

M.Sc. Physics

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SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत भाग १ व २ परिक्षा २००७
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PROSPECTUS
OF
MASTER OF SCIENCE IN
PHYSICS
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Dr.K.G.Khamare
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SANT GADGE BABA AMRAVATI UNIVERSITY

SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

- (1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.
- (2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinance Booklet the various conditions/provisions pertaining to examination as prescribed in the following Ordinances.

Ordinance No. 1	:	Enrolment of Students.
Ordinance No. 2	:	Admission of Students
Ordinance No. 4	:	National cadet corps
Ordinance No. 6	:	Examinations in General (relevent extracts)
Ordinance No. 18/2001	:	An Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the Statute NO.18, Ordinance 2001.
Ordinance No. 9	:	Conduct of Examinations (relevent extracts)
Ordinance No. 10	:	Providing for Exemptions and Compartments
Ordinance No. 19	:	Admission of Candidates to Degrees.
Ordinance No. 109	:	Recording of a change of name of a University student in the records of the University.

- Ordinance No. 138 : For improvement of Division/Grade.
- Ordinance No.19/2001 : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

Dr.K.G.Khamare
Registrar
Sant Gadge Baba Amravati University.

PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM.

The pattern of question paper as per unit system will be broadly based on the following pattern

- (1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.
- (2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.
- (3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.
- (4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60
- (5) Each short answer type question shall contain 4 to 8 short sub question with no internal choice.

**Syllabus prescribed for
M.Sc. Part-I and Part-II Examinations in Physics
(Semester Pattern)**

There shall be total four semesters (Two for M.Sc.Part-I and Two for M.Sc. Part-II) There shall be four theory papers (50 marks each) for each semester. There shall be two practicals (50 marks each) for Semesters-I, II & III, whereas ONE PRACTICAL of (50 marks) and ONE PROJECT of (50 marks) for the Semester-IV.

It is expected that the students should visit Research Laboratories and Industrial Establishments of repute. Every student should deliver a seminar during every semester on the topics related to the Theory / Practicals / Research Applications of Physics.

M.Sc.Part-I Examination

M.Sc. Part-I Semester-I :

Theory Papers	Marks
(1) Mathematical Physics	50
(2) Computational Methods and Programming	50
(3) Classical Mechanics	50
(4) Physics of Lasers and Laser Applications	50

Practicals	Marks
(1) Laboratory Practical Course-I	50
(2) Laboratory Practical Course-II	50

M.Sc. Part-I Semester-II :

Theory Papers	Marks
(5) Quantum Mechanics-I	50
(6) Electrodynamics and Plasma Physics	50
(7) Network Theorems and Electronic Devices	50
(8) Statistical Mechanics	50

Practicals	Marks
(1) Laboratory Practical Course-I	50
(2) Laboratory Practical Course-II	50

M.Sc. Part-II Semester-III :

Theory Papers	Marks
(9) Quantum Mechanics-II	50
(10) Atomic and Molecular Physics	50
*(11) Condensed Matter Physics -I	50
*(12) Electronics-I	50

Practicals	Marks
(1) Laboratory Practical Course-I	50

(2) Laboratory Practical Course-II	50
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M.Sc. Part-II Semester-IV :

Theory Papers	Marks
(13) Solid State Physics	50
(14) Nuclear and Particle Physics	50
*(15) Condensed Matter Physics -II	50
*(16) Electronics-II	50

In addition to these, the college / department can make any of the following specialisations available to students by obtaining a prior permission of the University-

- (i) Atomic and Molecular Physics
- (ii) Nuclear and Particle Physics
- (iii) Informatics (Materials and Data Communication)

Practical and Project :	Marks
(1) Laboratory Practical course	50
(2) Project	50

Note : (1) Each M.Sc.-II student is required to submit two copies of the project report at the time of examination. The project work will be evaluated by an external and an internal examiners appointed by the S.G.B.Amravati University, Amravati.

- (2) Break-up of marks for -

(a) Laboratory Practical

(i) Experiment	— 30 Marks
(ii) Practical Record	— 05 Marks
(iii) Viva-voce	— 05 Marks
(iv) Internal Assessment	— 10 Marks
Total	— 50 Marks

(b) Project Work :

(i) Theory / Experiment/ Computation	— 30 Marks
(ii) Project Report	— 05 Marks
(iii) Viva-voce	— 05 Marks
(iv) Internal Assessment	— 10 Marks
Total	— 50 Marks

- (3) * Paper 11 & 15 are the special papers of “Condensed Matter Physics.” and Papers 12 and 16 are the special papers of Electronics.

M.Sc.Part-I Semester-I**PAPER I****Mathamatical Physics**

- UNIT I** : Matrix Algebra :- Vector spaces and transformations, the algebra of matrix, partitioning of matrices. The eigen value problem. Functions of a Matrix, Kronecker sum and product of matrices, Matrices in classical and quantum mechanics.
- UNIT II** : The Complex Vairables : Complex variables and their representation, functions of a Complex vairiable, Analyticity, Harmonic functions, Cauchy's integral theorem and integral formula, series expansion, Taylor and Laurent series, Residue theorem.
- UNIT III** : Differential Equations of the Second Order :
Linear differential equation with variable coefficients, Series, Solution, The Legendre equation, Legendre function of the second kind, Generating function, Rodrigue's formula, Orthogonality of generating functions, Recurrence relations.
- UNIT IV** : Bessel Differential Equation :
Bessel's function of the third kind (Hankel function), Generating function, Recurrence relations, Orthogonality of Bessel's function, Hermite differential equation, Hermite polynomials, Generating function, Recurrence relations, Rodrigue's formula, Orthogonalality of Hermite Polynomials.
- UNIT V** : Integral Transforms :
Laplace Transforms - Properties of Laplace transform, differential equation method of finding Laplace transform, Inverse Laplace transform.
Fourier Transforms - Fourier Series, properties of Fourier Series, Fourier integral, Fourier transform of derivatives, Applications of Fourier transform.

