COURSES OF STUDIES

M.Sc DEGREE UNDER SEMESTER SYSTEM IN GANGADHAR MEHER UNIVERSITY, AMRUTA VIHAR, SAMALPUR

SCHOOL OF PHYSICS

GANGADHAR MEHER UNIVERSITY, AMRUTA VIHAR, SAMALPUR-768004, ODISHA

FIRST SEMESTER			
Course No.	**Name of the course**	**Marks**	**Credit**
PHY-101	Mathematical Methods of physics	80+20	4CH
PHY-102	Classical Mechanics	80+20	4CH
PHY-103	Computer Programming and Numerical Analysis	80+20	4CH
PHY-104	Quantum Mechanics-I	80+20	4CH
PHY-105	Computer Programming in Physics-(Lab)	100	6CH
SECOND SEMESTER			
PHY-201	Classical Electrodynamics	80+20	4CH
PHY-202	Basics Nuclear Physics	80+20	4CH
PHY-203	Basics Solid State Physics	80+20	4CH
PHY-204	Quantum Mechanics-II	80+20	4CH
PHY-205	Optics(Lab)	80+20	4CH
PHY-206	Introduction To Biophysics	100	6CH
THIRD SEMESTER			
PHY-301	Relativistic Quantum Mechanics	80+20	4CH
PHY-302	General Theory of Relativity	80+20	4CH
PHY-303	Electronics (Special Paper-I)	80+20	4CH
PHY-304	Condensed Matter & material Physics	80+20	4CH
PHY-305	Modern Physics(Lab)	80+20	4CH
PHY-306	Environmental Physics	100	6CH
FOURTH SEMESTER			
PHY-401	Statistical Mechanics	80+20	4CH
PHY-402	Particle Physics	80+20	4CH
PHY-403	Electronics (Special Paper-II)	80+20	4CH
PHY-404	Electronics (Special Paper-III)	80+20	4CH
PHY-405	Practical		
	(A)Experiments on Special Paper	100	6CH
	(B)Experiments on Special Paper		
	Project/Dissertation		

FIRST SEMESTER
COURSE IN DETAILS

Course No. PHY- 101:Mathematical Methods in Physics
Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. **Complex Variables:**
   Analytic functions, contour integrals, Laurent's series, the residue theorem, evaluation of single and multivalued functions, branch points and branch points and branch cuts, contour integration involving branch point.

Unit-2

2. **Tensors:**
   Introduction, Types of tensors, Invariant tensor, epsilon tensor, Pseudo tensor, The Algebra of tensor, Quotient law, covariant derivative of tensor, Fundamental Tensor, Cartesian tensor, Christoffel symbol.

Unit-3

3. **Group Theory:**
   Definition of groups, Sub groups and classes, Cayley's theorem, Group representations, Characters, Irreducible representations of SU(2) and O(3) groups.

Unit-4

4. **Special Function:**
   Legendre polynomials, generating functions, Recurrence formulae, orthogonality properties of Legendre's polynomial of 1stkind , Bessel generating function, recurrence formulae, orthoganality properties of Bessel's polynomials, Fourier and Laplace transform.

Text books:

1. Mathematical Methods of physics by Mathews and Walker (W.A. Benjamin Inc)
2. Elements of Group Theory by A.W. Joshi (New Age Publisher)
3. Matrices and tensors in Physics by A.W. Joshi (New Age International Publisher)
4. Mathematical Methods for Physicist by G.Arfken and H.Weber, Academic Press (Elsevier)

Reference Books:

1. Mathematical Physics by B.D. Gupta(Vikas publishing house)
2. Mathematical physics by P.K. Chattopadhyaya (New age international)

Course No. PHY- 102: Classical mechanics

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit -1

1. Kinematics of rigid body motion:
Independent co-ordinates of a rigid body, orthogonal transformations ,Eulerian angles, infinitesimal rotations, rate of change of vector, coriolisforece, angular momentum and kinetic energy of motion about a point , inertial tensor and the moment of inertia , eigen values of inertial tensor and the principal axis transformation , methods of solving rigid body problems and Euler's equations of motion, torque free motion of a rigid body , Heavy symmetrical top with one point fixed.

UNIT-2

2. Hamiltonian formulation:
Calculus of variations and Euler-Lagrange's equation, Brachistrochrone problem, Hamilton's principle, extension of Hamilton's principle to nonholonomic systems, Legendre transformation and Hamilton equations of motion, Physical significance of Hamiltonian, Derivation of Hamilton's equation of motion from a variational principle, Routh's procedure, principle of Least action.

