ASSAM UNIVERSITY, SILCHAR.
DEPARTMENT OF PHYSICS

SEMESTER: I

PHY 101 : CLASSICAL MECHANICS **Total Marks : 75**

(All units carry equal Marks. Two questions of equal marks are to be set in each unit. Students have to answer one question from each unit.)

UNIT-I: Types of constraints on dynamical systems, generalized coordinates, D' Alembert principle, Euler- Lagrange equations of motion, variational calculus and Hamilton's variational principles, Hamilton's canonical equations of motions, cyclic coordinates.

15

UNIT-II: Lagrangian and Hamiltonian for central forces, electromagnetic forces, coupled oscillators and other simple systems.

15

UNIT-III: Canonical variables, poission's bracket, Jacobi identity, Canonical transformations, generators of infinitesimal canonical transformations, symmetry principles and conservation laws.

15

UNIT-IV: Hamilton Jacobi theory, Action and angle variables, centre of mass and laboratory systems, Kepler problem, processing orbits.

15

UNIT-V: Small oscillations, normal coordinates and its applications to chain molecules and other problems.

Degree of freedom for a rigid body. Euler angles, Rotating frame coriolis force, Foucault's pendulum. Eulerian coordinates and equations of motion for a rigid body, Motion of a symmetrical top.

15

Text Books:

1. Goldstein, Classical Mechanics — Naro;sa Publishing, Delhi
2. Landau & Lifshitz, Course of theoretical Physics, Vol-I0 — Oxford University, Press
3. Joag & rana, Classical Mechanics — Mc Graw Hill

Reference Books:

1. Berger, Classical Mechanics A modern Perspective — Mc Graw Hill International
2. Awqhmare, Classical Mechanics — Prentice Hall
3. Landau & Lifshitz, Theoritical Lecture Series. Vol- 1-10 — Paragon Press, 1976
4. Sommerfield, Lectures on theoretical Physics. Vol-I — Academic Press, NY 1952
5. Hestness, New foundations for classical Mechanics. — Kluwer Academic Publisher
6. R. Resnik, Introductions of Relativity — Wiley Eastern 1967

7. Corben & Stehle, Classical Mechanics — Wiley NY 1974
8. Einstein, The meaning of relativity 5th Ed. — Princeton University Press
9. K. Fock, Theory of space time and Gravitational 2nd Ed. — Peragon 1964
10. Schwartz, Introduction on to special relativity — Mc Graw Hill, 1968,

PHY: 102 : MATHEMATICAL PHYSICS **Total Marks= 75**

(All units carry equal marks. Two questions of equal marks are to be set in each unit. Students have to answer one question from each unit)

UNIT-I: Complex Variable : Fundamental laws of algebra of complex numbers, Analytic function and Cauchy-Riemann condition, complex integration contour integration, Cauchy's theorem, Singularity, Residue, Method of finding residue. The Residue Theorem and examples.

15

UNIT –II: DIFFERENTIAL AND INTEGRAL EQUATIONS:

Simultaneous Linear differential equations with constant variables Co-efficients, Non-linear differential equations, Euler and picard- lineloft existence theorems, Stability Variety of critical points, Vander Pol's equations.

15

UNIT-III: NUMERICAL TECHNIQUES AND COMPUTER APPLICATIONS :

Solution of Algebric equations by Newton Raphson method, Numerical integration-Simpson rule, Numerical Solution of Ordinary and non-linear equations, Picard's method, Runge- Kutta method.

INTRODUCTION TO OPERATING SYSTEMS :

DOS, WINDOWS, UNIX, Algorithms and flowcharts, Programming Languages: FORTRAN, C^{++}.

15

UNIT-IV: GROUP THEORY OF FINITE GROUPS :

Abstract groups, subgroups, classes cosets, factor-group, normal subgroup.

ILLUSTRATIONS :

Point symmetry groups, direct and semidirect product of groups. Mappings, homomorphism and isomorphism (outer and inner automorphism.)
Representations: Reducible and irreducible representations, unitary groups.

15

UNIT-V: **CURVILLINEAR CO-ORDINATES AND TENSOR**:

Introduction to curvilinear co-ordinates, orthogonal curvilinear co-ordinates, differential operators in terms of orthogonal curvilinear co-ordinates. Gauss's theorem, Green's theorem and Stock's theorem.

Definition, notation and summation convention of Tensor, Symmetric and antisymmetric tensor, covariant and contravariant tensor, christoffel symbol and it's transformarion law. Covariant Differentiation of tensor.

