DETAILED SYLLABUS

FOR

DISTANCE EDUCATION

POST GRADUATE PROGRAM

M.Sc(PHYSICS)

YEARLY SYSTEM

COURSE TITLE : MSc Phy
DURATION : 2 YEAR
MODE : SEMESTER
TOTAL DIPLOMA MARKS : 900

COURSE TITLE	***Paper Code***	***MARKS***				
		THEORY		***PRACTICAL***		***TOTAL MARKS***
		INTER-NAL	***EXTER-NAL***	***INTER-NAL***	***EXTER-NAL***	
Classical Mechanics	**MSCP/Y/110**	**40**	**60**	**NA**	**NA**	**100**
Mathematical Physics	**MSCP/Y/120**	**40**	**60**	**NA**	**NA**	**100**
Nuclear Physics	**MSCP/Y/130**	**40**	**60**	**NA**	**NA**	**100**
Solid State Physics	**MSCP/Y/140**	**40**	**60**	**NA**	**NA**	**100**
Electronic Devices and Circuits	**MSCP/Y/150**	**40**	**60**	**NA**	**NA**	**100**
Quantum Mechanics	**MSCP/Y/160**	**40**	**60**	**NA**	**NA**	**100**
Lab. Work	**MSCP/Y/170**	**NA**	**NA**	**40**	**60**	**100**
Lab. Work	**MSCP/Y/180**	**NA**	**NA**	**40**	**60**	**100**
SEMINAR	**MSCP/Y/190**	**NA**	**NA**	**NA**	**100**	**100**

CLASSICAL MECHANICS SUBJECT CODE: MSCP/Y/110

UNIT I

Lagrangian Formulation
Mechanics of a particle and system of particles, Constraints and generalized co-ordinates, D'Alembert's principle, Principle of Virtual work, Lagrange's equations of motion, Velocity dependent potential and dissipation function, Applications of Lagrange's equation of motion for systems like single particle in space, Atwood's machine, Bead sliding on rotating wire.

Hamiltonian Formulation
Hamilton's principle, Derivation of Lagrange's equations from Hamilton's principle, Hamilton's equation of motion, Cyclic co-ordinates and conservation theorems, Derivation of Hamilton's equations from Variational principle and principle of least action.

UNIT II

Canonical Transformation
The equations and examples of Canonical transformations, Harmonic oscillator, Poisson bracket, Poisson theorem, The angular momentum, Poisson bracket relation, Liouville's Theorem.

Two Body Central Force Problems
Reduction to the equivalent one body problem, The equivalent one dimensional problem, Classification of orbits, Virial theorem, Differential equations for the orbit, Integral power law potential, Kepler's problem, Motion and time in Kepler's problem, Scattering in central force field, Transformation of scattering problem to laboratory co-ordinates.

References:

1. Classical Mechanics (3rd Ed.) - H.Goldstein, Pearson Education
2. Classical Mechanics (I st Ed.) - N C Rana and P S Joag, Tata McGraw Hill
3. Classical Mechanics - S L Gupta and V Kumar (Pragati Prakashan)

MATHEMATICAL PHYSICS SUBJECT CODE: MSCP/Y/120

UNIT I

Special Functions
Bessel functions: Bessel function of first kind, Generating function, Recurrence relations, $J_n(x)$ as solution of Bessel function , Expansion of $J_n(x)$ when n is half an odd integer; **Legendre Polynomial:** Generating functions for $P_n(x)$, Recurrence relations and special properties, $P_n(x)$ as solution of Legendre differential equation, Orthogonality of $P_n(x)$.

Laplace and Inverse Laplace Transform
Conditions of existence, Laplace transformations of elementary functions, Basic theorem of Laplace transforms and its properties, Laplace transform of derivatives, Laplace transform of integrals.

Properties and related theorem for Inverse Laplace Transform, Inverse Laplace transforms of derivatives and integrals, Convolution theorem.

UNIT II

Gamma and Beta Functions: Definition of beta and gamma function in terms of Euler integrals, Evaluation of $\Gamma(1/2)$, Recurrence relation for gamma functions, Various forms of beta functions, Relation between beta and gamma functions, Evaluation of integrals using gamma functions.

Fourier Series and Transform: Fourier series, Dirichlet conditions, Expansion of periodic functions in Fourier series, Sine and Cosine transforms, Complex form of Fourier series, Fourier Integral theorem and Fourier Transform.

Fourier integrals, Physical applications of Fourier series analysis: Square waves (high frequencies), Full wave rectifier, Expansion of Riemann Zeta function.

References:

1. Mathematical Physics - B S Rajput
2. Mathematical Physics - B D Gupta
3. Mathematical Methods for Physicists - Arfken and Weber, Academic Press
4. Theory and Problems of Laplace Tranforms - Murray R Spiegel, Schaum's Series, McGraw Hill Pub.

NUCLEAR PHYSICS **SUBJECT CODE: MSCP/Y/130**

UNIT-I

Nuclear Properties
Survey of some nuclear properties, Nuclear radius, Nuclear masses and abundances, Binding energy, Electric and magnetic moments and nuclear shapes, Nuclear angular momentum and parity, Nuclear spin, Nuclear moments.