UNIT-3

3.Canonical Transformations:
Canonical transformation, types of generating function, conditions for canonical transformation, integral invariance of Poincare, Poisson bracket, Poisson's theorem, Lagrange bracket, Poisson and Lagrange brackets as canonical invariant, infinitesimal canonical transformation and conservation theorems, Liouville's theorem
Hamilton Jacobi Theory:
Hamilton-Jacobi equation for Hamilton's principle function, harmonic oscillator and kepler problem by Hamilton-Jacobi method, action-angle variables for completely separable system, kepler problem in action angle variables.

UNIT-4

4.Small Oscillation:
Problem of small oscillation, Example of Two coupled oscillator, General theory of small oscillations, normal coordinates and normal modes of vibration.

Text book:

1.Classical mechanics by H.Goldstein(Addison-Wesley)

Reference books:

1.classical mechanics by S.N.Biswas, Books and allied Publisher Ltd.
2.Classical Mechanics by J.C Upadhya , Himalay Publishing House.
3.Classical Mechanics by Landau and Liftshitz(Butter Worth)

Course No. PHY-103: Computer Programming and numerical Analysis

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

UNIT-1

1.**FORTRAN 77:** Data types, expression ,statements, input and output commands, condiyional and interactive constructs, character and data managements, array manipulation, subprogram,subroutine.

UNIT-2

2.Fortran programs for problems like numerical integration by trapezoidal and simsonmethod,finding the root of an equation by Newton-Rapson method, finding prime numbers,Runga-Kutta method, interpolation sorting and similar other problems.

UNIT-3

3.Numerical Analysis-1:

Solution of simulation linear equation, Gaussian elimination , pivoting, Iterative Method, Matrix inversion, Root of a transcendental equation by Newton Rapson Method, Least square fitting.

UNIT-4

4.**Numerical Analysis-2:** Eigen values and eigen vector of matrices, power and Jacobi method, finite differences , Interpolation with equally spaced and unevenly spaced points (Newton's and Lagrange's method), Forward and backward interpolation , Extrapolation, Numerical Integration by Trapizoid and Simpson's rule, Solution of first and second order differential equation using Runge-Kutta method .

Text books:

1.Fundamentals of computer by V. Rajaraman, Prentice Hall of India Ltd Punlisher.
2.Numerical Mathematical Analysis by J.B Scarborough , Oxford and IBH Publishing Company.

Reference book:

1.Numerical methods for engineering and scientific computation by M K Jain(Wiley Eastern)
2.Computer programming in Fortran-77 by V.Rajaraman , Prentice Hall of India Ltd Publsihers.

Course no- PHY-104: Quantum Mechanics-I

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. General Principals of Quantum Mechanics:

Linear Vector space, Ket and Bra vectors, scalar product of vectors and their properties, Dirac delta function, Linear operators, Adjoint operators, Unitary operators, Expectation Values of dynamical variables and physical interpretation of Hermitian operators, Eigen values and eigen vectors, orthonormality of eigen vectors, Probability interpretation, degeneracy,Schmidt method of orthogonalisation.

Expansion theorem, completeness and closure properties of the basis sets, coordinate and momentum representations, compatible and incompatible observables, commutator algebra, uncertainty relation as a consequence of non-commutability, minimum uncertainty wave packet, representations of Ket and Bra vectors and operators in matrix form, Unitary transformation of basis vectors and operators.

Unit-2

2. Quantum Dynamics:

Time evolution of quantum states, Time evolution operator and its properties, Schrodinger, Heisenberg and Interaction picture, Equations of motion, Operator method solution of Harmonic Oscillator problem, Matrix representation and time evolution of creation and anhillation operators.

Unit-3

3. Rotation and Orbital Angular Momentum:

Orbital angular momentum operators as generators of rotation, L_x, L_y, L_z and L^2 and their commutation relations, Raising and Lowering operators (L_+, L_-), L_x, L_y, L_z and L^2 in spherical polar coordinates, Eigen values and Eigen functions of L_z and L^2 (operator method),Matrix representation of L_x, L_y, L_z and L^2.

Unit-4

4. Spin angular momentum

Spin ½ particles, Pauli's spin matrices and their properties, Eigen values and Eigen functions,Spin and rotations.