15

Text Books :

1. Artken, Gearge Brand Weber, Hons J. Mathamatical methods for Physicist, 4th Ed, Prism Books Pvt. Ltd. 1995.
2. Alkinson, Kendall, Elementary Numerical Analysis, 2nd Ed, John Willy & Sons, 1994.
3. Simons, Differential equation, tata McGraw Hill.
4. Rajaraman, Fortran 77 : Tata McGraw Hill.
5. Ponnusamy S., Foundation of Complen Analysis, Narosa Pub.

Reference Books:

1. Ayres F. & Ault J.C. , Theory and problems of Differential equation McGraw Hill Book Co.
2. Bronson R. , Therory and problem of differential equation, McGraw Hill Inc. , New York.
3. Courant R. and Hilbert D . , Methods of Mathematical Physics John wiley &
4. Devries Paul L.,A furst ciurse un cinputational Physics, John wily & Sons.
5. Harper. C., Introduction to Mathematical Physics, Prentice Hall, New Delhi.

PHY : 103 ELECTRONICS, COMPUTER & COMMUNICATION Total Marks= 75

(All units carry equal marks, two questions of equal marks are to be set in each unit. Students have to answer one question from each unit.)

UNIT-I: **CIRCUIT ANALYSIS** : Kirchhoff's voltage law, Kirchhoff's current law, voltage Division and current Division. Series-Parallel Network Reduction, Super position Thevenin's and Norton's Theorems, Maximum power Transfer theorem. DC Mesh and Node analysis.

Fourier Method of waveform Analysis: Trigonometric Fourier series, experimental Fourier series, wave form synthesis, Applications in circuit analysis.

Laplance Transform Method: Laplace – Transform, selected Laplace Transform, initial-value and final value theorems, S-Domain circuits.

15

UNIT-II: **ELECTRONICS DEVICES** : Junction-Diode characteristics, space-charge, capacitance, CT Diffusion capacitance, Junction-Diode Switching times, Breakdown Diodes, Tunnel diode, Photodiode photovoltaic Effect, light emitting diodes, npn & pnp transistor equivalent circuits and high and low frequency effect, UJT, MOSFET-I-V characteristics, equivalent.

15

UNIT-III: **DIGITAL CIRCUITS** : DTL, TTL, High-Threshold logic, Resistor-Transistor logic, Direct- Coupled Transistor logic comparison of logic families.

Combinational digital systems; Standard gate assemblies, binary adders, Half adder Full adder, 2 complement, BCD Multiplex, Demultiplexer, ROM, applications.

Sequential Digital systems: Flip- Flops, synchronous counters, applications RAM, Register, Simple computer architecture, CPU storage Devices, Communication BUS.

15

UNIT-IV: **COMMUNICATION SYSTEMS**: Classification of signals, representation of signals, Fourier transform, correlation, auto-correlation and cross-correlation of periodic and aperiodic functions, Frequency spectrum.

Amplitude modulation, Double side Band Suppressed (DSBS) carrier modulation generation and detection of DSBS waves, single side band modulation. PC modulation and demodulation Networking, LAN, WAN X 400 TCP/ IP Protocol.

15

UNIT-V: **INSTRUMENTATION** : Analog and digital instrumentations, Interfacing using D/A and A/D converters and tuners. Optical Fibre Technology.

DATA acquisition systems : Pulse height analysis- single and multichannel analysers.

Noise : Various types of noises, signal to noise ratio.

15

Text Books :

1. Millman & Halkias, Integrated Electronics : Analog & digital circuits and digital circuits and system, Mc Graw Hill, 1972
2. SM Sze, Physics of semiconductor devices, 2nd Edn. Wiley Inter Science
3. Millman & Halkias, Electronics Instrumentation, Tata Mc Graw Hill.
4. Prokis J.G. Digital communication 3rd Edn. C Graw Hill International

Reference Books :

1. Neamen D.A, Semiconductor Physics and devices- Basic Principles, Irasin Homewood, 1992.
2. Taub & Schiling, Principle of communication system, Tata Mc Graw Hill
3. Kennedy, Dlectronics Communication system, Tata Mc Graw Hill
4. Dennis, Roddy, Coolen J, Electronics Communications, Prentice Hall of India.

