COURSE CODE: 6SMPH101

MATHEMATICAL PHYSICS

COURSE OBJECTIVES:-

To impart knowledge about various mathematical tools employed to study physics problems.

Syllabus:

UNIT – I Special Functions & Vector Analysis Recursion relation, Generating functions and Orthogonality of Bessel functions of first and second kind, Hermite, Legendre, Associate Legendre and Laguerre Polynomials; Dimensional analysis, Vector algebra and Vector Calculus.

UNIT – II Integral Transforms Fourier integrals, Fourier transforms and inverse Fourier transforms, Fourier transform of derivatives, Convolution theorem, Elementary Laplace transforms;Laplace transform of derivatives, Laplace transformation of Dirac's delta function.

UNIT – III Green's Functions Non-homogenous boundary value problems, Green's function for one dimensional problem, Eigen function expansion of Green's function, Fourier transform, Method of constructing Green's function, Green's function for electrostatic boundary value.

UNIT – IV Complex Variables& Matrix Analyticity of complex functions, Cauchy Riemann equations, Cauchy theorem, Cauchy integral formula, Taylors, McLaren, Laurent series & Mapping, Theorem of residues, Simple cases of contour integration, Matrices Cayley – Hamilton theorem, Matrix representation, Eigen values & Eigen functions.

COURSE OUTCOMES:-

Students will have understanding of:

1. Various techniques to solve differential equations.
2. How to use special functions in various physics problems.

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(Board of Studies)	**(Academic Council)**	**Seal**

COURSE CODE: 6SMPH102

CLASSICAL MECHANICS

COURSE OBJECTIVES:-

To apprise the students of Lagrangian and Hamiltonian formulation and their applications.

Syllabus:

UNIT – I Newtonian Mechanics of One and Many Particles Systems Conservation laws, Constrains & their classification, Principle of virtual work, D'Almbert's principle in generalized coordinates, The Lagrange's equation from D'Almbert's principle. Configuration space, Hamilton's principle deduction from D'Almbert's principle, generalized moment and Lagrangian formulation of the conservation theorems, Reduction to the equivalent one body problem, the equation of motion and first integrals.

UNIT – II Hamiltonian Formulation of Mechanics & Motion under Central Force The equations of canonical transformation and generating functions, The Hamilton-Jacobi Action, Poisson's bracket, Simple algebraic properties of Poisson's bracket, The equation of motion in Poisson's Bracket notation, Poisson theorem,Principle of least action, Kepler's problem, Inverse central force field, Rutherford scattering.

UNI T – III Rotating Frames & Rigid Bodies Theory of small oscillations, Equations of motion, Eigen frequencies and general motion, normal modes and coordinates, Rotating coordinate systems, Acceleration in rotating frames, Coriolis force and its applications, Elementary treatment of Eulerian coordinates and transformation matrices, Angular momentum inertia tensor, Euler equations of motion for a rigid body, Torque free motion for a rigid body.

UNIT – IV Special Relativity in Classical Mechanics Symmetries of space and time, Special theory of relativity, Mass-energy equivalence, Galilean transformation, 4-Vectors and 4–Scalars, Relativistic generalization of Newton's laws, 4-momentum and 4-force, variance under Lorentz transformation relativistic mechanics.

COURSE OUTCOMES:-

Students will have understanding of:

1. Necessity of Lagrangian and Hamiltonian formulation
2. Essential features of a problem (Like motion under central force, rigid body dynamics, periodic motion) use them to set up and solve the appropriate mathematical equations and make quick and easy checks on the answer to catch simple mistakes.
3. Theory of small oscillations which is important in several areas of physics i.e. molecular spectra, acoustics, variation of atoms in solids, coupled mechanical oscillators and electrical circuits.

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COURSE CODE: 6SMPH103

QUANTUM MECHANICS-I

COURSE OBJECTIVES:-

To give exposure about various tools employed to analyze the quantum mechanical problems.

Syllabus:

UNIT – I Foundation of Quantum Mechanics Basic Postulates of quantum Mechanics, wave – particle duality, Schrodinger time dependent & time independent wave equation, Equation of continuity, Normality, Orthogonality, Expectation values and Ehrenfest theorem, Solution of Schrodinger equation for one dimensional motion inPotential well, Potential step and Potential barrier, Wave packets.

UNIT – II General Formalism of Wave Mechanics Linear vector space, Concept of Hibert space, Bra and Ket notation for state vector, unitary transformation (translation and rotation), Matrices for Position (x) and Momentum (p), Heisenberg uncertainty relation and its applications, Schwartz inequality.

UNIT – III Exactly Soluble Eigen Value Problems Solution of Schrodinger equation for linear harmonic oscillator, hydrogen - like atom, square well potential and their respective application to atomic spectra, Molecular spectra and low energy nuclear states (Deuteron).

UNIT – IV Angular Momentum in Quantum Mechanics Theory of angular momentum, Orbital angular momentum, Spin angular momentum, Eigen values and Eigen function of L^2 and L_z in term of spherical harmonics, Commutation relations.

COURSE OUTCOMES:-

Students will have understanding of:

1. Importance of quantum mechanics compared to classical mechanics at microscopic level.
2. Various tools to calculate Eigen values and total angular momentum of particles.
3. Application of approximation method and scattering theories.