Total angular momentum: Total angular momentum J, Eigen value problem of J_z and J^2, Angular momentum matrices, addition of angular momentum and C.G. coefficients for the states with (i) $J_1=1/2$ and $J_2=1/2$ (ii) $J_1=1$,$J_2=1/2$

Text Book:

1. Quantum Mechanics concepts and Applications by NouredineZettli, John Willey and sons Publications.

Reference books:

1. Quantum mechanics by L.I. Schiff, International Student edition
2. Quantum mechanics by D. Griffith, Pearson Publication
3. Quantum Mechanics by S. Gasiorowicz, John Wiley Edition
4. Quantum Mechanics by Eugene Merzbacher, Wiley International edition

Course no-PHY-105: Computer Programming in Physics

(Laboratory work- Total Marks-100

1. Numerical Integration by Trapezoidal method
2. Numerical Integration by Simpson method
3. Solution of 1^{st} and 2^{nd} order differential equation by Rungakutta method
4. Matrix addition, subtraction, multiplication and manipulation
5. Matrix Inversion
6. Finding the roots of an equation by Newton- Raphson Method
7. Least square fitting of linear parameters
8. Determination of prime numbers
9. To arrange a set of numbers in increasing or decreasing order
10. Sum of A.P and G.P series, sine and cosine series
11. Factorial of a number
12. Evaluation of log and exponentials by summing of series
13. Any other suitable experiments

Any other experiments that can be set up from time to time.

SECOND SEMESTER

Course No.PHY-201: Classical Electrodynamics

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. Wave equations interms of Lorentz & Coulomb gauge for potentials, solution by Fourier analysis using Green function, Radiation field, Radiation energy, Hertz potential, Computation of radiation fields by Hertz method, electric dipole radiation and magnetic dipole radiation, power radiated by centerfed linear antenna with linear and sinusoidal approximation of current

Unit-2

2. Field of unifoimly moving electron, Lienard-Wiechart potential, Fields of a charge in uniforrn motion, TE & TM modes in diaelectric slab , Wave guide , Cylindrical waveguides and cavity, modes of rectangular wave guides with conducting walls.

Unit-3

3. Radiation from an accelerated charge, Fields of an accelerated charge, radiation at low velocity, case of velocity parallel to acceleration, larmour's formula, radiation from circular orbits, Radiation with no restriction on the acceleration or velocity, Classical cross section for bremstrahlung in a Coulomb field, Cherenkov radiation.

Unit-4

4. Radiation, Scattering and dispersion: Radiative damping of a charged harmonic oscillator, scattering by a small dielectric sphere in long wavelength limit, scattering by an individual free electron (Thomson Scattering), Scattering by a bound electron(Rayleigh Scattering), Dispersion relation for dielectric, conductor and plasma.

Reference books:

1. Classical Electricity and Magnetism by W.K.H. Panofsky and M.Phillips (Addition-Wesley)
2. Classical Electrodynamics-J.D.Jackson, John Wiley and Sons.
3. Introduction to electrodynarnics- D.J.Griffiths, Pearsons Publishers.

Course No. PHY-202: Basic Nuclear Physics
Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. (A) Brief Discussion of Nuclear Properties: Nuclear Radius, Nuclear Ma, and Binding Energy, Angular Momentum, Parity and Symmetry, Magnetic Dipole Moment and Electric Quadruple Moment. (B) Two Nucleons Bound State Problem: Central and non central force, the deuteron, tensor forces, magnetic moment and quadruple moment of deuteron.

Unit-2

2. Nucleon Scattering Problem: n-p scattering at low energy, scattering cross section and scattering length, effective range theory. Nuclear force: Meson theory of nuclear force, Yukawa interaction

Unit-3

3. Nuclear Reactions and nuclear energy: Nuclear reaction and resonances, Breit-Wigner formula for s-waves, compound nucleus. Liquid drop model, Bohr-Wheeler theory of fission, nuclear fusion

Unit-4

4. Nuclear Models: Single particle model of nucleus, magic numbers, spin-orbit coupling, angular moment and parities of nuclear ground states, magnetic moments and Schmidt lines, Collective model of Bohr and Mottelson.

Text Book:

1. Nuclear Physics by R.R. Roy and B.P. Nigam (John Wiley)

Reference Books:

. 1. Physics of the nucleus by M.A. Preston (Addison Wesley)
2. Nuclear Physics by S.S.M. Wong (Prentice Hall)
3. Introduction to Nuclear Physics by H. A. Enge (Addison Wesley)

Course No PHY-203: Basic Solid State Physics
Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. Crystal Binding: Crystals of inert gases, Ionic crystals, covalent crystals, Metals Lattice DynamicsVibrations of a mono atomic linear chain, Vibration of a diatomic linear chain, Dispersion relations, Acoustic and Optic modes, Long-wavelength limits