5. Helfrick A.D. & Cooper W.D. Electronics instrumentation & Measurement Technique, Prentice Hall of India.
6. Wang S. Fundamentals of semiconductor theory and Devices physics. Prentice Hall of India.
7. Combs C.F Electronics Instruments Hand Book, 2nd Edn. Prentice Hall ;of India.
8. Pankove J.I. Optical process in semiconductor, Prentice Hall Engle wood. NY.
9. Stretman B.G. Solid state Electronics devices, Prentice Hall 1995.
10. Singh J. Semiconductor devices, Mc Graw Hill, NY 1994.
11. Cheo P.K. Fibre o;ptics and opto Electronics Mc Grae Hill. NY 1990.
12. Gowar, optical communication Prentice Hall of India, 1993

PHY 104 : LABORATORY-I **Total Marks =75**

1. Characteristics of FET and its application
2. Zener characteristics of a Sold State diodes and its applications
3. Study of logic gates
4. Study of P-N junction
5. Use of Oscilloscope
6. Characteristics of a Solid State diode and application
7. Study of regulated power supply
8. Transistor Amplifier : gain and phase shift, frequency
9. Study of Multivibrator
10. Study of transistorized R-C couple amplifier
11. Use of operational Amplifier
12. Study of lock – in – Amplifier
13. Experiments on Modulation
14. Use of DA and AD Converters & timers
15. Study of Microprocessor. The programming language used for Scientific computation such as FORTRAN, C^{++} etc.
16. Determination of roots nth degree polynomial by using FORTRAN and C^{++}
17. Experiments involving simple Dos, WINDOWS and UNIX Commands.
18. Numerical Integration, Differentiation, Interpolation and Extrapolation using FORTRAN, C^{++}.

SEMESTER: II

PHY 201 : ELECTROMAGNETIC THEORY Total Marks = 75

(All units carry Equal Marks. Two questions of equal marks are to be set in equal units. Students have to Answer one question from each unit.)

UNIT-I. Review of special theory of Relativity, concept of invariant interval, Four vector, Lorentz Transformation in four Dimensional Space, Electromagnetic field Tensor in four dimensional space Maxwell Equation, Lagrangian of a charged particle, Lorentz Force.

15

UNIT-II: Motion of a charged particle in electromagnetic field: uniform E and B fields. Non uniform fields, Diffusion Across Magnetic Fields, Time varying E and B Fields, Adiabatic Invariants. 15

UNIT-III: Saha's equation of ionization, Plasma oscillations, Plasma Parameters, Debye Length, Hydrodynamical description of Plasma, Fundamental equations, Hydro-magnetic waves : Magneto Sonic and Alfven waves, waves, propagation, phase and group velocity.

15

UNIT-IV: Radiation from an accelerated point charge, Lienard-wieohirt potentials, power radiated by a point charge. Spectral Resolution of retarded potential, Dipole, Quadrupole and magnetic dipole radiation, angular distribution of power radiation by linearly and circularly accelerated charge.

15

UNIT-V: Scattering: Scattering due to harmonically bound charge, Rayleigh and Thomson scattering, resonance fluorescence energy transfer in coulomb collision due to a harmonically bound charge.

15

Text Books :

1. J.D. Jackson, classical Electrodynamics, Wiley Eastern, 1989.
2. Grifiths, Introduction of Electrodynamics, Prentice Hall.
3. L.D. London & E,M Lifshitz, The classical theory of fields, Butterworth Heinemann Ltd. Oxford.

Reference Books :

1. Berestetkii, Lifshit, Pitaevski, Quantum Electrodynamics, Pergaman Press.
2. Miah M.A.W. Fundamentals of Electromagnetics, Tata Mc Graw Hill.
3. Cook D.M Theory of Electromagnetic Fluids. Prentice.
4. Lorrain & Corson, Electromagnetic field and waves, Freeman & company San Fransiscs.
5. Somber field, Electrodynamics Vol- III, Academic Press.

PHY 202 : QUAMTUM MECHANICS – I **Total Marks = 75**

(All units carry equal marks, two questions of equal marks are to be set in each units, Students have to answer one question from each unit).

UNIT-I: REVIEW OF ELEMENTARY QUANTUM IDEAS: Inadequacy of classical concepts, photoelectric effect, Compton effect, Davisson–Germer experiment, Double slit experiment and wave-particle duality, uncertainty principle.

Review of wave mechanism: Wave packets, Schrodinger equation probability interpretation of wave function position and momentum operators, Expectation Values Ehrenfest theorem.

15

UNIT-II: ABSTRACT DFORMULATIONS OF QUANTUM MECHANICS : Mathematical properties of linear vectors spaces, postulate of quantum mechanics, Eigen values and Eigen vectors, orthonormality, completeness, closure Dirac's bra and ket notation, Matrix representation of operators, position and momentum representations, connection with wave mechanics, commuting operators, generalised uncertainty principle, change of basic and unitary transformation.

15

UNIT-III: QUANTUM DYNAMICS: Schrodinger picture, Heisenberg picture, Heisenberg equation of motion, classical limit. Solution of harmonic oscillator problem by the operator method.