Chairperson (Board of Studies)	**Dean (Academic Council)**	**(Registrar) Seal**

COURSE CODE: 6SMPH104

ELECTRONIC DEVICES

COURSE OBJECTIVES:-

To introduce students to entire circuit design and to provide in dept theoretical base of electronics and digital electronics.

Syllabus:

UNIT – I Transistors Introduction and types of transistors, JFET, BJT, MOSFET and MESFET: structure derivations of the equations for I-V characteristics under different condition, Microwave devices, Tunnel diode, Transfer electron devices (Gunn diode), Avalanche transits time devices, Impatt diodes and Parametric devices.

UNIT – II Photonic Devices Photo conductive devices (LDR), Photo detectors, Solar cell (open circuit voltage and short circuit current, fill factor), LED (high frequency limit, Effect of surface and indirect recombination current, operation of LED), Diode lasers (Conditions for population inversion in active region, Light confinement factor, Optical gain and Threshold current for lasing).

UNIT – III Memory Devices Review of logic gates, Read Only Memory (ROM) and Random Access Memory(RAM), Types of ROM, PROM, EPROM, EEPROM and EAPROM, Static and Dynamic RAMs (SRAM & DRAM), Characteristics of SRAM and DRAM, Hybrid Memories: CMOS and NMOS memories, Non-volatile RAM, Ferroelectric memories, Charge coupled devices (CCD),**Storage devices:** Optical Storage devices (CD-ROM, CD-R, CD-R/W, DVD).

UNIT – IV Optical Electronics Electro-optics, Magneto-optic and Acousto-optic effects, Materials properties related to get theseeffects, Important Ferroelectric, liquid crystal and polymericmaterials forthesedevices,Piezoelectric, Electrostrictive and magnetostrictive effects. Acoustic delay lines, Piezoelectricresonators and filters, High frequency piezoelectric devices surface, Acoustic wave devices.

COURSE OUTCOMES:-

Students will have understanding of:

1. Fundamental design concept of different types of logic gates, minimization techniques etc.
2. Characteristics of device like PNP, NPN, Diodes and truth table of various logic gates.
3. Basic elements and to measure their values with multimeter and their characteristics study.

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COURSE CODE: 6SMPH105

LAB I :-

ELECTRONICS

1. To determine the energy band gap of a semiconductor material using P–N Junction diode.
2. To study and draw the characteristics curve of P–N Junction diode.
3. To study and draw the characteristics curve of Zener diode.
4. To study the characteristics of the given NPN or (PNP) transistor in the common emitter (CE) mode.
5. To study the characteristics of the given NPN or (PNP) transistor in the common base (CB) mode.
6. To study the characteristics of the given NPN or (PNP) transistor in the common collector (CC) mode.
7. To study the stable, mono stable and bi-stable multivibrators by using IC-555.
8. To study the characteristics and applications of Silicon Controlled Rectifier (SCR).
9. To study the frequency response / output voltage gain & charge in critical frequency with and without feedback capacitor with the help of common emitter transistor amplifier. (Miller Effect)
10. To study the input impedance with the help of common emitter transistor amplifier.
11. To study the output impedance with the help of common emitter transistor amplifier.
12. To study the effect of negative feedback on output gain with the help of common emitter transistor amplifier.
13. To study the characteristic curve of Field Effect Transistor (FET).
14. To study the characteristics curve of Uni-Junction Transistor (UJT).
15. To study the Hall Effect and to calculate: -
    (i) The hall coefficient (R_H).
    (ii) The concentration of the majority charge carriers.
    (iii) The mobility of the majority charge carriers.
    (iv) An identification type of the given semiconductor.

Note:-

- **Two experiments will be asked in the semester practical examination.**

Chairperson (Board of Studies)	**Dean (Academic Council)**	**(Registrar) Seal**

COURSE CODE: 6SMPH106

LAB II:-

OPTICAL FIBER

1. Determination of NA by using optical fibre cable.
2. Setting up fiber optic analog link.
3. Setting up fiber optic digital link.
4. Intensity modulation system using analog input signal.
5. Intensity modulation system using digital input signal.
6. Frequency modulation system.
7. Pulse width modulation system.
8. Study of propagation loss in optical fiber.
9. Study of bending loss
10. Measurement of optical power using optical power meter.
11. Measurement of propagation loss using OPM.

Note:-

- **Two experiments will be asked in the semester practical examination.**

Chairperson (Board of Studies)	Dean (Academic Council)	(Registrar) Seal

COURSE CODE: 6SMPH201

QUANTUM MECHANICS-II

COURSE OBJECTIVES:-

To impart knowledge of advanced quantum mechanics for solving relevant physical problems.

Syllabus:

UNIT – I Approximation Method for Bound States Rayleigh- Schrodinger Perturbation theory of non-degenerate and degenerate levels and their applications, Variation method and its applications, W K B Approximation method, Connection formulae and ideas on potential barrier with applications to theory of alpha decay.

UNIT – II Time Dependant Perturbation Theory Methods of variation of constants and transition probability, Adiabatic and sudden approximation, Wave equation for a system of charged particles under the influence of external electromagnetic field, Absorption and induced emission, Einstein's A and B coefficients and transition probability.

UNIT – III Theory of Scattering Physical concepts, Scattering amplitude, Scattering cross section, Born Approximation and partial waves, Scattering by perfectly rigid sphere, Complex potential and absorption, Scattering by spherically symmetric potential, Identical particles with spin, Pauli's spin matrices.