Unit-2

2. Specific heat of insulators: Phonon heat Capacity, Debye model for density of states, Debye T ‘law, Einstein’s theory of the specific heat Free Electron Fermi gas-Energy levels in onedimension, Effect of temperature on the Fermi-Dirac distribution function, Free electron gas in three dimension, Heat Capacity of the electron gas, Electrical conductivity and Ohm’s law, Motion in magnetic fields, Static magneto-conductivity tensor, Hall effect, Thermal conductivity of metals, Wiedemann- Franz law

Unit-3

3. Energy bands: Nearly free electron model, origin of the energy gap, Bloch functions, KronigPenney model, Wave equation of electron in a periodic potential, restatement of Bloch theorem, solution of the central equation, approximate solution near a zone boundary, number of orbitals in a band, metals and insulators

Unit-4

4. Semiconductor crystals: Band gap, Holes, effective mass, intrinsic carrier concentration, intrinsic mobility, impurity conductivity, donor states, acceptor states, thermal ionisation of donors and acceptors. Defects -Classification of defects, Point defects- Schottky and Frenkel defects, Diffusion and ionic conductivity. Dielectrics-local electric field at an atom, Lorentz field, field of dipoles inside cavity, dielectric constant and polarisability-Claussius-Mossotti relation, Mechanisms of electronic ionic and orientationalpolarisability.

Text Book-:

1. Introduction to Solid State Physics by C. Kittel, 7th edition, (John-Wiley, 1996)

Reference books:

1. Introduction to the theory of Solid State Physics by J. D. Patterson (Addison- Wesley,1971)
2. Solid State Physics by N. W. Ashcroft and N. D. Mermin , (Harcourt Asia PTE Ltd.) • sits of Condensed Matter by PrasantaK.Misra (Academic Press, 2010)
3. Physics by Condensed matter by Prasantk.Mishra (Academic press, 2010)

Course No. PHY-204: Quantum Mechanics-II
Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. Motion in a spherically symmetric field: Hydrogen atom, Reduction to equivalent one body problem, radial equation, Energy eigen values and eigen functions, Degeneracy, Radial probability distribution, free-particle problem, Expression of plane waves in terms of spherical waves

Unit-2

2. Approximate methods: stationary perturbation theory, Rayleigh Schrodinger method for nondegenerate case, first and second order perturbation, anharmonic oscillator, general theory for the degenerate case, removal of degeneracy, linear Stark effect, normal Zeeman effect.

Unit-3

3. Time-dependent perturbation theory: Transition probability, constant and harmonic perturbation, Fermi Golden rule. Variational method: Ground state of He atom. W. K. B. method: connection formulas, Bohr-Sommerfeld quantization rule, Harmonic oscillator and cold emission.

Unit-4

4. Scattering amplitude and scattering cross section, Born approximation, application to Coulomb and screened Coulomb potentials, Partial wave analysis for scattering, optical theorem, scattering from a hard sphere, resonant scattering from a square well potential, Identical particles, Symmetric and antisymmetric wave function, Coulomb and exchange interactions

Text Book:

1. Quantum Mechanics concepts and Applications by NouredineZettili, John Wiley and sons, Publications

Reference books:

1. Quantum Mechanics by L. I. Schiff, International Student edition
2. Quantum Mechanics by D. Griffith, Pearson Publishers
3. Quantum Mechanics by S. Gasiorowicz, John Wiley edition
4. Quantum Mechanics by Eugene Merzbacher, Wiley International Editi

Course No. PHY-205 : Optics (Laboratory work)

Total Marks: 100

1. Experiments with optical bench Biprism Straight edge and narrow wire
2. Experiments with spectrometer: Single and Double split
3. Experiments with Michelson interferometer : Determination of A and a Thickness of mica sheet
4. Fabry Perot interferometer 5. Polarization Experiments
    a. Babinet compensator
    b. Edsar-Butlerbands
    c. Quarter wave plate
    d. Mallus Law
    e. Study of elliptical polarized light
5. Constant Deviation Spectrograph
    a. Calibration
    b. Zeeman effect
6. Babinet Quartz Spectrography

8. Any other suitable experiments

Any other experiments that may be set up from time to time

Course-PHY-206 (A) : INTRODUCTORY BIOPHYSICS

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit -1

1. Thermodynamics NEW-Laws of thermodynamics, concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimctry, chemical kinetics — rate, order, molecularity of reactions and energy of activation.

Unit -2

2. Redox potential T3MEEET Oxidation and reduction, redox potential and its calculation by Nernst equation, examples of redox potential in biological system.

Unit -3

3. Bioenergetics :- Energy requirements in cell metabolism, role and structure of mitochondria, high energy phosphate bond, electron transfer phenomenon and biological transfer.