Reference Books :

- (1) Matrices and Tensors in Physics (2nd Edition), A.W.Joshi, Wiley Eastern Limited.
- (2) Applied Mathematics for Engineers and Physicists (2nd Edition), L.A.Pipes, Mc Graw Hill Book Co.
- (3) Mathematical Physics, Satya Prakash, S.Chand & Sons.
- (4) Mathematical Physics, Kalani and Hemrajani, Himalaya Publishing House.
- (5) Introduction to Mathematical Physics, Charlie Harper, Prentice Hall India Pvt.Ltd.
- (6) Mathematical Physics (17th Edition), B.S.Rajput, Pragati Prakashan,

Meerut.

- (7) Mathematical Physics with Classical Mechanics, Gupta, Yadav, Malik, Kedar Nath, Ram Nath, Meerut.
- (8) Mathematical Physics, Sisodia, Kachava, Khamesra, Dashora Ramesh Book Dept., Jaipur.
- (9) Mathematical Physics, P.K.Chottopadhyay, New Age International (P.) Ltd.
- (10) Mathematical Physics, (2nd Rev.Edition), B.D.Gupta, Vikas Publishing House, New Delhi.
- (11) Advanced Engineering Mathematics (8th Edition), Erwin Kreyszig, Wiley Student Edition, John Wiley & Sons, Inc.

PAPER II**COMPUATIONAL METHODS AND PROGRAMMING**

- UNIT I** : Methods for determination of zeroes of linear and nonlinear equations and transcendental equations, convergence of solutions.
Solution of simulataneous linear equations, Gauss elimination, Pivoting, Iterative method, Matrix inversion.
- UNIT II** : Eigen values and Eigen vectors of matrices, Power and Jacobi methods.
Finite differences, Interpolation with equally spaced and unevenly spaced points, curve fitting, Least squares fitting, Cubic spline fitting.
Numerical differentiation and integration, Newton-Cotes formulae, Error estimates, Gauss methods
- UNIT III** : Random variate, Monte Carlo evaluation of integrals, Methods of importance sampling, Random walk and metropolis methods.
Numerical solution of ordinary differential equations, Euler and Runge Kutta methods, Predictor and Corrector methods, Elementary ideas of solutions of partial differtial equations.
- UNIT IV** : Introduction to programming and study of logic, Elementary information about digital computer principles, compilers, interprets and operating systems, Fortran programming, Flow charts, Integer and floating point arithmetic, Expression, Built in functions.
- UNIT V** : Formats and Format statements, List directed and formatted input and output statements, Assignment statement, control statements: GO TO statements, ON GO TO statements, IF-THEN statements, IF-THEN-ELSE statements, Arithmetic IF statements, Subroutines and functions, Operation with files.

TEXT AND REFERENCES BOOKS

Introductory methods of numerical analysis	Sastry
Numerical analysis	Rajaraman
Computer oriented numerical methods	Rajaraman
Fortran programming	Rajaraman
Programming with FORTRAN	B.H.Pawar

PAPER III**CLASSICAL MECHANICS**

- UNIT I** : Basic Concepts in Classical Mechanics. Newtonian mechanics for single particle and system of particles, Types of the forces and the single particle system examples, Limitation of Newton's program, conservation laws viz linear momentum, Angular Momentum and Total Energy, Work-energy theorem; open systems (with variable mass). Principle of virtual work, D'Alembert's principle with applications.
- UNIT II** : Constraints; Definition, Types, cause and effects, Need, Justification for realizing constraints on the system, difficulties introduced by imposing constraints on the system. Examples of constraints, Introduction of generalized coordinates justification. Lagrange's Equations; Properties of Kinetic Energy function, Theorem on total energy, gyroscopic forces; dissipative systems; Rotating frames; inertial forces; terrestrial and astronomical applications of Coriolis force.
- UNIT III** : Linear generalized potentials, Generalized coordinates and momenta & Energy; Gauge function for Lagrangian, gauge invariance; cyclic coordinates, integrals of the motion, Concepts of symmetry, homogeneity and isotropy, Invariance under Galilean transformations Hamilton's equation of motion : Legendre's dual transformation, Principle of least action; derivation of equations of motion; variation and end points; Hamilton's Principle and characteristics functions; Hamilton-Jacobi equation.
- UNIT IV** : Central Force : Definition and Properties, Two-body central force problem, closure and stability of circular orbits; general analysis of orbits; Kepler's laws of equation, Classification of orbits, differential equation of orbit, Variational theorem, artificial satellites; Rutherford scattering.
- UNIT V** : Canonical transformation; generating functions; properties; group property; examples; infinitesimal generators; Poisson bracket; Poisson theorems; angular momentum PBs;

Transition from discrete to continuous system, small oscillations (longitudinal oscillations in elastic rod).

Books :

- (1) Classical Mechanics, by N.C.Rana and P.S.Joag (Tata Mc-Graw-Hill, 1971)
- (2) Classical Mechanics, by H.Goldstein (Addison Wesley, 1980)
- (3) Mechanics, Sommerfeld (Academic Press, 1952)
- (4) Introduction to Dynamics, by I Perceival and D.Richards (Cambridge Univ. Press, 1982).
- (5) Classical Mechanics by J.C.Upadhyay (Himalaya Publishing)
- (6) Classical Mechanics by Waghmare (West Wiley)
- (7) Mathematical Physics by B.D.Gupta (Vikas Publication)
- (8) Classical Mechanics, S.N.Biswas, Book and Allied (P.) Ltd., Kolkata.

PAPER IV**PHYSICS OF LASERS AND LASER APPLICATIONS**

- UNIT I** : Spontaneous emission, Stimulated emission, Population inversion, Fabry Perot etalon, Stable two mirror optical resonators, Longitudinal and transverse modes of laser cavity, Mode selection, Gain in a regenerative laser cavity.
- UNIT II** : Two level laser system, Threshold for three and four level laser systems, Mode locking, Pulse shortening- pico second and femto second operation, Spectral narrowing and stabilization, Gaussian beam and its properties
- UNIT III** : Ammonia maser, Nitrogen laser, Carbon dioxide laser, Excimer laser, Dye laser, Ruby laser, Nd-YAG laser, Diode-pumped solid state lasers, Semiconductor lasers, High power laser systems,.
- UNIT IV** : Laser induced fluorescence, Raman scattering and its applications, Non-linear interaction of light with matter, Laser induced multi-photon processes and their applications.
- UNIT V** : Ultra high resolution spectroscopy with lasers and its applications, Propagation of light in a medium with variable refractive index, Optical fibers, Light wave communication, Qualitative treatment of medical and engineering applications of lasers, Material processing.