15

UNIT-IV: SYMMETRY IN QUANTUM MECHANICS : General view of symmetries, a partial translation- continuous and discrete, time translation time reversal parity.

15

UNIT-V: ANGULAR MOMENTUM : Commutation relation of angular momentum operators, Eigen values, Eigen functions, Ladder operators and their matrix representation, Addition of angular momenta, Clebsch-Gordan co-efficients.

15

Text Books :

1. Schiff, Quantum Mechanics, McGraw Hill International
2. Sakurai, Modern Mechanics, Narosa Publishing House
3. Mathews & Venkateshan, Text Book of quantum Machanics, Tata McGraw Hill

Reference Book :

1. Dirac P.A.M. The principle of Quantum Mechanics, Oxford University,
2. Merzbacher E, Quantum Machanics, John Willey & Sons.
3. Jinkham, Group theory and Quantum Mechanics, Tata McGraw Hill.
4. Powell & Graseman, Quantum Mechanics, Narosa Publishing House
5. Liboff, Introdunctory Quntum Mechanics, Narosa Publishing House.

PHY 203 : Nuclear and particle Physics **Total Marks = 75**

(All Units Carry Equal Marks) (Two questions of equal marks are to be set in each units. Student have to answer one question from each unit)

UNIT- I: STATICS PROPERTIES OF NUCLEI: Nuclear size and its determination from electron scattering, Nuclear form factors, Angular Momentum in the nucleus, spin and Momenta of nuclei.

15

UNIT-II: NUCLEAR FORCES AND TWO NUCLEON SYSTEMS : Evidence for saturation property. Exchange character, spin dependence (ortho and para hydrogen) scattering, charge independence and charge symmetry. Iso-spin formation, Central and tensor forces, General form of the Nucleon-nucleon force, Dipole and Quadrupole moments of the deuteron, S-wave effective theory, photon-proton scattering evidence for hardcore potential.

15

UNIT-III: NUCLEAR MODELS : The shell model, Nilson model, physical concepts of the unified model.

Nculear Decays and Reactions : Electromagnentic decays, selection rules Fermi theory of beta-decay, kurie plot, Fermi and Gammow-Teller transitions, parity violation in beta-decay, Introduction to nuclear reactions.

15

UNIT-IV: ELEMENTARY PARTICLES : Classification : Spin and parity determination of points and strange particles, Gell-Mann Nishi Nishijima scheme, properties of quark and their classification, Elementary ideas of SU3 and SU2 symmetry groups and hadron classification, Introduction to the standard model, Electroweakinteraction- W & Z Bosons.

15

UNIT-V: NUCLEAR DETECTORS : Ge and Si solid state detectors, calorimeters and their use for measuring jet energies, scintillation and Cherenkov counters, qualitative ideas, Hybrid detectors.

15

Text Book :

1.Evans R.D.The Atomic Nucleus, McGraw Hill, NY 1995
2.Cohen, concepts of Nuclear Physics, Tata McGraw Hill
3.Price, Nuclear Radiation Detection, McGraw Hill.

Reference Books.

1.Yang and Hamilton, Modern Atomic and Nuclear Physics, Tata Mc Graw Hill.
2.Serge , Experimental Nuclear Physics Vol-1,2,3. Willey Ny
3. Bethe and Morrison, Elementary Nuclear Physics , Willey Ny.
4. Bhatt and Weisskof, Theoretical Nuclear Physics , Willey Ny
5. Kieinkeecht, Detectors for particle radiation, MC Graw Hill , Ny.

PHY 204 : LABORATORY –II **Total Marks : 75**

1. Gamma energy spectrum by single channel analyzer.
2. Determination of ratio of axes of elliptically polarized light
3. Jamin's Interferometer.
4. Constant Deviation spectrometer
5. Febry - perot Interferometer.
6. Michelson's Interferometer
7. Study of G.M. Counter
    a) Characteristics
    b) Statistical distribution of counting rate
    c) Dead time
8. Absorption co-efficient of gamma rays in lead
9. End point energy of beta – spectrum.

NB. : The list of experiments should be considered as suggestive of the standard and are subject to availability of equipments. The teachers are authorised to either add or delete experiments whenever considered necessary.

SEMESTER-III

PHY 301 : STATISTICAL MECHANICS **Total Marks = 75**

(All units carry equal marks, Two questions of equal marks are to be set in each unit. Students have to answer one question from each unit).

UNIT-I: Classical Ensemble Theory : Phase space, Liouvilles equation, Micro canonical and grand-canonical ensembles, Boltzmann relation for Entropy, Application to classical systems of interacting particles.

15

UNIT-II: Quantum Ensemble Theory : Density Operator, quantum Liouvilles equation, Density Operator for equilibrium microcanonical .