Unit -4

4. **Biophysical properties :-** surface tension, adsorption, diffusion, osmosis, dialysis and colloids Molecular alphabets of lifes amino acids, nucleic acid bases and lipids, classification and properties of amino acids, peptides and poly peptides. Nucleoside, nucleotides, poly-nucleotides. pentose and hexose poly saccharides.

References books:-

1. Physical Chemistry for Life Sciences by Barrow C, MC-Grow Hill
2. Biophysical Chemistry by Bloomfield V A and Harrington R E, WA Freeman and Co.
3. Biophysical Chemistry by Cantor C R and Schimmel. P R, WA Freeman and Co. J.
4. Protein, by Hasehernyer R N and Hasehemyer ACBV. John Willy and Sons
5. Aspects of Biophysics, Hughe S W, John Willy and Sons.
6. Introduction of Biophysics by Pranab Kumar Bosom's. S Chand and Co.
7. Principles of Nuclic acid structure by Saenge W. Springer-verlag.
8. 8.Principles of Protein Structure by Schule G E and Schirmer R H. Sprin.ger-Verlag.
9. Biochemistry by Stryer I., W A Freeman and Co.
10. Essentials of Biophysics by P Narayanan, New Age International Publishers.

THIRD SEMESTER

Course No. PHY-301: Relativistic Quantum Mechanics and Field Theory

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Relativistic quantum mechanics :

Unit – 1

1. Brief introduction to Relativistic quantum mechanics, Notations, Klein-Gordon equation and its drawbacks, Charge and Current densities, Positive and negative energy states, Dirac's Hole theory, Free particle Dirac equation, Properties of the Dirac Matrices, Continuity Equation, Spin of electron .

Unit – 2

2. Plain wave solutions of Dirac Equation, Normalization of the wave function, Dirac equation in an electromagnetic field, its non relativistic correspondence, magnetic moment, Dirac equation for a central potential, spin-orbit coupling, Covariant form of the Dirac equation, Proof of Lorentz covariance, Properties of the gamma-matrices.

Field Theory:

Unit 3:

3. Concepts of fields, Classical field equation, Noethe'stheorm and conservation law, Gauge invariance and charge conservation, Creation, Annihilation and number operators.

Unit 4:

4. Field quantization : (a) neutral scalar meson field (b) charged scalar meson field (c) Dirac-field .

Text book:

1. Relativistic quantum field theory by J.D. Bjorken and S.D. Drell, Mc Graw-Hill Book Company

Reference Books:

1. Lectures on Quantum field theory, Ashok Das (World Scientific Publishing Co. Pvt. Ltd.)
2. Introduction to quantum field theory by P. Roman
3. Quantum mechanics and Field Theory by B.K. Agrawal, Asita Publishing House.

Course No. PHY- 302: General Theory of Relativity

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. Special theory of relativity: Lorentz transformation; 4 vectors, tensors and its transformation properties, Contraction, Symmetric and antisymmetric tensors; 4- dimensional velocity and acceleration; four- momentum and four force; Covariant equations of motion, Relativistic kinematics (decay and scattering), Lagrangian and Hamiltonian of a relativistic particle`

Unit-2

2. The equivalence principle, The weak and strong principle of equivalance, The equation of Motion in presence of Gravitational force, The affine connection, The transformation of Affine connection, Covariant derivatives.

Unit -3

3. The Newtonian Limit: Relation between g00 and the Newtonian potential, Time dilation in a Gravitational Field, Red shift of spectral lines, The Solar red shift.

Unit -4

4. Definition of Curvature tensor, Algebraic Properties of the curvature tensor, Ricci Tensor and Curvature Scalar, Bianchi identities.
   Einsteine's filed Equations, Energy, Momentum and Angular Momentum of Gravition.

Text Books:

1. Special theory of Relativity, Robert Resnick, Oxford University
2. Gravitation and Cosmology by Steven Weinberg, Jon Willey and Sons

Reference Books:

1. Introducing Einsteins's Relativity by Ray D Inverno, Clarendon Press
2. An introduction to General Relativity and Cosmology by Tail. Chow , Springer
3. Principle of Cosmology and Gravitation by M. Berry, Cambridge University
4. Special Theory of Relativity, Robert Katz D. Van, Nostrond Company, INC

Course No- PHY-303: Electronics (Special-I)

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

UNIT – 1

Electronic Network & Network Theorems

Mesh and node circuit analysis, reduction of network, conversion between T And Pi sections, bridged T & Lattice networks, superposition theorems, reciprocity theorem ,Thevenin's theorem, Norton's theorem, composition theorem and maximum power transfer theorem, driving point impedance transfer impedance.