TEXT AND REFERENCE BOOKS

Introduction to laser physics	Koichi Shimoda
Introduction to laser physics	BA Lengyl
Lasers	Svelto
Optical electronics	Yariv
Laser spectroscopy	Demtroder

Nonlinear laser spectroscopy	Letekhove
Laser physics	Silfrast
An Introduction to Lasers : Theory and Applications	M.N.Avdahanulu (S.Chand & Co.)

M.Sc.Part-I Semester-I

LABORATORY/PRACTICAL COURSE I

- 1) Develop and execute a program to obtain volumes and areas of regular bodies and figures.
- 2) Develop and execute a program to convert temperature from one system to other system (at least three).
- 3) Develop and execute a program to fit a straight line to experimental data.
- 4) Develop and execute a program to fit exponential function to experimental results.
- 5) Develop and execute a program to obtain integral of a tabular function.
- 6) Develop and execute a program to obtain inverse of a matrix.
- 7) Develop and execute a program to obtain roots of a polynomial by a) Newton-Rapson Method and b) Bisection Method.
- 8) Develop and execute a program to obtain product of two matrices.
- 9) Develop and execute a program to obtain solution of differential equation by a) Euler and B) Runge Kutta Method.
- 10) Develop and execute a program to obtain value of an equation using subroutine.

M.Sc.Part-I Semester-I

LABORATORY/PRACTICAL COURSE II

- 1) Measurement of wavelength of He-Ne laser using ruler
- 2) Measurement of thickness of a thin wire using laser.
- 3) To study the Faraday effect using He-Ne laser.
- 4) Experiments using Babinator.
- 5) To determine λ , D of sodium light and thickness of mica sheet using Michelson Interferometer.
- 6) To measure the intensity distribution across the laser beam.
- 7) To study the fluorescence spectrum of a dye
- 8) Study of Electron spin resonance spectrometer.
- 9) Determination of h/e by using photocell.
- 10) Chi-square test
- 11) To determine Range of Beta particles in aluminum.
- 12) Random nature of radioactivity.
- 13) Determination of wavelength of sodium light using Fabry Perot Etalon.

M.SC.PART-I SEMESTER-II

PAPER V

Quantum Mechanics-I

- UNIT I** : Operators and Eigen Functions : Linear Operators, Operator formation, orthogonal systems, Hermitian operators, Parity operator, commutators. Equations of motion, commutation rules and uncertainty principle. Angular Momentum, Rotations in three dimensional space, Rotations in the coordinate frame. Effect of magnetic field, quantum theory of Normal Zeeman effect, addition of angular momenta (Clebsch-Gordon Coefficients).
- UNIT II** : Quantum Dynamics - The Equations of motion, Schrodinger Picture, Heisenberg Picture, Interaction Picture, Applications to Linear Harmonic Oscillator and Hydrogen atom.
- UNIT III** : Approximation Methods :-
WKB Approximation - Principle, WKB wavefunction, criterion for validity of approximation, application to Bound State.
Variational Method - Principle, application to the theory of deuteron using Yukawa Potential.
- UNIT IV** : Approximation method :-
Time Dependent Perturbations, transition probability, transitions to the continuum.
Time Independent Perturbations, non-degenerate and degenerate cases, application to the explanation of Stark effect.
- UNIT V** : Identical Particles - Principle of indistinguishability of identical particles, The Helium atom, Pauli's exclusion Principle.
Electron Spin :- Spin states of an electron, Pauli spin matrices, spin states for two particles of spin half.

Reference Books :

- (1) Quantum Mechanics, Second Edition, V.K.Thankappan, New Age International (P) Ltd., New Delhi.
- (2) Quantum Mechanics - Eugen Merzbacher, Second Edition, John Wiley & Sons, New York.
- (3) Quantum Mechanics - John L.Powell & Bernard Crasemann, Addison-Wesley Publishing Company, Massachusetts.
- (4) Quantum Mechanics, Thrid Edition, Author - Leonard I Schiff. McGraw Hill Kogakusha- Tokyo.
- (5) Modern Quantum Mechanics - J.J.Sakurai, Pearson Eduction- Delhi.
- (6) Essentials of Quantum Mechanics -B.N.Srivastava

- (7) Advanced Quantum Mechanics - B.S.Rajput, Pragati Prakashan-Mechanics.
- (8) Quantum Mechanics - Monica Gupta, Campus Books International, New Delhi.
- (9) Fundamental of Quantum Mechanics & Spectroscopy - R.C.Bhandari, N.C.Jain, C.M.Kachhava, S.M.Khamesra
- (10) A Text Book Depot - Jaipur - P.M.Mathews and K.Venkatesara, Tata Mc Graw Hill Publishing company, New Delhi
- (11) Quantum Mechanics - G.Aruldas, Prentice-Hall of India, New Delhi.
- (12) Quantum Mechanics - K.Ishita, Sarup & Sons, New Delhi.
- (13) Quantum Mechanics - G.R.Chatwal, S.K.Anand, Himalaya Publication, Bombay
- (14) Quantum Mechanics - Satyaprakash & C.K.Singh, Kedarnath Ramnath & Co.-Meerut.
- (15) Problems in Quantum Mechanics - K.Ishita, Sarup and Sons, New Delhi.

PAPER-VI

ELECTRODYNAMICS AND PLASMA PHYSICS

- Unit-I :** Wave Equation for Electric and Magnetic. Fields in free space, Wave Equation for Vector and Scalar Potential and Solution Retarded Potential and Lienard-Wiechert Potential, Electric and Magnetic fields due to a Uniformly Moving Charge and an Accelerated Charge. Linear and Circular Acceleration and Angular Distribution of Power Radiated, Bremsstrahlung, Synchrotron Radiation and Cerenkhov Radiation, Reaction Force of Radiation.
- Unit-II :** Motion of charged Particles in Electromagnetic Field: Uniform E and B Fields, Nonuniform Fields. Diffusion Across Magnetic Fields, Time Varying E and B Fields. Adiabatic Invariants: First, Second and Third Adiabatic Invariants.
- Unit-III :** Elementary Concepts: Derivation of moment equations from Boltzmann Equation, Plasma Oscillations, Debye Shielding, Plasma Parameters, Magneto-Plasma, Plasma Confinement. Mirror Method.
- Unit-IV :** Hydrodynamical Description of Plasma: Fundamental Equations, Hydromagnetic Waves: Magnetosonic and Alfvén Waves. Relation of Plasma Physics to ordinary electromagnetics, Classical treatment of Magnetic Materials and Dielectric. Dielectric constant of Plasma
- Unit-V :** Wave Phenomena in Magnetoplasma: Polarization, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and

Perpendicular to the Magnetic Field, Propagation at Finite Angle and CMA Diagram, Appleton-Hartree Formula and Propagation through Ionosphere and Magnetosphere; Helicon, Whistler, Faraday Rotation.