UNIT – IV Relativistic Quantum Mechanics Schrödinger's relativistic equation (Klein-Gordon equation), Probability and current density, Klein - Gordon equation in presence of electromagnetic field, Short comings of Klein-Gordon equation, Dirac's relativistic equation for free electron, Dirac's Matrices, Dirac's relativistic equation in electromagnetic field, Negative energy states and their interpretation in hydrogen atom, Hyperfine splitting.

COURSE OUTCOMES:-

Students will have understanding of:

1. Importance of relativistic quantum mechanics compared to non – relativistic quantum mechanics.
2. Various tools to understand filled quantization and related concept.
3. Exposure to quantum field theory and universal interactions.

Chairperson	**Dean**	**(Registrar)**
(Board of Studies)	**(Academic Council)**	**Seal**

COURSE CODE: 6SMPH201

STATISTICAL MECHANICS

COURSE OBJECTIVES:-

The objective of this course is to learn the properties of macroscopic system using the knowledge of the properties of individual particles.

Syllabus:

UNIT – I Basic Principles of Statistical Mechanics Foundation of statistical mechanics, Specification of states of a system contact between statistics and thermodynamics, Classical ideal gas entropy of mixing and Gibb's paradox, Micro canonical ensemble, Phase space, Trajectories and density of states, Liouville theorem, Canonical and Grand canonical ensembles, Partition function, Calculation of statistical quantities, Energy and density fluctuations.

UNIT – II Ideal Bose and Fermi Systems Statistics of ensembles, Statistics of indistinguishable particles, Density matrix, Maxwell- Boltzmann, Fermi Dirac and Bose- Einstein statistics, Properties of ideal Bose gases, Bose -Einstein condensation, properties of ideal Fermi gas, Electron gas in metals, Boltzmann transport equation.

UNIT – III Imperfect Gases & Ising Model Cluster expansion for a classical gas, Virial equation of state, Mean field theory of Ising model in 3, 2 and 1 dimension, Exact solution in one-dimension.

UNIT – IV Dynamical Theory of Gases: Thermodynamics fluctuation spatial correlation Brownian motion, Langevin theory, Fluctuation dissipation theorem, Fokker-Planck equation, Onsager reciprocity relations

COURSE OUTCOMES:-

Students will have understanding of:

1. Connection between statistics and thermodynamics.
2. Difference ensembles and theories to explain the behaviour of the system.
3. Difference between classical statistics and quantum statistics.
4. Statistical behaviour of ideal Bose and Fermi svstems.

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COURSE CODE: 6SMPH203

SOLID STATE PHYSICS

COURSE OBJECTIVES:-

To Study some of the basic properties of the condensed phase of materials specially solids.

Syllabus:

UNIT – I Electron Theory Drude Model, Electrical and thermal conductivity, Wiedemann–Franz law,Lorentz theory, Somerfield theory of Metals, Boltzmann differential equation, Relaxation-time approximation, Solution of the Boltzmann equation for metals, Peltiercoefficient.

UNIT – II Electrons in a Periodic Lattice Nearly free electron model, Bloch theorem, Kronig – Penneymodel, Fermi energy, Metals–Semimetals–Semiconductors–Insulators, Tight binding approach, Fermi surface, De-Haas Van Alfen effect, Magnetoresistance, Quantum Hall effect.

UNIT – III Elementary Excitations Polarizability and dielectric function of the electron gas, Collectiveexcitations, Screening, Metal-insulator transition, Electron-electron interaction, Polaritons, Polarons, Excitons, Ferroelectric effects.

UNIT – IV Superconductivity Macroscopic electromagnetic properties, Thermal properties, Isotope effect, Energy gap, London theory, Two fluid model, Flux quantization, Single particle tunnelling, dc and ac Josephson effect, Quantum interference, Electron-phonon interaction, Cooper pair, BCS theory for ground and excited states, High temperature superconductors.

COURSE OUTCOMES:-

Students will have understanding of:

1. Sturucture in solids and their determination using XRD.
2. Behaviour of electrons in solids including the concept of energy bands and effect of the same on material properties.
3. Electrical, thermal, magnetic and dielectric properties of solids.

Chairperson	**Dean**	**(Registrar)**
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COURSE CODE: 6SMPH204

ATOMIC & MOLECULAR PHYSICS

COURSE OBJECTIVES:-

Objective of this course is to learn atomic, molecular and spin resonance spectroscopy.

Syllabus:

UNIT – I Atomic Structure and Methods of Molecular Quantum Mechanics Quantum states of one electron atom, Atomic orbital, Hydrogen spectrum, Paulis exclusion principle, Spectra of alkali elements, Spin orbit interaction and line structure of alkali Spectra, Methods of molecular quantum mechanics(Thomas Fermi statistical model, Hartree and Hartreefock method), Two electron system, Interaction energy in L-S and J-J coupling, Hyperfine structure (qualitative), Line broadening mechanisms(general ideas), Zeeman Effect, Stark effect, Paschen Back effect.

UNIT – II Pure Rotational Spectra Diatomic linear, Symmetric top, asymmetric top and spherical top molecules, Intersteller molecules, Rotational spectra of diatomic molecules as a rigid rotator, Energy level and Spectra of non-rigid rotator, Intensity of rotational lines.