Conduction in the Solid State

The intrinsic semiconductor, n & p materials, charge densities in n & p materials , conduction by charge drift, conduction by diffusion of charge, the p-n junction, the p-diode equation.

UNIT – II

Bipolar transistor and FET

The bipolar junction transistor, current and voltage notation, currents and current gains, volt ampere relations for the bipolar junction transistor, the load line, the small signal requirement, voltage breakdown, the Ebers - Moll model Field, - effect transistor , the MOS field effect transistor, circuit characteristics of FET.

Unit - III

Active Networks & Transistor

Two port network analysis, controlled sources, active circuit model, transfer impedances, gain in decibels, an equivalent circuit for the BJT, the trans conductance model, the common-emitter amplifier, the common-base amplifier, the common collector amplifier, summary of amplifier performance, conversion of the h parameters, the equivalent circuit for the FET, the common- source amplifier, the source follower circuit.

Unit- IV

Feedback Principle

An amplifier "Black Box" with feedback, stabilization of gain by negative feedback. Reduction of non linear distortion by negative feedback, effect of feedback on output Resistance, effect of feedback on input resistance, Voltage - series feedback, Voltage – shunt feedback, Current - series feedback

Bias for Transistor Amplifier

Location of the quiescent point for the bipolar transistor, variation of the bias current, fixed bias, emitter-feedback bias, design of an emitter-feedback bias circuit, bias Tor the FET, Voltage - feedback bias, bias for the emitter follower.

Course No-PHY-304: Condensed Matter and Material Physics

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-I

Quantisation of lattice vibration:

Phonons normal coordinate transformation creation and annihilation operators methods of band calculation-tight binding method, OPW and pseudo-potential methods For surface de Haas Van Alphen effect Transport theory Boltzmann equation, relaxation Time approximation electrical conductivity and thermal conductivity.

Unit-2

Electron - electron interaction:

Introduction, Hartree - Fock approximation, Hartree - Fock theory for helium Density functional theory general formulation. Local Density approximation –

Unit-3

Superconductivity:

Occurrence of superconductivity, Meissner effect, Type- l and II superconductors; energy gap, Isotope effect, Theoretical Surveys: Occurrence Thermodynamics of superconducting transition, London equations, coherence length, Qualitative Ideas about the BCS theory, Single particle tunnelingjosephson effect.

Unit-4

Advanced Superconductivity:

Electron - phonon interaction, Microscopic theory of superconductivity, quasi lectrons, Copper pairs, BCS theory , Ground State of superconducting electron gas, elementary ideas of high TC Superconductors.

Text book

1. Physics of Condensed Matter ByPrasantaK.Misra (Academic Press, 2010)
2.Quantum Theory of Solid State by Callaway Academic Press

Reference books

1. Principles of the theory of solids, J.M.Ziman, Cambridge, University press
2 Solid State Physics By C. Kittel, clin Wiley and sons, In Singapore.

Course No- PHY-305 Modern Physics
(LABORATORY WORK)
Full Mark – 100 Marks

1.Determination of e/m by

I) Braun tube method

II) Magnetron Valve method

2. Determination of Planck's constant (h) by

Photoelectric effect methods

3.Measurement of velocity of light by Lecher wire

4.GM counter experiments:

I) Characteristics of the Geiger tube

II) Inverse Square Law.

III) Absorption coefficient of the aluminium foil.

5. Characteristics of Diode and Zener diode.

6.Study of logic gates AND, OR NOT, NAND, NOR, XOR

7.Making AND, OR, NOT Gates using NAND Gates.

8.verification of Boolean Algebra.

9. Verification of Dual nature.

10. Characteristics of FET (Field Effect Transistor).

Course No- PHY-306: ENVIRONMENTAL PHYSICS

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit - I

The human environment:

Laws of thermodynamics: First law, Second law and third law of thermodynamics, Laws of thermodynamics and the human body, Energy and metabolism First law of thermodynamics and the human body. Second law of thermodynamics and the human body, Energy transfer Conductor , Convection, Radiation, Evaporation, survival in cold climates, survival in hot climates.

Unit-2

Atmosphere and radiation:

Structure and composition of the atmosphere Residence time Photochemical pollution, Atmospheric aerosol, Atmospheric pressure, Escape velocity Ozone. Ozone hole Ozone in polar region, Terrestrial radiation, Earth as a black body, Greenhouse effect, Greenhouse gases, Global warming.