Reference Books

1. Electrodynamics : Gupta Kumar Singh Pragati Prakashan
2. Electricity and magnetism: Mahajan and Rangawala Tata Mc Graw-Hill, New York.
3. Electrodynamics : Laud New Age Publication
4. Introduction to Plasma Physics : Francis Chen, Plenum Press
5. Fundamentals of Plasma Physics : Bitten Court, Pergamon Press
6. Mathematical Physics : Satya Prakash, S.Chand and Sons
7. Electrodynamics : J.D.Jackson
8. Plasma Physics, B.Chakravarty.

PAPER-VII

NETWORK THEOREMS AND ELECTRONIC DEVICES

- Unit I : Network Theorems**
Kirchoff's current law and voltage law. Thevenin's theorem, Norton's theorem. Milliman's theorem, maximum power transfer theorem, superposition theorem, Miller's theorem.
- Unit II : Semiconductor discrete devices**
Construction, characteristics and parameters of p-n junction, Schottky, tunnel and MOS diodes. Bipolar junction transistor (BJT), Junction field effect transistor (JFET). Metal-oxide semiconductor field effect transistor (MOSFET). Uni-junction transistor (UJT), silicon controlled rectifier (SCR). Optoelectronic devices: LED, photodiode, solar cell, LCD and phototransistor.
- Unit III : Application of semiconductor devices in linear circuits**
Biasing of a transistor [Bipolar, JFET and MOSFET] as amplifier. Hybrid parameter analysis for CE BJT amplifier. Self bias circuit and voltage divider bias circuit for JFET. Enhancement mode MOSFET and depletion mode MOSFET. Coupling of amplifier stages. Direct coupling, RC and transformer coupling. Frequency response at low, medium and high frequency range for CE BJT amplifier.
- Unit IV : Power Amplifiers and oscillators**
Power amplifiers : Push-pull and complementary symmetry pair type.
Feedback in amplifiers – Negative and positive feedbacks. Oscillators: Phase shift, Hartley, Colpitts and Crystal controlled. Clipping and clamping circuits. Multivibrators

using BJT. Sweep generators using BJT, UJT and SCR.

- Unit V** : **Application of semiconductor devices in digital circuit**
 Transistor as a switch.
 Logic gates : AND, OR, NOT, NOR, NAND. Boolean algebra and De Morgan's theorems. Combination logic circuits. XOR, HA, FA, Multiplexers, demultiplexers and decoders. Sequential logic circuits. RSFF, CLKRSFF, DFF, JKFF and JKM/SFF. Shift registers : SISO, SIPO, PISO, PIPO and universal shift registers.
 Counters – Asynchronous, parallel and decade counters.

Reference Books :

1. Text book of Electrical Technology, Vol. I and IV- Theraja B. L. and Theraja A. K. ; S.Chand and Co.
2. Electronic Devices and Circuits – Gupta S.; Dhanpat Rai Pub.
3. Electronic Devices and Circuits , Vol. I and II–Godse A.P. & Bakshi U. A. Technical Publications, Pune
4. Semiconductor Devices : Physics and Technology - Sze S. M. : Wiley Pub.
5. Introduction to Semiconductor Devices – Tyagi M. S. : John Wiley & Sons.
6. Optical Electronics – Ghatak A. and Thyagarajan K. : Cambridge University Press
7. Digital Principles and Applications – Malvino A. P. and Leach D. P. :Tata McGraw – Hill Publishing Company.
8. Solid State Electronic Devices – Streetman B. G. and Banerjee S. : Prentice - Hall of India Pvt. Ltd.
9. Micro Electronics – Millman J. : McGraw – Hill Publishing Company.

PAPER-VIII

STATISTICAL MECHANICS

- Unit I** : Classical Statistics :- Specification of States, phase space, trajectory and density of states, Liouville's theorem, ensemble, micro canonical, Canonical and grand canonical ensembles, comparison of ensembles, Partition function and its correlation with thermodynamic quantities, Properties of partition function. Gibbs Paradox.
- Unit II** : Quantum Statistics :- Basic Concepts regarding statistics of indistinguishable particles, Concepts about Fermi-Dirac and Bose-Einstein distribution. Ideal Bose-Einstein gas, degeneracy, Bose-Einstein condensation. Thermal properties of B-E gas.

- Unit III** : Ideal Fermi-Dirac Gas : Thermodynamic function of degenerate F-D gas, Free electron model and electron emission. Di-atomic molecule, specific heats of solids, Einstein & Debye theory.
- Unit IV** : Phase Transitions : Landau's theory of phase transition, critical indices, scale transformation and dimensional analysis. Fluctuation in Thermodynamic Quantities, Correlation of space - time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, The Fokker-Planck Equation and its solution.
- Unit V** : Irreversible Processes : Onsager relations, Applications of Onsager relations, Superfluidity - Experimentally observed properties of superfluid He II. Landau's theory.

Reference Books :

- (1) Statistical Mechanics, K.Huang, Wiley Eastern Limited.
- (2) Statistical Physics, Landau and Lifshitz
- (3) Statistical Mechanics, B.K.Agrawal and M.Eisner, Wiley Eastern Limited.
- (4) Introduction to Statistical Mechanics, B.B.Laud.
- (5) Statistical Mechanics, Gupta, Kumar, Pragati Prakashan, Meerut.