15

UNIT-III: Canonical and Grand canonical ensembles, calculation of grand partition function and distribution function.

15

UNIT-IV: Bose-Einstein transitions and nature of discontinuity of specific heat, pauli paramagnetism, Landau's theory of liquid Helium II, phonon-roton spectrum, calculation of O_s and O_n .

15

UNIT:V: General Theory of Phase Transitions: Order parameter, Landau's theory, critical exponents order, Parameter functions in Gaussian approximation scale invariance critical dimensionally concept of universality of phase transitions, Ising and Heisenberg models, Bethe approximation. Introduction to irreversible process and their applications.

15

Text Books :

1. Reif. Fundamentals of statistical & Thermal physics, Tata McGraw Hill.
2. Robertson, Statistical Thermodynamics, Prentice Hall.

Reference Books :

1.Grandy, Fundations of statistical Mechanics, Kluwer Academic
2.Grimment, Probabillity and phase transmission, Kluwer Academic
3.Popov, Collection effect on Quantum statistics of Radiation & matter. Kluwer Academic.

PHY 302 : QUANTUM MECHANICS – II **Total Marks – 75**

(All units carry equal marks, Two questions of equal marks are to be set in each unit, Students have to answer one question from each unit).

UNIT-I: Approximation methods for stationary systems : Time – independence perturbation theory : (a) Non–degenerate and (b) Degenerate, application to Zeeman effect, Isotopic shift and stark effect, variational method and its applications.

15

UNIT-II: Interaction picture, Time-dependent perturbation theory, Transition to a continuum of final states – Fermi's Golden rule. Application to constant and harmonic perturbations, Adiabatic and sudden approximations.

15

UNIT-III: Dynamics of two – level systems-exact and approximate treatment.

15

UNIT IV: Scatterering : Wave packet description of scattering, Formal treatment of scattering by Green function method, Born approximation and applications. Partial wave analysis, optical theorem, Eikonal approximation.

15

UNIT-V: Dirac equation : Motivation for Dirac equation, Properties of Dirac matrices. Plane wave solution of Dirac equation, Spin and magnetic moment of electron, Norelativistic reduction of the Dirac equation, Spin – Orbit coupling, Energy levels in coulomb field.

15

Text Book :

1. Bjoken and Drell, Relativistics Quantum Mechanics, Tata McGraw Hill,
2. Mathews and Venkateshan, Text Books of Quantum Mechanics, Tata McGraw Hill 1995
3. Gathak & Loknathan, Introduction to Quantum Mechanics-Narosa Publishing House.

Reference Books :

1. Parling, Introduction to Quantum Mechanics, McGraw Hill, 1d995
2. Griffiths, Introduction to Quantum Mechanics, McGraw Hill, 1995
3. Park, Introduction to Quantum Mechanics, Tata McGraw Hill 1995
4. Jownsend, A Modern approach to quantum Mechanics, Tata McGraw Hill.
5. Resnick & Halliday : Basic concept of relativity & Early quantum Theory Prentice Hill.

303(A) : ASTROPHYSICS –I **Total Marks : 75**

(All units carry equal marks, two questions of equal marks are to be set in each units. Students have to answer one from each unit.)

UNIT-I: Celestial co-ordinate system and observational techniques: Celestial sphere-Sidereal and solar time, Equation of time, different co-ordinate system, determination of luminosity-Black body radiations-luminosity and magnitude of star relations with mass, radius, colour index, distance determination by parallax and other methods.

15

UNIT II: Telescopes and Instrumentations :

Different optical configuration for astronomical telescope plate scale and diffraction limits-telescopes for γ-ray, X-ray, UV, IR, mm and radio astronomy- photometry with photometers and CCD- spectrometry and polarimetry with various instruments.

15

UNIT III: Stellar structure and Evolution Part-I :
Spectral classification of stars-Saha's equation-CNO- cycles –HR Diagram-description of radiation fields opacities radiative transfer-structure of spectral line-hydrostatic equilibrium equation of state-main sequence.

15

UNIT-IV: Stallar structure of Evolution Part-II.
Evolution of main sequence-late stages-supernovae degenerate remnants: white dwarf Chandrasekhar limit-Neutron star- pulsars Black Holes.

Binary stars- different types of binaries- WD binaries-neutron star and black hole binaries.

15

UNIT-V: Sun and Solar system : Physical characteristics of sun-rotation, magnetic field, granulation, sunspots, other chromospheric activities.

Primordial Solar Nebula-Origin and evolution of solar system- planets, comets, asteroids and other minor bodies-formation of comets-ort cloud planetary dust and gas.