Unit-3

Wind

Measuring the wind, Physics of wind creation: Principal forces acting on air masses Gravitational force, Pressure gradient, Coriolis inertial Force, Frictional force, Cyclones and anticyclones: Global convection, Global wind patterns

Unit-4

Energy for living

Fossil fuels, Nuclear power, Renewable resources: Hydroelectric power. Tidal power, Wind power, Wave power, Biomass, Solar power, Solar collector, Solar photovoltaic.

Text Book:

1. Environmental physics by M. Dzelalija,

University of Molise , University of Split , Valahia University of Targoviste

Course No. PHY 401: STATISTICAL MECHANICS

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

UNIT -1

1. Classical statistical Mechanics :

Postulates of classical statistical mechanics , Liouville's theorem micro – canonical ensemble , derivation of thermodynamics , equipartition theorem ,Classical ideal gas , Gibb's paradox , canonical ensemble , density fluctuation in grand canonical ensemble , equivalence of canonical and grand canonical ensemble .

UNIT – 2

2. Quantum Statistical Mechanics :

Postulates of quantum statistical mechanics , density matrix , Liouville's theorem, ensembles in quantum statistical mechanics , third law of thermodynamics , ideal gases in micro – canonical and grand canonical ensemble , particle in a box , Maxwell -Boltzmann , Boltzmann –Einstein and Fermi – Dirac distributions .

UNIT – 3

3. Fermi gas : Equation of state of ideal Fermi gas , Theory of white dwarf stars , Pauli paramagnetism

UNIT – 4

4. Bose gas : Ideal Bose gas , photon , plank's law , Bose - Einstein condensation .

Phase Transition : 1st order and 2nd order phase transitions, Isingmodel (one dimensional)

Text Book :

1. Statistical mechanics - k . Huang , Wiley India

Reference Books :

1. Statistical mechanics - Landau and Lifshitz , ButterWorth
2. Statistical mechanics – R.K Patheria , P.D Beale 3rd Ed, ButterWorth
3. Fundamental statistical and thermal physics – F.Reif , Tata Mc Graw – Hill Edition
4. Elementary statistical mechanics , C. Kittel , Dover Publications.

Course No. PHY-402: Elementary Particle Physics

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

UNIT-1

1.Histrorical introduction to the Elementary Particles, Classification of elementary particles and their interactions: Photons, Leptons Quarks Mesons. Lepton number , Baryon number, color quantum number, Strangeness quantum number.

UNIT-2

2.Charge independence of nuclear forces , Isospin , Test for isospin conservation , Associated production of strange particles, Gell-Mann Nishijima scheme, conservation laws in relation to particle reaction particle reactions and decays.

UNIT-3

3. Discrete Symmetry: Parity(P): Parity in quantum mechanics and field theories, Test of parity. Time revarsal(T): Time reversal in quantum mechanics and Field theories , Test of

time revarsal charge conjugation (C) :additive quantum number , charge conjugation in field theories , Test of charge conjugation, CPT theorem and its consequences.

UNIT-4

4.Unitary symmetry :SU(2),SU(3), concept of I-Spin ,U-spin ,V-Spin, Su(3) quark model, the Eight fold way, Mesons and Baryons in the octet representation , the baryon Decouplets , Evidence of color, Baryon Meson coupling.

Test Books:

1.Introduction to elementary particles by D. Griffiths.

Reference Book

1.Elementary particles physics by Gasiorwicz.
2.Modern elementary particle physics by G.Kane, addition-Weslaey Publishing Company.
3. Quarks and leptons by F. Halzen and A.D. Martin world scientific Singapore

Course No. PHY 403: Electronics (SPECIAL PAPER-II)

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. Frequency response of Linear Amplifier

The RC coupled CE amplifier, the frequency response of the RC amplifier, Gain frequency plots of amplifier response, Band width of cascaded amplifier, Band width criteria for the transistor, the gain-, Band width product, Band width increased with negative feedback, bootstrapping the FET, amplifier stability wish feedback, noise in amplifiers.

2. Tuned and Wide Band Amplifier

Band pass amplifiers, the parallel resonant circuit, Impedance variation at frequencies near resonance, Band width of the parallel resonant circuit, transformation from series-resistance form, inductive coupled circuits, the tuned primary amplifier, the tuned secondary FET amplifier, Impedance, Adjustment with tapped circuit, the double tuned transformer.