SEMESTER-II

Lab-I-LIST OF EXPERIMENTS (ELECTROMAGNETICS)

1. e/m by Magnetron.
2. e/m by Helical Method.
3. e/m by Thomson Method.
4. Characteristics of G.M.Tube.
5. Determination of dead time of G.M.counter
6. Determination of Lande's factor of DPPH using Electron Spin Resonance Spectrometer.
7. Measurement of Hall coefficient of given semiconductor.
8. Determination of Rydberg constant.
9. Directional characteristics of Yagi Antenna.
10. Study of Transmission line.
11. Study of microphone / loud speaker characteristics.
12. Determination of 'e' by Millikan's oil drop method.
13. Determination of Current sensitivity of B.G.
14. Determination of Magnetic Susceptibility of Material by Quincke's Method.
15. Study of Magnetic Properties (Coercivity, retentivity, saturation magnetisation and hysteresis loops) of ferromagnetic samples (soft iron, hard steel & nickel).

SEMESTER-II**Lab. II - List of Experiments**

1. Verification of Network theorems : Thevenin's, Norton's, Milliman's and Maximum Power transfer theorem.
2. Characterization and design of common emitter transistor amplifier and its frequency response.
3. Characterization and design of JFET amplifier.
4. Characterization and design of MOSFET amplifier.
5. Characterization and applications of UJT.
6. Characterization and applications of SCR.
7. Study of negative feedback in amplifier (voltage series/ shunt and current series/ shunt).
8. Astable, monostable and bistable multivibrators by using BJT.
9. Study of oscillators : Phase shift, Hartley and Collpitts oscillators.
10. Study of basic logic gates and their applications as combination logic XOR, HA and FA.
11. Application of basic logic gates as MUX and DMUX.
12. Applications of basic gates as shift registers; SIPO, SISO, PIPO, PISO and universal S/R.
13. Applications of logic gates as counters; serial, parallel and decade counters.

M.Sc. Part-II SEMESTER-III**PAPER-IX****QUANTUM MECHANICS-II**

- Unit-I** : Theory of Scattering - Basic phenomenon of Scattering, Laboratory and CM reference frames, Scattering amplitude, differential Scattering Cross Section, total Scattering Cross Section, Scattering by spherically Symmetric potentials, partial waves and phase shifts, scattering by a perfectly rigid sphere and by square well potentials.
- Unit-II** : Relativistic Wave Equations - The first order wave equations, the Dirac equation, Properties of Dirac matrices, free Dirac particles, equation of continuity, non-relativistic limit, Lorentz-covariance of Dirac equation, the Hole theory.
- Unit-III** : The Second order wave equations, The Klein-Gordon equation, wave equation of the photon, charge conjugation, charge conjugation operator corresponding to Dirac equation and Klein Gordon equation.
- Unit-IV** : Elements of Field Quantization - Lagrangian Field theory, classical field equations, Hamiltonian formulation, Quantization of the field, non-relativistic fields.

Unit-V : Relativistic Fields, The Klein-Gorden field, the Dirac field, the Electromagnetic field, Interacting fields, Feynman diagrams.

Reference Books :

- (1) Quantum Mechanics - S.N.Biswas [Books & Allied (P) Ltd.], Kolkata.
- (2) Quantum Mechanics - Ghatak & Loknatran.
- (3) Quantum Mechanics - Satyaprakash & Singh - Kedarnath Publication.
- (4) Quantum Mechanics - Thankappan - New Age Int. (P) Ltd., N.P.
- (5) Essentials of Quantum Mechanics - B.N.Srivastava - Pragati Prakashan.
- (6) Advanced Quantum Theory and Fields - S.L.Gupta & I.D.Gupta, S Chand & Comp. Ltd.

PAPER-X**ATOMIC AND MOLECULAR PHYSICS**

- Unit-I** : Bohr's theory of Hydrogen spectrum, Different Series in Hydrogen Spectrum. Energy level diagram; Merits and demerits of Bohr's theory. Sommerfield's model of Elliptical orbits (Qualitative Explanation). Fine structure of H_α line. Vector atom model; Space quantization and spin of electron, significance of Principle quantum number (n), Orbital quantum number (l), Magnetic Orbital quantum number (m_l), Spin quantum number (s), Magnetic spin quantum number (m_s), Total Angular Momentum quantum number (j), Magnetic Total number (m_j). l-s coupling for single valence electron atom. Stern Gerlac Experiment. Pauli's exclusion principle. Spectra of alkali elements. Fine structure in alkali spectra.
- Unit-II** : Normal and Anomalous Zeeman effect. Experimental setup to study Zeeman effect. Classical explanation of Normal Zeeman effect. Debye's explanation of Normal Zeeman effect. Theory of Anomalous Zeeman effect. Expression of Lande's spectroscopic splitting factor (g) and effective magnetic moment for single valence electron atom. Origin of Sodium D_1 & D_2 lines. Anomalous Zeeman effect in Sodium D_1 & D_2 lines.
- Unit-III** : Paschen Back effect; Stark effect. LS & JJ coupling in two valence electron atoms. Interaction energy in LS & JJ coupling. Hyperfine structure (Qualitative), line broadening mechanism (general ideas).
- Unit-IV** : Types of Molecules : Diatomic linear symmetric top, asymmetric top and spherical top molecules. Molecular (band) spectra. Classification of molecular spectra (pure

rotational spectra, Rotation-vibration spectra, Visible and UV spectra), Rotational spectra of diatomic molecules as a rigid rotator. Quantum mechanical theory of pure rotational spectra (rigid rotator). Energy levels and spectra of non-rigid rotator. Comparison between spectra of rigid and non-rigid rotators. Isotopic effect in pure rotational spectra. Intensity of rotational lines. Stark Modulated microwave spectrometer (Qualitative).

Unit-V : Vibrational energy of Diatomic molecule. Diatomic molecule as a simple harmonic oscillator. Energy levels and spectrum. Morse potential energy curve. Molecules as a vibrating rotator. Vibration spectrum of diatomic molecule. PQR branches, IR spectrometer (Qualitative).