15

Text Books:

1. Astrophysics –K.S Krishnaswamy (CUP)
2. Astrophysics-Baidyanath Basu, Prentical Hall
3. Astrophysics-KD Abhankar (Orient Longman)
4. Electronic Imaging in Astronomy Mclean (Willey)
5. Text Book on Astronomy and Astrophysics with elements of cosmology V.B.Bhatia, Narosa.

Reference Books.

1. Observational Astrophysics-Smith (Cup)
2. Physical Universe-F Shu (Cup)
3. Astrophysical Quantities Allen (Willey)
4. Astrophysical Quantities KR Lang (Springer verlag)

PHY 303 (B) CONDENSED MATER PHYSICS - I Total Marks – 75

(All units carry equal marks. Two questions of equal marks are to be set in each units. Students have to answer one question from each units.)

UNIT- I: Diffraction of electromagnetic waves by crystals, Reciprocal lattice, powder and rotating crystals methods, neutron and electron diffraction, introductory- points defects, line defects, dislocation and circulation- quasi crystals.

15

UNIT-II: Type of crystals binding : London Theory of van dar Wall forces, ionic binding and Madelung constant.

Normal modes of linear mono-atomic chain, quantization of vibrations phonon.

15

UNIT-III: Motion of electron in a periodic lattice, Block theorem in 3 dimensions, nearly free electron and tight binding approximation, Fermi surface and its study by the Hass-Van Alphen effect and cyclotron resonance.

15

UNIT IV: Intrinsic and Extrinsic Semiconductor, Determination of impurity level and Fermi level, recombination process, continuity equation, I-V Characteristics of p-n junction.

15

UNIT-V: Thermodynamics of Superconducting transition, Landau **Gingberg** equations, calculation of surface energy Hc 1 and Hc 2, Copper problem, ideas of BCS theory, flux quantization and Josephson effect.

15

Text Books. :

1. Kittel/Introduction solid State Physics, Willy Eastern Limited
2. Dekker/Solid State Physics, McMillan Student Ed.
3. Asherft & Mermin/Solid State Physics , Sauders College Pup.

Reference Books :

1. Zimam/ Principles of Solid State Physics, Cambridge University Press
2. Shur/Physics of Semi conductor Devices, Prentice Hall of India

PHY 304 (A) Laboratory on Astrophysics-I **Total Marks- 75**

Experiments on:

1. Calibration of plate scale of a given astronomical telescope
2. Determination of diameter of moon by transit
3. Determination of diameter of sun by transit
4. Calibration of a photometer for astronomical measurement
5. Determination of the width of lunar craters and Maria
6. Recording of the number of sunspots and study of its variation
7. Determination of the time period and angular velocity of spin motion of sun (from Sun spot studies)
8. Determination of photospheric temperature of sun from Planck's law
9. Determination of solar constants
10. Determination of intensity of solar Fraunhoffer lines
11. Determination of orbital periods of satellite of Jupiter
12. Determination of angular diameter of Saturn Ring
13. Application of Image Processing Software(IRAF/Epoch 2002) to determine magnitudes of different stars in a star field.
14. Application of image processing software(IRAF/Epoch 2002) to determine angular separations of different stars in a star field.

This list is tentative, subject to the availability of equipments and other relevant considerations.

304 (B) : LABORATORY ON CONDENSED MATTER PHYSICS-I Total Marks-75

1. Energy gap in Semiconductor.
2. Determination of Lander g factor by ESR
3. Ultrasonic- Experiment by Interference
4. Ultrasonic- Exoerument By Diffraction
5. Verification of Stefan's Law
6. Hall effect.
7. Curie temperature Study
8. Study of Specific heat of Solid
9. Study of Curie temperature of a sample
10. Study of critical temperature of High Tc sample.

N.B. : The list of experiments should be considered as suggestive of the standard and are subject to availability of equipments. The teachers are authorized to either add or delete experiments whenever considered necessary.

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SEMESTER-IV

PHY 401 : Atomic and Molecular Physics : Total Marks – 75

(All units carry equal marks, two question of equal marks are to be set in each unit. Students have to answer one question from each unit).

UNIT I: Atomic Physics: Fine structure of hydrogen atom, Mass correction, spin-orbit terms, Darwin term, Intensity of fine structure lines. The ground state of two –electron atoms - perturbation theory and variation method.

15

UNIT II: Many electron atoms: LS and Coupling schemes, Lande interval Rule. The idea of Hartree-Fock equations. The spectra of alkalies using quantum defect theory, fraction percentage co-efficients, selection rules- ferro electric and magnetic multipole in radiation, oscillator strengths and Thomas-Reiche-Kuhn rule.