Unit-2

1. Operational Amplifier

Integrated amplifiers, Differential amplifiers,rejection of common mode signals, the OP-AMP, input and output impedance, the slew rate, input offset voltage, input offset current

2. Application of Operational Amplifier

The Operational Amplifier; the unity gain buffer, the adding operation; comparator; logarithmic amplifiers;, integrator; analog computer

Unit-3

1. Power Amplifier

Operating conditions for power amplifiers, power relations, the class A power amplifiers, transistor operating temperatures, thermal stability of the power amplifiers, the push pull principle, the classB push pull amplifiers, the classB linear radio frequency amplifiers, the class C resonant load amplifier.

Unit-4

1. Oscillator Principles

Feedback requirements for oscillations, circuit requirement for oscillations, basic oscillator analysis, piezoelectric frequency control, resistane-capacitance oscillator.

Course No. PHY 404 :Electronics (SPECIAL PAPER-III)

Total Marks: 100 (End Term Theory- 80 + Mid Term Theory -20)

Unit-1

1. Modulation and Frequency Conversion

Fundamental of modulation, frequency spectrum in amplitude modulation, powerin the AM wave, methods of amplitude modulation, the modulated class C amplifier,efficiency modulation, linear demodulation of AM signals, automatic volume control,frequency conversion, the SSB system, the balanced modulation, the product detector, thefrequency spectrum for FM, diode FM generation, the amplitude limiter, FM demodulationwith the discriminator.

2. Special Semiconductor Devices

Principle, working and application of UJT, SCR TRIAC, Zener diode, tunnel diode,impatt diode, photoconductor, photovoltaic cell, solar cells.

UNIT - II

1. Digital Circuits

The binary number system and other codes, binary arithmetic, logic fundamentals,Boolean theorems, the exclusive- OR operations, the Karnaugh diagram, Logic circuit foraddition, logic gates, the NOT or inversion operation OR, NOR, NAND, combinational circuit,half & full adder, diode -transistor logic, resistance - transistor logic gates, transistortransistor logic gates, emitter coupled logic gates.

2. Digital Switching using Integrated Circuits

The RS flip flops, the D-flip flop, the T or toggling flip flop, the JK flip flop, theSchmidt trigger, the mono stable multivibrator, the astablemultivibrator, the shift register;counting, decoder matrices, binary comparison, sampling of analog signals, sampleconversion to digital form, digital to analog conversion, multiplex use of a wide frequencyband.

UNIT – III

1. Wave Shaping Circuits

Linear wave shaping circuit, RC, LCR circuits, non linear wave shaping circuits,clipping and clamping circuits, blocking oscillator, time-base generators.

UNIT – IV

1. Lasers and Optoelectronics

Physics of Laser Emissions, Spontaneous and stimulated emission, Populationinversion, Einstein's coefficients, Threshold condition, Different classes of Lasers (i) DopedInsulator

type (ii) Semiconductor (Ga-As) and hetero Junction Lasers (iii) Gas Lasers andmolecular Lasers (iv) Liquid dye Lasers.
Laser Resonant cavities, Different types of modes in the cavity, Q-switching.Output characteristics of Semiconductor Laser diodes and LEDs, Elementary ideaabout optical fibre communication, properties of Lasers and applications.

Course no . PHY 405 :PHYSICS PRACTICAL
TOTAL MARKS – 100

(A) LIST OF EXPERIMENTS ON ELECTRONICS (full mark – 80 marks)

1. Characteristics of Zener diode
2. . Characteristics of TRANSISTOR (B.J.T)
3. Characteristics of U.J.T
4. Characteristics of silicon and controlled rectifier .
5. Characteristics of F.E.T .
6. Network Theorem
7. De Morgan's Theory
8. Study of OR, AND,NOR, NAND, NOT, Logic gates
9. Study of OPAMP
10 . Study of multistage voltage and power amplifier.
11. Study of Laboratory power supply.
12. Study of multivibrator .
13. Study of R-C coupled amplifier .
14 . Study of phase shift amplifier.
15 . Study of Hartley oscillator .
16 . Study of amplitude modulation and measurement of modulation .
17. Study of frequency response with negative feedback .
18 . Measurement of wavelength by Lecher wire .

(B) SEMINAR AND PROJECT ON SPECIAL PAPER (FULL MARK - 20 MARKS)

Each student has to submit a minor project related to the special paper for valuation or perform an experiment related to diode laser .
List of equipment / experiments for project / dissertation based on diode lasers (B.S.R lab under UGC programme)
1. Standard laser kit
2. Michelson's interferometer
3. Fabry-Perot Interferometer
4. Apparatus for determination of particle size
5. Brewster's angle apparatus
6. Goiniometer apparatus
7. Malus law apparatus

This will be examined by external and internal examiners during practical examination of Semester IV i.e. paper Phy-404