Text and Reference Books :

- (1) Elements of Spectroscopy - Gupta, Kumar, Sharma, Pragati Prakashan, Meerut.
- (2) Introduction to Atomic Spectra- H.E.White (T)
- (3) Fundamentals of Molecular Spectroscopy - C.B.Banwell (T)
- (4) Spectroscopy Vol. -I,II & III - Walker & Straughen
- (5) Introduction to Molecular Spectroscopy - G.M.Barrow
- (6) Spectra of Diatomic Molecules - Herzberg
- (7) Molecular Spectroscopy - Jeanne L McHale
- (8) Molecular Spectroscopy - J.M.Brown
- (9) Spectra of atoms and molecules - P.F.Bemath
- (10) Modern Spectroscopy - J.M.Holias

PAPER-XI

CONDENSED MATTER PHYSICS-I

UNIT-I : Crystallography-Single Crystal and Poly crystal , crystal symmetry, symmetry elements, crystal types, two dimensional point group, enumeration of 2-Dimensional crystallographic point group, two-dimensional space group,3-D point group,3-D Bravais lattice,3- D space group, Hexagonal closed packed structure, Liquid crystal & its types

UNIT-II : Diffraction of X-rays - Braggs law in one dimension and 3-dimensions, X-ray diffractions techniques: Laue, Rotating Crystal method, Powder-Photograph method, Diffraction of electrons and neutrons, Inelastic Scattering, atomic scattering factor, Concept of Reciprocal lattice, vector demonstration of reciprocal lattice in two dimensions, Braggs diffraction condition in term of reciprocal lattice, Brillouin zones

UNIT-III : Inter-atomic forces and lattice dynamics of simple metals, ionic and covalent crystals

Optical constant and dielectric constant, Inelastic neutron scattering, Mossbauer effect ,Debye- Waller factor, Anharmonicity and thermal expansion, thermal conductivity, Interaction of electron with photons, direct and indirect transitions, Polaritons, one phonon absorption, optical properties of metals, Skin effect & anomalous skin effect.

UNIT-IV : Nanotechnology - Carbon Nanotubes and its types. Fabrication of CNT, structure, electrical properties. mechanical properties, Applications of carbon nanotubes : Field emission & shielding, Computers, Fuel cells, Chemical sensors, Catalysis.

Bulk nanostructured materials :- Synthesis method of Chill block melting, gas atomization, mechanical properties, electrical properties

Quasi crystal, Fullerenes, Penrose lattice, Formation and characterization of Fullerenes.

Concepts of quantum well and dot ,size effect, preparation of quantum nanostructure.*

UNIT-V : Superconductivity :Introduction, Meissner effect, D.C. resistivity, the heat capacity, flux quantization. Superconducting energy gap, coherence length, London penetration depth ,BCS theory, Ginzberg- Landau theory, Interacting Cooper pairs, the condensate. Type I and II superconductors. Tunneling, phase and momentum, DC and AC Josephson effects, SQUID, Introduction to high Tc superconductors.

TEXT BOOKS

1. Solid State Physics : N.W. Ashcroft and N.D. Mermin, CBS Publishing Asia Ltd.
2. Introduction to Solid State Physics : Charles Kittel : John Wiley and Sons
3. Solid State Physics : H. Ibach and H. Luth -Springer-Verlag
4. Fundamentals of Solid State Physics : J.R. Christman; John Wiley and Sons
5. Solid State Physics A.J. Dekkar; Prentice Hall
6. Introduction to Nanotechnology-C.P.Poole Jr. & F.J.Owens, A John Wiley & Sons ,Inc.Pub.
7. Nanotechnology –Appin Lab- BPB Publication, New Delhi.
8. Introduction to Solid State Physics – Madulung
9. Elementary solid state Physics- Omar
10. Crystal Structure analysis - Burger

PAPER XII
ELECTRONICS-I

- Unit I** : Linear integrated circuits
Operational Amplifier (IC741), Block diagram, characteristics and parameters : Input offset voltage, input bias current, input offset current, CMRR, PSRR, slew rate, frequency response. OPAMP applications as inverting amplifier. Non-inverting amplifier, adder, subtractor, integrator, differentiator, comparator, Schmitt trigger, wave form generator and analog computer.
- Unit II** : Applications of Linear ICs
OPAMP as instrumentation amplifier, Digital to Analog converter : ladder and weighted register type. Analog to Digital converter : Counter type and successive approximation type. PLL circuit and its applications. OPAMP as butter worth filter (low pass, high pass and band pass only). Semiconductor memories RAM, ROM and EPROM.
- Unit III** : Microprocessors 8085
8085 CPU – Architecture, Bus timings, address bus, generating control signals. Addressing modes, Instruction set; writing assembly language programmes looping, counting and indexing, counters and timing delays, stack and subroutine.
- Unit IV** : Microprocessors 8086
Internal architecture and pin diagram of 8086 microprocessors. Minimum and maximum modes. Support chip 8282, 8284, 8286 and 8288. Timing diagrams, read and write machine cycles, address decoding. Even and odd memory banks, accessing memory and I/O ports. Programmer's model of 8086 – Addressing modes, accessing data in memory, instruction set, instruction encoding format, ALP.
- Unit V** : I/O Interfacing
I/O interface, I/O port address decoding. Programmable peripheral interface IC 8255
Keyboard display controller IC 8279
Programmable internal timer IC 8254
Interfacing of ADC and DAC to microprocessors

Reference Books :

- OPAmps and Linear Integrated Circuits- Gaikwad R. A. : Prentice – Hall of India Pvt. Ltd.

- Electronic Devices and Circuits , Vol. II – Godse A. P. and Bakshi U. A., Technical Publications, Pune .
- Microprocessor Architecture, Programming and Applications with 8085/8086 - Gaonkar R. S. : Wiley – Eastern Ltd.
- Microprocessor and Interfacing Techniques - Godse A. P. and Godse D. A., Technical Publications, Pune .
- Microprocessor and Interfacing Techniques – Katre J. S. and Shah U. S. : Tech – Max Publications, Pune.
- Intel Microprocessor – Brey B. B. : Pearson Education..