15

UNIT III: Molecular structure: Born-Oppenheimer separation for diatomic molecules, Rotation vibration-rotation and electronics structure of diatomic molecules, Molecular orbital and valence bond methods for H2 & H2 correlation diagram for heteronuclear molecules. The structure of polyatomic molecules.

15

UNIT IV: Molecular spectra : Rotation, vibration-rotation and electronic spectra of diatomic molecules. The Franck-Condon principle. The electron spin and Hund's cases. Idea of symmetry elements and point groups for simple molecules.

15

UNIT-V: Lasers: Multilevel Rate Equations and saturation, Rabi frequency, Laser pumping and population inversion. He-Ne Laser , Solid State Laser, Free electron, Liquid and gas lasers, Semi conductor Lasers.

15

Text Books :

1. Herzberg, Infrared & Raman Spectra of poly atomic molecules, Van Nostrand .
2. G. Herzberg, Molecular structure and molecular spectra vol-1,2,3, Dover Publisher NY.
3. 3. White, Introduction to atomic spectra-McGraw Hill.

Reference Books:

1. Muller, Super intense Laser atomic physics TV, Kluwer Academic Press, 1996
2. Smeyers, Structure & dynamics of non-rigid molecular system, kluwer Academic Press,1996.
3. Averg, the quantum theory of atom-molecular and photons,McGraw Hill 1972
4. Chang, Basic principles of spectroscopy McGraw Hill,
5. Herzberg, Atomic spectra, Dover Pub, NY.

PHY 402: Radiation Theory **Total Marks : 75**

(All unit carry equal marks, two questions of equal marks are to be set in each unit, Students have to answer one question from each unit).

UNIT-I: Classical field theory : Concept of systems with infinite degrees of freedom, classical fields, equations of motion, Hamiltonian, symmetries and invariance principles, Noether's theorem (statement and short derivation, applications, stress tensor).

15

UNIT-II: Field Quantization: Canonical quantization of scalar field -creation, annihilation operators, commutation relations Hamiltonian Interpretation of the quantized field (number operator, connection with harmonic oscillators).

15

UNIT-III: Radiation field : Classical Haxel field, gauge invariance, canonical quantization , discussion of arbiguities in quantization removal.

Applications: Interaction of radiation with matter (Spontaneous, stimulated emission, absorption).

15

UNIT-IV: Planck's Law, Kramer Heisenberg formula, Coherent and Raman scattering, Theory of line width, Elementary theory of photoelectric effect (preferably to be done in tutorials), Nonrelativistic theory of Lamp shift, elementary ideas of mass recombination.

Gauge Theorem : Ideas about gauge theories as non abelian extensions of Maxwell theory (SU 2 Yang : Mills Theory, Higgs mechanism and spontaneous symmetry braking, some elementary ideas about winberg - Salsm theory (particle content, Lagrangian etc.)

15

UNIT-V: Quantum optic : Co-herent states and their properties photon, counting distribution, Henbury-Brown Twiss effects.

15

Text Books :

1. Bjorken & Drill, Relativistic quantum Field, McGraw Hill.
2. Sakurai JJ Modern quantum Mechanics, McGraw Hill.
3. Nandy & Wold, Coherence optics.
4. Landau & Liftshitz, The classical theory of Fields, Butterworth & Heimemann.

Reference Books.

1. The Quantum theory of Field Vol-1,2 Weinberg publishers, HC.

PHY 403 (A) : Astrophysics II **Total Marks : 75**

(All units carry equal marks. Two questions of equal marks are to be set in each unit. students have to answer one question from each unit.)

UNIT-I: Star High Energy Radiative Processes in Astronomy:
Synchrotron emission for a single particle and an ensemble of particles – Energy loss and electron scattering-Compton scattering-Bremsstrahlung radiation.

15

UNIT-II: Star formation in ISM, clusters, variable and binary stars, Interstellar medium(ISM)-various nebula-Jeans condition for collapse-Protostars –star formation.
Stellar Clusters: open and Globular- IMF.
Variable stars-period luminosity relations and distance determination Binary stars-types of binaries.

15

UNIT-III: Galaxies : The Milky way Galaxy- kinematics- Hubble's classification scheme for external galaxies- spirals and ellipticals –irregulars-Normal galaxies and AGNs- Quasi-stellar objects-Unified Model-Gamma Ray burst.

15

UNIT-IV. General Theory of Relativity:
Principle of Equivalence- Gravity and Geometry Metric Tensor and its properties- curved space time-tensor calculus –co-variant differentiation-parallel transport-particle trajectories in Grave field- Einstein's field Equations-Bianchi Identities- Schwa child metric.