UNIT – III Vibrational Spectra: Vibration energy of diatomic molecule, Diatomic molecule as a simple harmonic oscillator, Energy levels and spectrum, Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule PQR branches, IR spectrometer(qualitative).

UNIT – IV Introduction to Spectroscopy Introduction to Ultraviolet, Visible and Infra-red (IR)Spectroscopy, Raman spectroscopy, Introduction, pure rotational and vibration spectra, Techniques and instrumentation, Photo electron spectroscopy, Elementary idea about photo acoustic spectroscopy and Mossbauer spectroscopy (principle).

COURSE OUTCOMES:-

Students will have understanding of:

1. Atomic spectroscopy of one and two valence electron atom.
2. The change in behaviour of atoms in external applied electric and magnetic field.
3. Rotation, vibrational, electronic and Raman spectra molecules.
4. Electron spin and nuclear magnetic resonance spectroscopy.

Chairperson	Dean	(Registrar)
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COURSE CODE: 6SMPH205

LAB I:-

SOLID STATE PHYSICS& ADVANCED ELECTRONICS

1. To study and verify the truth table of Basic & Universal logic gates.
2. To study the characteristics curve of Tunnel Diode and its application.
3. To study the characteristics of MOSFET and its application.
4. To draw and study the characteristic curve of DIAC.
5. To draw and study the characteristic curve of TRIAC.
6. To study the pulse amplitude modulation using sample output, sample & hold output and flat top output.
7. To study the pulse amplitude demodulation using sample output, sample & hold output and flat top output.
8. To study the voice signal using pulse amplitude modulation.
9. To study the wave form of Operational Amplifier (741).
10. To study the wave form Differential Amplifier.
11. To study of crystal faces & structure by using given model.
12. **Solar Energy Trainer:**
    - 12.1 To study the voltage and current of the solar cells.
    - 12.2 Study of the voltage and current of the solar cells in series and parallel combinations.
    - 12.3 Study of both the current–voltage characteristic and the power curve to find the maximum power point (MPP) and efficiency of a solar cell.
    - 12.4 To determine the efficiency (η) of the solar cell.
    - 12.5 To study of both the current–voltage characteristic and the power curve to find the maximum power point (MPP) and efficiency of a solar cell.
    - 12.6 Study of the application of solar cells of providing electrical energy to the domestic appliances such as lamp, fan and radio.
13. **Fabrication:** To study the characteristics of FET, MOSFET, UJT, SCR, P-N Junction Diode &Zener Diode by designing its circuit.

Note:-

- ❖ **Two experiments will be asked in the semester practical examination.**

Chairperson **(Board of Studies)**	**Dean** **(Academic Council)**	**(Registrar)** **Seal**

COURSE CODE: 6SMPH206

LAB II:-

LASER

1. To determine the wavelength of given laser light.
2. To determine the beam divergence of a laser beam.
3. To observe the diffraction pattern and to calculate the slit width.
4. Verification of Inverse Square Law.
5. Study of photo cell.
6. Study of polarization of light by reflection and thus verify Brewster's law.
7. Study and verify Malus Law using a plain glass plate and a Polaroid.
8. Study and verify Malus Law using two polaroids.
9. Study of Spectrophotometer.
10. To determine λ_{max} (wave length of maximum absorption) of solution of $KMnO_4$ using spectrophotometer.
11. Verify the Beer's law $\log\frac{I_0}{I} = A = \in cl$.

Note:-

- ❖ **Two experiments will be asked in the semester practical examination.**

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(Board of Studies)	**(Academic Council)**	**Seal**

COURSE: CODE: 6SMPH301

CONDENSED MATTER PHYSICS

COURSE OBJECTIVES:-

To study some of the basic properties of the condensed phase of materials specially solids.

Syllabus:

UNIT – I Crystal Physics & X-ray Crystallography Interaction of X-ray with matters, Absorption of X-rays, Fundamental types of lattices (Two and Three dimensional), SCC, BCC and FCC, Miller indices,The reciprocal lattice and its application to diffraction techniques, The Laue, power and rotating crystal methods, Crystal structure factor, Point defects, Line defects and planer (stacking) faults, The role of dislocation in plastic deformation and crystal growth.

UNIT – II Electrical Properties of Matter & Superconductivity Free electron Fermi gas, Energy levels of orbital in one and three dimensions,Electrons in a periodic lattice,Band theory of solids, Classification of solids effective mass, cellular and pseudo potential methods, Superconductivity,Type I & Type II Superconductors, Critical temperature, Persistent current,Meissner effect.

UNIT – III Polarizability Atomic and molecular Polarizability, Claussius-Mossotti relation, Types of Polarizability, Dipolar Polarizability and frequency dependence of dipolar Polarizability, Ionic and Electronic Polarizability, Hall Effect.

UNIT – IV Magnetism Quantum View Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, Spin waves and magnous, Curie - Weiss law for susceptibility, Ferro and Anti-ferro-magnetic domains.

COURSE OUTCOMES:-

Students will have understanding of:

1. Sturucture in solids and their determination using XRD.
2. Behaviour of electrons in solids including the concept of energy bands and effect of the same on material properties.
3. Electrical, thermal, magnetic and dielectric properties of solids.

