	On the successful completion of the course, student will be able to
CO-1	acquire the knowledge of the fundamental concept of physics
CO-2	understand the concepts of fundamental physics
CO-3	apply the concept of physics to solve various problems
CO-4	strengthen an appropriate problem-solving approach and assess a stepto describe the quantitative analysis.
CO-5	evaluate the results of new analytical problems and develop a correctsolutions or conclusions.

Unit-I: General Mechanics and Properties of Matter

Physical quantities - SI system of units - dimensions - scalars and vectors (Concepts) - Newton's equations of motion - impulse - principle of conservation of linear momentum - projectile motion
Kepler's laws - Newton's law of gravitation - acceleration due to gravity - escape velocity - angularmomentum - banking of roads - simple harmonic motion - viscosity - surface Tension.

Unit-II: Heat and Thermodynamics

Different scales of temperatures - thermal expansions - calorimetry - specific heat - latent heat - triple point - transmission of heat - heat conductivity - Black body radiation - Stefan Boltzmann law - Wien's displacement law - Gas equation - Boyle's law - Charle's law - Law of equipartitionof energy.

Unit-III: Light and Sound

Reflection and refraction - Snell's law - total internal reflection - polarization - Brewster's Law - Huygen's principle – Young's double slit interference and single slit diffraction - longitudinal and transverse waves - velocity of sound - Newton's formula, Laplace correction, effects of pressure - beats - laws of vibrating strings - open and closed organ pipes - resonance.

Unit-IV: Electricity and Magnetism

Coulomb's Law - Electric field due to charged particles: a point charge, a dipole, a line of charge electric flux - Gauss' law and applications – Biot-Savart law, magnetic field due to a current in:a long straight wire, a circular arc of wire - Ampere's Law - magnetic field outside and inside a long straight wire - solenoids and toroids - Faraday's laws and Lenz's law.

Unit-V: Modern Physics

Postulates of Einstein's theory of relativity - Galilean and Lorentz transformation - time dilation - length contraction - Planck's radiation - photoelectric effect - Compton shift, matter waves - Bohr's atomic theory.

Nuclear properties - binding energy and mass defect -radioactive decay - alpha decay, beta decay and gamma decay - Radioactive dating.

Books for Study

1. J. Walker, D. Halliday, R. Resnick, Fundamentals of Physics, 10th Edition, Wiley, Unitedstates of America, 2007.
2. H.C Verma, Concept of Physics, (Volume II), 1st Edition, Bharati Bhawan Publishers &Distributors, New Delhi, 2008.
3. H.C Verma, Concept of Physics, (Volume I), 1st Edition, Bharati Bhawan Publishers &Distributors, New Delhi, 2008.