15

UNIT-V: Large scale Structure and Cosmology :
Hubble's law- angular size- Friedmann Robertson-Walker Model, cosmological constants-the early universe-thermodynamics of early universe- nucleo-synthesis-Microwave Background radiation- elementary ideas on structure formations- age of universe. Big Bang and Steady State Theory.

15

Text Books :

1. Astrophysics-K S Krishnaswamy (CUP)
2. Astrophysics-Baidyanath Basu, Prentice Hall.
3. Astrophysics-K D Abhaynakar(Orient Longman)
4. Electronic Imaging Astronomy-Melean(Wiley)
5. The classical theory of Fields Vol-2 Landau and Lifshitz (Butte worthHeinemann)
6. Introduction to cosmology-J V Narlikar(CUP)
7. General relativity and cosmology J V Narlikar-Mcmmillan
8. Text Book on Astrono and Astrophysics with Elements of cosmology-V B Bhatia, Narosa.

Reference Books:

1. Observational Astrophysics- Smith(CUP)
2. Physical Universe –F Shu (OUP)
3. Astrophysical quantities – Allen (Willey)
4. Astrophysical quantities –K R Lang(Springer Verlag)

403 (B) CONDENSED MATTER PHYSICS – II Total Marks : 75

(All units carry equal marks, two questions of equal marks are to be set in each unit, students have to answer one question from each unit).

UNIT-I: Transport Properties: Electrical and thermal conductivities of degenerate and non-degenerate materials and their temperature variation. Scattering mechanisms, impurity and phonon scattering, Normal and Umklapp processes, Mobility of charge carriers, Seeback co-efficients.

15

UNIT –II: Dynamics of conduction of electrons : Concept of hole and open orbits on high field magneto-resistance, Experimental determination of Fermi surface, de Hass Van Alphen effect, anomalous skin effect use of high magnetic fields.

15

UNIT-III: Crystals growth and imperfections : Imperfactions in crystals, equilibrium concentration of point defects, dislocation and their properties, partial dislocation and stacking faults, boundaries kinetics of crystals growth.

15

UNIT-IV: Magnetic Relaxation and Resonance: Spin-spin and spin-lattice relaxation times, Bloch equation, weak and strong fields.

Magnetism : Ferromagnetism and anti-ferromagnetism, Heisenberg exchange model. Quantization of spin waves.

Diffusion in soild : Fick's law, diffusion constant, self-diffusion, colour centres excitons.

15

UNIT-V: Quantum Hall effect : Fractional and integral.

Superconductivity : Phenonmenological theories of superconductivity, BC's Theory- two fluid and pippard's theory. Experimental evidence Ground state and energy gap. Determination of energy gap. Electron tunneling in various configurations. SQUID High temperature superconductors.

15

Text Books :

1. Anderson : Basic Notions of condensed Matter Physics, Narosa Publishing House.
2. Schrieffer, the theory of super conductivity, Narosa Publishing House
3. Stuart, Vacumm Technology Thin Film & Sputtering an introduction, Kluwer Academic press, 1989.

Ref. Books :

1. Catlow, Defects and Disorder in Cystalline and amorphous, Kluwer Academic press, 1994.
2. Doni, Progress in electron properties of solids, Kluwer academic press,1989.
3. Kossowky, Physics and materials science of high temperature conductor Kluwer Academic Press,1992.
4. Martinez, Optical properties of semiconductor, Kluwer Academic Press, 1992.
5. Mac. Donald : Quantum Hall effect, Kluwer Academic Press, 1989.

PHY 404 (A) : LABORATORY ON ASTROPHYSICS – II Total Marks- 75
PROJECT – 100 MARKS (15 CONTACT HOURS PER WEEK)

PHY 404 (B) LABORATORY ON CONDENSED MATTER PHYSICS –II
Total Marks - 75

1. Hall Effect to determine Hall Co-efficient and to calculate the value of mobility of carriers and carrier concentration.
2. Transverse magneto – resistance Co-efficient and resistivity to calculate the value of mobility of carriers and the concentration.
3. Variation of Hall coefficient mdc. Conductivity and mobility of semiconductor with temperature.
4. Relaxation time (EPR) and value of "G"
5. Determination of di electric constant.
6. Calibration and use of Silicon resistance thermometer.
7. Calibration and use of Silicon resistance thermometer.
8. Thermoluminescence of F-centres in alkali halides crystals
9. Use of computerized data acquision systems.
10. Programming and interfacing with a microprocessor.

NB. The list of experiments should be considered as suggestive of the standard and are subject to availability of equipments. The teachers are to authorized to either and ordelete experiments whenever considered necessary.

OR

A SUITABLE PROJECT FOR 100 MARKS.

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