Chairperson	**Dean**	**(Registrar)**
(Board of Studies)	**(Academic Council)**	**Seal**

COURSE CODE: 6SMPH302

NUCLEAR & PARTICLE PHYSICS

COURSE OBJECTIVES:-

To impart knowledge about basic nuclear physics provide the students with an understanding of basic radiation interaction and detection techniques for nuclear physics, radioactive decays, nuclear reactions and elementary particle physics.

Syllabus:

UNIT – I Nuclear Interactions and Nuclear Reactions Nucleon- nucleon interaction, Exchange forces and tensor forces, Meson theory of Nuclear forces, Nucleon - Nucleon scattering, Effective range theory, Spin dependence of nuclear forces, Charge independence, Yukawa interaction. Direct and Compound nuclear reaction mechanisms, Compound nucleus. Scattering matrix, Reciprocity theorem, Breit-Winger one level formula, Resonance scattering.

UNIT – II Nuclear Models Liquid drop model, Bohr Wheeler theory of fission, Experimental evidence for shell effects, Shell model, Spin orbit coupling, Magic numbers, Angular moment and parities of nuclear ground states, Magnetic moment and Schmidt lines, Collective model of Bohr and Mottelson.

UNIT – III Nuclear Decay Beta Decay, Fermi theory of beta decay, Comparative half lives, Parity violation, Detection and properties of neutrino, Gamma decay, multiple transitions in nuclei, Shape of the beta spectrum, Total decay rate, Angular momentum and parity selection rules, General ideas of nuclear radiation detectors, Linear accelerator, Betatron, Proton synchrotron, Electron synchrotron.

UNIT – IV Elementary Particle Types of interaction between elementary particles, Hadrons and Leptons symmetry and conservation laws, Elementary idea of CP and CPT invariance, Classification of Hadrons, Lie algebra, SU(2), SU(3) multiples, Quark model, Gell-mann, Cosmic Rays : Nature, composition, charge and energy spectrum of primary cosmic rays, Production and propagation of secondary cosmic rays, Soft penetrating and nucleonic component, Origin of cosmic rays, Rossi curve, Bhabha- Heitlr theory of cascade showers.

COURSE OUTCOMES:-

Students will have understanding of:

1. Basic properties of nucleus and nuclear models to study the nuclear structure properties.
2. Various aspects of nuclear reactions will give idea how nuclear power can be generated.
3. Need of standard model and its limitations.
4. Week interaction between quarks and how that this is responsible for beta decay.
5. Laptons and how the electron neutrons and antineutrons are produced during beta plus and beta minus decays.

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(Board of Studies)	**(Academic Council)**	**Seal**

Discipline Specific Elective -I
ELECTRODYNAMICS

COURSE OBJECTIVES:-

Completion, the students will be able to: Demonstrate an understanding of the use of scalar and vector potentials of Gauss invariance, know and use methods of solution of Poisson and Laplace equations, and use principle of Lorentz covariant formalism and tensor analysis and basic understanding of plasma state essential for higher study.

Syllabus:

UNIT – I Basics of Electrostatics and Magneto Statics Laplace's and Poisson equations, Method of images, Biot-Sawart law, Ampere law, Maxwell's equations, Scalar and vector potentials, Gauge transformation, Lorentz gauge, Coulomb Gauge, Solution of Maxwell equations in conducting media radiations by moving charges, Retarded potentials, Lienard-Wiechrt potentials, Fields of charged particles in uniform motion.

UNIT – II Relativistic Electrodynamics Fields of an accelerated charged particles at low velocity and high velocity, Angular distribution of power radiated, Invariance of electric charge, relativistic transformation properties of E and H fields, Electromagnetic fields tensor in 4-dimensional Maxwell equation, Four Vector current and potential and their invariance under Lorentz transformation, Co-variance of electrodynamics, Lagrangian and Hamiltonian for a relativistic charged particle in external E M field,Motion of charged particles in electromagnetic field, Uniform and non uniform E and B fields.

UNIT – III Production of Plasma& Wave in a Fluid Plasma Elementary concept of occurrence of plasma, Gaseous and solid state plasma, Production of gaseous and solid state plasma, Plasma parameters, Plasma confinement pinch effect instability in a pinched- plasma column, Electrical neutrality in a plasma, Plasma oscillations: Transverse oscillations and longitudinal oscillations.

UNIT – IV Domain of Magneto Hydrodynamics and Plasma Physics Magneto hydrodynamic equations, Magnetic hydro-static pressure, Hydrodynamic waves: Magneto-sonic and Alfven waves, particle orbits and drift motion in a plasmas, Experimental study of Plasma, The theory of single and double probes.

COURSE OUTCOMES:-

Students will have understanding of:

1. Time varying field and Maxwell Equations.
2. Various concepts of electromagnetic waves.
3. Radiation from ionised time varying sources and charged particle dynamics.

Chairperson (Board of Studies)	**Dean (Academic Council)**	**(Registrar) Seal**

COURSE CODE: 6SMPH304

Discipline Specific Elective -I
PLASMA PHYSICS

COURSE OBJECTIVES:-

To expose the students to theory related to motion charge particle in inhomogeneous field, production of plasma and uses of plasma.