SEMESTER-III

LAB I - List of Experiments

- Determination of Electrical Conductivity of a given material by Four Probe Method.
- Determination of Thermoelectronic Power of a substance.
- To study variation of Dielectric constant of a given solid / liquid with temperature.
- Determinations of specific heat of graphite sample.
- Measurement of ultrasonic velocity in a given liquid.
- Determination of thermal conductivity of a given material sample.
- Study of Crystal structure by Laue's Pattern.
- Determination of Lattice parameters using powder photograph / graph.
- Determination of grain size of the given samples by using XRD patterns and SEM photographs.
- To determine coefficient of linear thermal expansion of metals.
- To study lattice dynamics of monoatomic and diatomic molecules.
- Study of stereographic projections.
- Comparative study of line spectra of known and unknown materials.
- Deposition of nanometer size thin films and determination of its thickness.
- Determination of Curie temperature of a given sample.

SEMESTER-III

LAB II - List of Experiments

- Application of OPAMP as inverting, non-inverting and summing amplifier.
- Applications of OPAMP as differentiator and integrator.
- OPAMP as square and triangular waveform generator.
- OPAMP as instrumentation amplifier for measurement of temperature.
- Study of ADC and DAC.
- Study of PLL and its applications.

7. OPAMP as Butterworth filter low pass, high pass and band pass circuit.
8. Addition, subtraction, multiplication and division using 8085 microprocessor.
9. Addition and subtraction using 8086 microprocessor.
10. Assembly language programming on PC.
11. Speed control of stepper motor using PPI 8255.
12. Assembly language program to design time delay and its application as up and down counter.

M.Sc.Part-II SEMESTER-IV

PAPER-XIII

SOLID STATE PHYSICS

- Unit-I** : X-ray diffraction : Principle of powder diffraction, significance and diffraction geometry of powder method, interpretation of powder photograph, measurement of Bragg's angle, interplaner spacing (d), Accurate lattice parameter determination. Analytical and Graphical methods for (known unit cell), Bernal chart, Oscillation and Burger precession method, Interpretation of oscillation photographs.
- Unit-II** : Band Structure - Electron levels in periodic potential (Kronig Penny Model), Bloch theorem - statement and proof. Crystal momentum, number of orbitals in a band, band index and the concept of effective mass. Motion of electrons in bands. Reduced, periodic and extended zone schemes. Construction of Fermi surface. Nearly free electron model : qualitative proof for origin of gap in periodic potential and perturbation theory. Tight binding model : assumptions and applications to SC, FCC and BCC structures.
- Unit-III** : Atomic magnetic moment, Larmor precession. Diamagnetism and paramagnetism. Ideal magnetic gas, classical and quantum mechanical treatments of paramagnetism. Weiss theory of ferromagnetism, Heisenberg model of molecular field theory, spin waves and magnons. Curie- Weiss law for susceptibility. Ferri and antiferro magnetic orders. Domains and domain walls.
- Unit-IV** : Transport Properties :- Boltzmann transport equation, collision operator, Lorentz solution, Sommerfield theory of electrical and thermal conductivity, Hall effect, Cyclotron resonance, drift velocity, Scattering by phonons. Thermoelectric effect, Magnoresistance effect.
- Unit-V** : Dielectrics, concept of dielectrics. Types of Polarization mechanisms, Clausius. Mosotti relation, complex dielectric

constant, loss angle and relaxation time, Concept of Ferroelectricity and its types.

Reference Books :

- (1) Solid State Physics, N.W.Ashcroft and N.D.Mermin; CBS Publishing Asia Ltd.
- (2) Introduction to Solid State Physics (2nd Edition), Charles Kittel; John Wiley and Sons.
- (3) Solid State Physics, H.Ibach and H.Luth; Springer-Verlag.
- (4) Fundamentals of Solid State Physics, J.R.Christman; John Wiley and Sons.
- (5) Solid State Physics, A.J.Dekkar; Prentice Hall.
- (6) Material Science & Engineering - V.Raghwan (Prentice Hall India.)
- (7) Science of Engineering Materials (2nd Ed.) - C.M.Shrinivasan and S.Shrinivasan, (New AgeInt.)
- (8) Elementary Solid State Physics - Omar
- (9) Solid State Physics- Gupta & Kumar (Pragati)
- (10) Solid State Physics - Gupta & Saxena (Pragati)

PAPER-XIV

NUCLEAR AND PARTICLE PHYSICS

- Unit-I** : The Nucleus : Static Properties of the Nucleus : Nuclear size, nuclear shape, nuclear radius (Hofstadter Experiment), Magnetic moments, Electric moments, Electric Quadrupole moments, Experimental methods for determination of nuclear magnetic moments. Dynamic properties of the nucleus, Decay of excited nucleus, Basic ideas of nuclear reactions : Compound nucleus, direct reactions.
- Unit-II** : Nuclear force, nucleon-nucleon interactions Exchange forces, tensor forces, Meson theory of nuclear forces, Spin dependence of nuclear forces, Charge independence and charge symmetry of nuclear forces. Isospin formalism. Models of the nucleus, liquid drop model, Shell model of the nucleus, Shell model and Magnetic moments of the Nucleus, Schmidt lines.
- Unit-III** : Neutron Physics, Properties of neutrons, classification of neutrons according to their energy, neutrons sources, neutrons detectors, slowing down of fast neutrons, absorption of neutrons. Reactor Physics : neutrons multiplication, types of reactors, General considerations for reactor design, four factor formula, moderators.
- Unit-IV** : Nuclear Detectors - Gas filled, solid state and high energy detectors. Wilson cloud chamber, Spark Counter. Particle Accelerators - Need for particle accelerators,

classification, wave guide type linear accelerator, focusing in linear accelerators, Betatron, Synchrotron, Synchrotron as a radiation source.

Unit-V : Particle Physics : Classification of elementary particles, types of interactions between elementary particles, symmetry and conservation laws, Basic ideas of CP and CPT invariance, the quark model, Lie algebra, SU(2) and SU(3) multiplets (Meson and Baryon states), the General model.

Reference Books :

- (1) Nuclear Physics, Second Edition - Irving Kaplan, Addison-Wesley Publishing - Massachusetts.
- (2) Concepts of Nuclear Physics - Bernard L.Cohen, Tata McGraw-Hill Publishing Co. - New Delhi.
- (3) Elements of Nuclear Physics - Pandya M.L.
- (4) Nuclear Physics : An Introduction - S.B.Patel, Wiley Eastern Limited - New Delhi.
- (5) Nuclear Physics : Theory and Experiment : R.R.Roy and B.P.Nigem, New Age International (P) Ltd.-New Delhi.
- (6) Nuclear Physics - D.C.Tayal, Himalaya Publishing House, Bombay.
- (7) Nuclear Physics - S.N.Ghoshal, S.Chand & Company, New Delhi.
- (8) Elementary - Particle Physics - Committee on Elementary Particle Physics Universities Press (India) Ltd., Hyderabad.
- (9) The Elements of Nuclear Reactor - Glasstone Samuel, D.Van Nestrland Company- New Jersey.