Nuclear Forces
Nuclear stability and the forces between nucleons, Deutron problem, n-p scattering at low energies, Scattering length, Spin dependence of n-p scattering, Effective range in n-p scattering.

Nuclear Models

Liquid drop model, Semi-empirical mass formula, Magic numbers, Shell model, The collective model.

UNIT-II

Nuclear Reactions

Types of nuclear reactions, Reaction cross-section, Conservation laws, Q-values and its significance, Breit-Winger formula, Compound nucleus, Optical model, Direct reactions.

Radiation Detectors

Interaction of radiation with matter, G.M. counter: Basic principle, working, quenching and mechanism of pulse formation; Gamma Ray Spectrometer: Basic principle and working of NaI(TI) detector, Pulse formation mechanism, Basic idea of pulse processing unit, Concept of energy resolution and efficiency;

Semiconductor detectors: Basic principle, Construction and working of Si Surface barrier, Lithium drifted and high purity Germanium detectors.

References:

1. Introductory Nuclear Physics - K.S.Krane
2. Nuclear Physics - Roy and Nigam (9th Edition), New Age Int.
3. Nuclear Physics - Irving Kaplan (2nd Edition), Narosa Pub.
4. Introductory Nuclear Physics - K S Krane, John Wiley
5. Nuclear Physics - D C Tayal, Himalaya Publication
6. Radiation Detectors - S S Kapoor

SOLID STATE PHYSICS SUBJECT CODE: MSCP/Y/140

UNIT-I

Crystal Structure

Basic Concepts, Crystal nomenclature, crystal structure, lattice planes and miller indices, Reciprocal lattice, Construction of reciprocal lattice, Relation between direct and reciprocal lattice vectors, Reciprocal lattice of simple cubic, bcc, fcc lattices. Origin of X-rays, Bragg's law, Laue method, Powder method and Rotating crystal method,

Free Electron Theory of Metals

Classical free electron theory, Drawbacks of Classical Theory, Relaxation time, Collision time and Mean free path, Quantum theory of free electrons, Fermi-Dirac Statistics and Distribution of Electrons in Solids, Effect of Temperature on F-D Distribution, Free Electron Gas in Three Dimension, Heat Capacity of Electron Gas, Electrical Conductivity and Ohm's Law, Matthiessen's Rule, Cyclotron Frequency, Hall Effect, Thermal Conductivity of Metals- Wiedemann-Franz Law.

UNIT-II

Band Theory of Solids

Introduction, Classification of Solids on the Basis of Band Theory, Bloch theorem, Nearly free electron model, origin of energy gap, magnitude of energy gap, Bloch theorem, The Kroning-Penney Model, The motion of electrons in one dimension according to the band theory, effective mass, concept of holes.

Superconductivity

Experimental Survey, Occurrence of Superconductivity, Destruction of Superconductivity by Magnetic Fields, Kondo Effect, Meissner Effect, Type I and Type II Superconductors, Thermal Properties of Superconductors, Magnetic Penetration Depth, Coherence Length., Ginzburg-Landau Coefficient, Isotope Effect, Thermodynamics of the superconducting transitions, London equation, Flux Quantization, Josephson Superconductor Tunneling, dc Josephson Effect, ac Josephson Effect, Applications of superconductors, High Temperature superconductors.

References:

1. Introduction to Solid State Physics - Kittel C (Wiley, INDIA)
2. Solid State Physics - Pillai S O (New Age Int.)
3. Solid State Physics - Kachhava C M (Tata McGraw Hill)
4. Science of Engineering Materials - Srivastava C M and Srinivasan C
5. Solid state physics - Gupta, Sexsena & Gupta
6. Elementary solid state Physics - M. Ali.Omar

ELECTRONICS DEVICES AND CIRCUITS SUBJECT CODE: MSCP/Y/150

UNIT-I

Bipolar Junction Transistor & its Biasing: Transistor Structure, Basic Transistor Operation, Transistor Characteristics and Parameters, Transistor as an Amplifier and as a Switch, DC Operating Point, Voltage Divider Bias.

Bipolar Junction Transistor Amplifiers: Amplifier Operation, AC Equivalent Circuit, Common-Emitter Amplifier, Common-Collector Amplifier, Common-Base Amplifier.

UNIT-II

Field Effect Transistor & its Biasing: JFET Structure, Basic Operation, JFET Characteristics and Parameters, JFET Biasing, MOSFET Structure & Operation, MOSFET Characteristics and Parameters.

Field Effect Transistor Amplifiers: FET Amplification, Common-Source Amplifier, Common-Drain Amplifier, Common-Gate Amplifier.

UNIT-III

Two Terminal Devices: Schottky (Hot-Carrier) Barrier Diodes, Varactor (Varicap) Diodes, Power Diodes, Tunnel Diodes, Photodiodes, Thermistors.

Thyristors and Other Devices: Basic 4-layer device, Silicon controlled rectifier (SCR), SCR applications: on-off control of current, half wave power control, SCR crowbar, Difference between power FET and SCR, DIAC, TRIAC, TRIAC phase control application, Silicon controlled switch (SCS), Uni-junction transistor (UJT).