Syllabus:

UNIT – I Occurrence of Plasma in Nature Criteria for plasmas, Single particle motion in uniform and non uniform electric (E) and magnetic (B) fields, Time varying E and B field, Adiabatic invariants magnetic mirrors, Fluid equation of motion. Fluid drifts parallel and perpendicular to B. Plasma Oscillations, Electron Plasma waves, Ion Waves, Validity of Plasma approximation.

UNIT – II Single Particle Orbit Theory &Diffusion Electrostatic electron and ion perpendicular to B, Electromagnetic waves with B_0=0, Propagation Vector (K) perpendicular and parallel to B_0, Diffusion in weakly and fully ionized plasmas, Decay of Plasma by diffusion.

UNIT – III Stability Two stream instability, Gravitational Instability, Weibel instability, Equations of kinetic theory, Derivation of the Fluid equations Landau damping.

UNIT – IV Waves in Plasma & Problem of Controlled Fusion Ion acoustic shock waves,Pondermotive Force, Instability threshold, Oscillating two stream instability; Plasma Echoes, Magnetic confinement, Magnetic Mirrors, Pinch effect, Plasma heating, Laser induced fusion.

COURSE OUTCOMES:-

Students will have understanding of:

1. What are theoretical method to study the charged particle motion.
2. How to generate plasma in the laboratory.
3. How plasma production is helpful to make fusion reactors.

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(Board of Studies)	**(Academic Council)**	**Seal**

COURSE CODE: 6SMPH305

Discipline Specific Elective -II
DIGITAL ELECTRONICS & MICROPROCESSOR

COURSE OBJECTIVES:-

To provide theoretical knowledge and develop practical skill in digital systems, logic systems and microprocessor. Electronic systems and microprocessors.

Syllabus:

UNIT – I Communication Electronics Amplitude modulation - generation of AM waves, Demodulation of AM waves, DSBSC modulation, Generation of DSBSC waves, Coherent detection of DSBSC waves, SSB modulation, Generation and detection of SSB waves, Vestigial sideband modulation.

UNIT – II Propagation of Waves Ground Waves, Sky wave, Space wave propagation, Maximum usable frequency, Skip distance, Virtual height, Fading of signals, Satellite communication: Orbital satellite, Geostationary satellites, Orbital pattern, Look angles, Orbital spacing, Satellite system, Link modules.

UNIT – III Microwave Advantages and disadvantages of microwave transmission loss in free-space, Propagation of microwaves, Atmospheric effects on propagation, Fresnel Zone problem, Used in microwave communication systems.

UNIT – IV Microprocessors and Micro Computers Microprocessor and Architecture: Intel 8086, Microprocessor architecture modes of memory addressing, 8086/8088 Hardware specification: Pin-outs and pin functions, Clock generator (8284A) Bus buffering and latching, Bus timing, Ready and wait state, Minimum mode versus maximum mode.

COURSE OUTCOMES:-

Students will have understanding of:

1. Logic circuits, digital systems and microprocessor and their peripheral devices.
2. Operating and designing digital systems.
3. How to solve problems in design and /or implementation of digital electronics.

COURSE CODE: 6SMPH306

Discipline Specific Elective -II
ENVIRONMENTAL PHYSICS

COURSE OBJECTIVES:-

The students shall acquire basic knowledge within selected environmental topics viz ionizing radiation, radioactivity, U-V & I-R radiation, ozone depletion problem, greenhouse effect and climate, whether and biological effects related to environments.

Syllabus:

UNIT – I Essentials of Environmental Physics Structure and thermodynamics of the atmosphere, Composition of air, Greenhouse effect, Transport of matter, Energy and momentum in nature, Stratification and stability of atmosphere, Laws of motion, Hydrostatic equilibrium.

UNIT – II Solar and Terrestrial Physics of radiation. Interaction of light with matter, Rayleigh and Mie scattering, Laws of radiation (Kirchoffs law, Planck's law, Wien's displacement law, etc.), Solar and terrestrial spectra, UV radiation, Ozone depletion problem, IR absorption.

UNIT – III Environmental Pollution and Degradation Elementary fluid dynamics, Diffusion, Turbulence and turbulent diffusion, Factors governing air, water and noise pollution, Air and water quality standards, Waste disposal, Gaseous and particulate matters, Wet and dry deposition.

UNIT – IV Environmental Changes and Remote Sensing Energy sources and combustion processes. Renewable sources of energy: Solar energy, Wind energy, Bio energy, Hydropower, Fuel cells, Nuclear energy. Global and Regional Climate: Elements of weather and climate, Stability and vertical motion of air, Horizontal motion of air and water, Pressure gradient forces, viscous forces.

COURSE OUTCOMES:-

Students will have understanding of:

1. Students will describe and analyze the current national and global environmental problems.
2. Students interpret biological and chemical data related to environments.
3. Know how climate models can be used for weather forecasting, climate simulation, and investigations of the causes of climate change.

Chairperson	**Dean**	**(Registrar)**
(Board of Studies)	**(Academic Council)**	**Seal**

COURSE CODE: 6SMPH307

LAB I:-

DIGITAL ELECTRONICS & COMMUNICATION

1. Verification of De-Morgan’s Theorem.
2. To study and verify various laws of Boolean algebra.
3. To study and verify the truth table of Compound logic gates.
4. To study the characteristics of JK flip-flops.
5. To study the characteristics of SR flip-flops.
6. To study the Pulse Position Modulation using Sine Wave Input.
7. To study the Pulse Position Demodulation.
8. To study the Voice Communication using Pulse Position Modulation.
9. To study the Pulse Width Modulation using different sampling frequency.
10. To study the Pulse Width Demodulation.
11. To study the Voice Communication using Pulse Width Modulation.
12. To study the microwave propagation by using X-band setup.
13. **MotorisedAntenna Trainer Setup**

13.1 Arranging the trainer and performing the functional checks.
13.2 Plotting the Polar graph/ radiation pattern of an Antenna using software.
13.3 Study of Simple Dipole (□/2) antenna.
13.4 Study of Simple Dipole (□/4) antenna.
13.5 Study of Folded Dipole (□/2) antenna.
13.6 Study of Simple Dipole (3□/2) antenna.
13.7 Study of Yagi-UDA 5 Element Simple dipole antenna.
13.8 Study of Yagi -UDA 3 Element Folded dipole antenna.
13.9 Study of Yagi-UDA 5 Element Folded dipole antenna.
13.10 Study of Yagi-UDA 7 Element Simple dipole antenna.
13.11 Study of Hertz antenna.
13.12 Study of Zeppelin antenna.
13.13 Study of □/2 Phase Array (End fire) antenna.
13.14 Study of □/ 4 Phase Array (End fire) antenna.
13.15 Study of Combined Co-linear Array antenna.
13.16 Study of Broad Side Array antenna.
13.17 Study of Log Periodic antenna.
13.18 Study of Cut Paraboloid Reflector antenna.
13.19 Study of Loop Antenna.
13.20 Study of Rhombus antenna.
13.21 Study of Ground Plane antenna.
13.22 Study of Slot antenna.
13.23 Study of Helix antenna.

Note:-

- **Two experiments will be asked in the semester practical examination.**

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COURSE CODE: 6SMPH308

LAB II:-

NUCLEAR PHYSICS

1. To draw the plateau characteristics of GM Counter using radioactive source (CS^{137}).
2. To study the pulse height with the applied voltage to the GM Tube.
3. To study the absorption of beta and gamma radiation.
4. To verify the Inverse Square Law using GM Counter.
5. Study of GM counter.
6. Study of design structure of GM counter.

Note:-

- **Two experiments will be asked in the semester practical examination.**

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COURSE CODE: 6SMPH401

Discipline Specific Elective -III

MATERIAL SCIENCE

COURSE OBJECTIVES:-

To give comprehensive exposures to the students regarding various materials, crystiline, non – crystalline materials, crystal structure and their defects the concept of phase and different type of phase diagram.

Syllabus:

UNIT – I Classification of Materials Crystalline, Polycrystalline, Amorphous (Introduction and their structure), Elementary idea of polymers (Structure and properties, Methods of polymerization), Glasses: Structure and properties, Type of Glasses, Fracture in glasses, Composite Materials: Introduction, their types and properties, Different types of bonding.

UNIT – II Phase Transitions Thermodynamics of phase transformation, Free-energy calculation, I and II order transformation, Hume-Rother rule, Solid solution and types of solid solutions, Phase rule, One-, Two- component systems, Eutectic and paratactic phase diagrams, Lever rule, phase diagrams of Mg- Al, Fe-C Kinetics of transformations, Homogeneous and heterogeneous nucleation, Growth kinetics.

UNIT – III Diffusion in Materials Mechanism of diffusion, Energy of formation and motion, Rate theory of diffusion, Einstein relation (relation between diffusivity and mobility), Fick's laws of diffusion and solution of Fick's second law, Kirkendal effect, Diffusion of vacancies in ionic crystals, Experimental determination of Diffusion coefficient.

UNIT – IV Transport Properties of Solids Electrical conductivity of metals and alloys, Extrinsic &intrinsic semiconductors and amorphous semiconductors, Scattering of electrons by phonons, Impurity,Carrier mobility and its temperature dependence, Mathiessio's rule for resistivity, Temperature dependence of metallic resistivity.

COURSE OUTCOMES:-

Students will have understanding of:

1. Different type of materials and their structure.
2. Structure dependence of various thermal, optical and mechanical properties.

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COURSE CODE: 6SMPH402

Discipline Specific Elective -III

PHYSICS OF NANO MATERIALS

COURSE OBJECTIVES:-

To provide knowledge about physics based nano processes, to design and conduct experiments relevant to nano physics as well as to analyse the results, to improve usage of physics for modern technology, to provide an adequate knowledge on various nano physics aspects.

Syllabus:

UNIT – I Free electron theory idea of band structure; metals; insulators; semiconductors; density of states in bands; variation of density of states with energy; band gap with size of crystal.

UNIT – II Nanotechnology definition of nanoscience & Nanotechnology. Structure of carbon nanotubes, nano wires; application of Nanotechnology in different field.

UNIT – III Quantum size effect idea of quantum well structure; quantum dots; quantum wires ; determination of particle size; increase in with of XRD peaks of nanoparticles; shift in photoluminescence peaks; variations in Raman spectra of Nanomaterials.

UNIT – IV Different methods of preparation of Nanomaterials cluster beam evaporation; ion beam deposition; chemical bath deposition with capping techniques and Top down, ball milling, Bottom up.

COURSE OUTCOMES:-

Students will have understanding of:

1. Fundamental principles of nanotechnology and their application.
2. Apply physical concepts to the nano scale and non – continuum domain.
3. Evaluate processing conditions to engineer functional nano materials.