UNIT-IV

Operational Amplifiers: Introduction, Basic Information of Operational Amplifier, Ideal Operational Amplifier, Inverting and Non-Inverting Amplifier, Differential Amplifier, Common Mode Rejection Ratio (CMRR), Emitter Coupled Difference Amplifier.

Operational Amplifier Characteristics: Introduction, DC Characteristics, Input Bias Current, Input Offset Current, Input Offset Voltage, Total Output Offset Voltage, Thermal Drift, Slew Rate.

References:

1. Electronic Devices - Floyd, 6th Ed, Pearson Education
2. Electronic Devices & Circuit Theory - Boylestad, 9th Ed, Pearson Education
3. Integrated Electronics - Millman & Halkias, TMH
4. Electronics Principles - Malvino, TMH
5. Linear Integrated Circuits - Choudhuri & Jain, New Age Int

QUANTUM MECHANICS SUBJECT CODE: MSCP/Y/0160

UNIT-I

Introduction to Quantum Mechanics

Inadequacy of classical mechanics, Operators and expectation values, Hermitian operator, Exchange operator and identical particles, Ehrenfest theorem, Postulates of quantum mechanics, Eigen values and eigenfunctions, Completeness of eigenfunctions, Uncertainty principle.

Matrix Algebra

Hermitian and Unitary matrices, Matrix transformation and diagonalization, Construction of unitary matrix, Representation of operators, transformation of operators with unitary matrices, Hilbert's space, Dirac's bra and ket notation. Time development of quantum system: Schroedinger, Heisenberg and interaction pictures, One dimensional harmonic oscillator problem in matrix formulation.

UNIT II

Angular Momentum

Orbital angular momentum, Representation in cartesian and polar coordinates, Commutation relations, General angular momentum, Eigen values and eigenfunctions of L^2 and L_z; J^2 and J_z.

Matrix Representation

Matrix representation of angular momentum operators, Spin angular momentum and Pauli's matrices, Addition of angular momenta, Clebsch-Gordon coefficients and its calculation for $j_1= j_2= 1/2$; $j_1=1$, $j_2= 1/2$, Properties of Clebsch-Gordon coefficients.

UNIT-III

Time Independent Perturbation Theory

Time independent perturbation theory for non-degenerate system up to second order perturbation, Physical applications of non-degenerate perturbation theory, The Variation (Rayleigh -Ritz) method with applications to ground state of helium, Zero point energy of one dimensional harmonic oscillator.

Time Dependent Perturbation Theory

Time dependent perturbation theory, Transition probability: Fermi-Golden rule, Harmonic perturbation, Adiabatic approximation, Sudden approximation, Application of time dependent perturbation theory to transition probability for induced absorption and emission, Selection rules.

UNIT-IV

Quantum Theory of Scattering-I

The scattering amplitude and cross section, Green's functions in scattering theory and expression for scattering amplitude, Born Approximation, Condition for validity of Born Approximation, Scattering by a screened Coulomb Potential, Rutherford's scattering formula from Born Approximation.

Quantum Theory of Scattering-II

Scattering by spherically symmetric potentials: Method of partial waves, phase shift, Scattering amplitude in terms of phase shift, Differential and total cross-sections, Optical theorem, Relation of phase shift with potential.

References:

1. Quantum mechanics (3rd edition) - L I Schiff, McGraw Hill
2. Introduction to quantum mechanics - Richard Liboff, Pearson Education
3. Quantum mechanics - A K Ghatak and S Loknathan, McMillan Publ
4. Quantum mechanics - J L Powell and B Crasemann, Narosa, New Delhi
5. Quantum mechanics - M P Khanna, Har-Anand Publ Delhi
6. Quantum Mechanics (third edition) - Eugen Merzbacher

LAB. WORK **SUBJECT CODE: MSCP/Y/170**

1. Study of transistor amplifier (RC coupled) cum feedback amplifier.
2. Study of power supply (solid state).
3. Study of modulation and demodulation with built in carrier frequency.
4. Study of an integrated circuit regulator.
5. Determination of temperature coefficient of junction voltage and energy band gap.
6. Study of basic Operational Amplifier.
7. Study of characteristics of Semiconductor diode.
8. Determination of reverse saturation current I_o and material constant η.
9. To determine dead time of a given G.M. Counter.
10. To determine energy of the pure β-emitter using G.M. Counter and Al absorbers.

LAB. WORK **SUBJECT CODE: MSCP/Y/180**

1. To study the propagation loss in optical fiber.
2. To study the bending loss in optical fibers.
3. To measure the numerical aperture (NA) of the fiber.
4. Estimation of splice loss due to misalignment at a fiber joint.
5. Construction of some simple intensity modulated fiber optic sensors for measurement of pressure.
6. To calculate the wavelength of laser light by double slit.
7. To determine grating element of a given diffraction grating.
8. To measure the angle of the wedge of a transparent plate using He-Ne leaser.
9. To determine the wavelength of laser light with a transmission grating.
10. To measure the wavelength of He-Ne laser light with a vernier caliper.