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COURSE CODE: 6SMPH403

Discipline Specific Elective -IV
COMPUTATIONAL METHODS & PROGRAMMING

COURSE OBJECTIVES:-

To provide various numerical methods for solving differential and integral equations to physical equations.

Syllabus:

UNIT – I Programming in C Data type (int, float, double, char, long, long double etc.),Operators (Unary. Binary and ternary), Input /output statement (scan(), print()), Control statements (if, for, while, do while, switch -case-default), Function (Type of Function, Function definition, Function calling, Formal arguments, Actual arguments, Function prototype), Program structure, String (Array, character array), String manipulation functions like strlens(), strcpy(), strcat(), strecmp() etc.

UNIT – II Method for Determination of Zeros of Linear and Non-linear Algebraic Equation and Transcendental Equations Bisection method, Regula-falsi method, Secant method, Newton raphson method, Solutions of simultaneous linear equation, Gaussian elimination method, Pivoting, Iterative method, Matrix inversion.

UNIT – III Eigen Value Problems, Curve Fitting & Numerical Differentiation and Integration Eigen Value and Eigen Vectors of Matrices, Power and Jacobi method; Finite difference interpolation with equally and unequally spread points, Polynomial least squares and cubic sp-line fittings; Newton-Cotes Formulae, Error estimation, Gauss-Method.

UNIT – IV Numerical Solution of Ordinary Differential Equation& Numerical Solution of Partial Differential Equation Taylor's series method, Picard's Methods, Eular and Modified Eular's method, Runga-Kutta Methods, Predicators and Corrector method, Solution of Laplace equation, Solution of one dimensional heat equation, Classification of second order equation.

COURSE OUTCOMES:-

Students will have understanding of:

1. Uses of computer in various fields.
2. Various technique to solve differential and integral equations.

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COURSE CODE: 6SMPH404

Discipline Specific Elective -IV
COMMUNICATION ELECTRONICS

COURSE OBJECTIVES:-

To built up the concept integrated circuits and its application in the electronics and communications.

Syllabus:

UNIT – I Binary Logic, Digital Switching Circuits &Counters Binary number systems and other codes, Binary arithmetic, Boolean theorem, Syntheses of Boolean functions, Karnaugh diagram, Half and full adders, Demultiplexers, Multiplexers, D/A and A/D converters, Clock generator, RS flip flip-flop, T flip flop, JK flip flop, Master- Slave flip flop, Shift Register, Ripple counter, Decade counter, Up-down counter, Divide by n counters, Synchronous counters, Application of counters.

UNIT – II Operational Amplifier Differential amplifier circuit configurations: dual input balanced output dual input, single input unbalanced output (ac analysis) only, block diagram of a typical op amp analysis, Schematic symbol of an op- amp., Ideal op-amp., Op-amp parameters; Input offset voltage, Input offset current, Input bias current, CMRR, SVRR, Large signal voltage gain, Slew rate, Gain band width product, Output resistance, Supply currents power consumption, Inverting and non-inverting inputs.

UNIT – III Application of Operational Amplifier Inverting and non-inverting amplifier, Summing, Scaling and averaging amplifier, integrator and differentiator. Oscillator Principles: Oscillator types, Frequency, Stability response, The Phase shift oscillator, Wein-bridge oscillator, L-C tunable oscillator, Square wave generator.

UNIT – IV Digital Communications Pulse-Modulation system, Sampling theorem, Low pass and Band pass signals, PAM, channel BW for a PAM signal, Natural Sampling, Flat top sampling, Signals Recovery through Holding, Quantization of signals, Quantization, Differential PCM Delta Modulation, Adaptive Delta Modulation, CVSD.

COURSE OUTCOMES:-

Students will have understanding of:

1. Operational amplifier and its applications.
2. Knowledge of computer and wave from generator.
3. Construction working and applications 555 timer, they will also acquire the knowledge of digital to analog and analog to digital techniques.

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COURSE CODE: 6SMPH405

LAB I:-

COMMUNICATION ELECTRONICS & COMPUTATION

1. Study of Microprocessor 8086.
2. To write a program to perform subtraction X – Y where X & Y are 48 bit numbers.
3. To find the largest number form a block of 15 bytes.
4. To find the smallest number for a block of 15 bytes.
5. To write a program to add series of 20 bytes.
6. To write a program to compare two data blocks.

Note:-

- **Two experiments will be asked in the semester practical examination.**

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COURSE CODE: 6SMPH406

LAB II:-

ADVANCED COMPUTATION

1. To write an assembly language program to solve following arithmetic equation: 3AX+5DX+BP.
2. To write a program to arrange a data block in ascending order.
3. To write a program to arrange a data block in descending order.
4. To write a program to convert an 8-bit BCD number into equivalent binary.
5. To write a program to insert a specific data byte under certain given conditions.

Note:-

- **Two experiments will be asked in the semester practical examination.**

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PROJECT WORK & VIVA VOCE

PROJECT All the candidates of M.Sc.(Physics) are required to submit a project-report based on the work done by him/her during the project period. A detailed Viva shall be conducted by an external examiner based on the project report. Students are advised to see the detailed project related guidelines on the website of RNTU.
under Project Guidelines for student section.

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