PAPER- XV

CONDENSED MATTER PHYSICS

Unit-I : Imperfection in Crystals -Mechanism of plastic deformation in solids, stress & strain field of screw dislocation, elastic energy dislocation, stress needed to operate Frank Read Source, Partial Dislocation and Stacking fault in close-packed structure.

Experimental method of observing dislocation and stacking fault, electron microscopy.

Unit-II : Multiple-beam interferometer and its application to study of surface topography, conditions for accurate determination of step height and film thickness (Fizeau fringes). Electrical conductivity of thin films, difference between properties of thin films and bulk materials, Boltzman transport equation for thin films (for diffused scattering).

Unit-III : Interacting electron gas, Hartee & Hartee-Fock approximation, Correlation energy, Screening, dielectric

function, Thomas-Fermi and Lindhard Theory, Frequency dependent Lindhard screening, Screening of Hartee-Fock approximation. Fermi Liquid Theory.

Unit-IV : Point Defects and Types, concentration of defects, description of point defect with in the frame work of band model, crystal field theory, localized lattice vibrations, localized states and associates wave function, diffusion and ionic conduction, recombination process of imperfection, optical transitions of imperfections, imperfections and scattering centers, Kondo effect, electronic surface states.

Unit-V : Types of lattice disorders, localized states, Anderson model, density of states : Impurity band semiconductor, amorphous semiconductors, transport in disordered lattice, hopping probability, fixed and variable range hopping, conductivity in impurity bands and in amorphous semiconductors.

TEXT BOOKS

- (1) Solid State Physics : N.W. Ashcroft and N.D. Mermin; CBS Publishing Asia Ltd.
- (2) Introduction to Solid State Physics [2nd Edition] Chap-1, Charles Kittel; John Wiley and Sons.
- (3) Introduction to Solid State Physics – Madulung
- (4) Fundamentals of Solid State Physics, J.R. Christman; John Wiley and Sons
- (5) Solid State Physics A.J. Dekkar; Prentice Hall
- (6) Crystallography applied to Solid State Physics- 2nd Edn, A.R.Varma.& O.N.Shrivastava ,Wiley Eastern Ltd.
- (7) Elementary Solid State Physics- M.Ali Omar
- (8) Multiple Beam Interferometry- Tolansky
- (9) Physics Of thin film-Chopra.
- (10) Solid State Physics-H. Ibach and H. Luth; Springer-Verlag

PAPER-XVI

ELECTRONICS – II

Unit I : Basic principles of amplitude, frequency and phase modulation. Simple circuit for amplitude modulation and demodulation. AM transmitter.

Frequency modulation circuit. Frequency demodulation circuits .FM transmitter. AFC circuits. SSB modulation technique. Generation and detection of SSB waves.

Unit II : Transmission lines. Antenna used in AM and FM receivers. Radio receivers. Principle and basic features of TRF radio receiver. Super heterodyne principle. Autodyne converter,

IF Amplifier. Super heterodyne receiver, its merits and demerits.

Unit III : Velocity modulation. Basic principles of two cavity Klystrons and Reflex Klystrons, principle of operation of magnetrons. Gunn effect. Principle of operation and mode of operation of Gunn diode, IMPATT diode. Advantages and disadvantages of microwave transmission, losses in free space, propagation of microwaves, atmospheric effect on propagation, Fresnel Zone problem, ground reflection, fading sources, detectors components, and antennas used in micro wave communication systems

Unit IV : Digital communication
Pulse modulation system: Sampling theorem – low pass and band pass signals, PAM, channel BW for a PAM signal. Natural sampling, flat –top sampling, signal recovery through holding, quantization of signals, quantization error, PCM, DPCM, delta modulation, adaptive delta modulation. Digital modulation techniques: BPSK, DPSK, ASK, QASK, BFSK, FSK.
Data transmission : Base band signal receiver, probability of error. Optimum filter. White noise, Matched filter and probability of error. Coherent reception, correlation, PSK, FSK, non-coherent detection of FSK and DPSK. Calculation of error probability for BPSK and BFSK.

Unit V : Computer communication system
Types of networks, design features of a communication networks. Examples TYMNET, ARPANET, ISDN, LAN. Time division multiple access (TDMA), frequency division multiple access (FDMA). ALOHA, slotted ALOHA, carrier sense multiple access (CSMA), Poisson distribution, protocols.

Reference Books :

1. Electronic Communication Systems – Kennedy : Tata McGraw Hill Pub. Co.
2. Microwaves – Gupta K. L. : Wiley – Eastern Ltd.
3. Microwave and Radar Engineering – Kulkarni M. : Umesh Publications, Delhi.
4. Electronic Devices and Circuits – Gupta S. ; Dhanpat Rai Pub.
5. Modern Digital and Analog Communication Systems – Lathi B. P. : Oxford University Press.
6. Principles of Communication Systems – Taub H. and Schilling D. L.: Tata McGraw Hill Pub. Co.

SEMESTER-IV

LAB. I - List of Experiments

1. Pulse amplitude modulation and demodulation.
2. Pulse position modulation and demodulation.
3. Pulse width modulation and demodulation.
4. Study of delta modulation and demodulation.
5. Characteristics of antenna.
6. Study of amplitude modulator.
7. Study of frequency modulator.
8. Study of FSK modulator and demodulator
9. Study of super-heterodyne receiver.
10. Study of fibre optics voice transmission and reception.
11. Study of Dislocation density of crystals by etching method.
12. Measurement of photoconductivity of a sample.
13. To study variation of ionic conductivity of a given sample with temperature.
14. Determination of susceptibility of a solid.
15. Study of modulus of rigidity & internal friction in metal as a function of temperature.
16. Determination of Poisson's ratio of glass by Cornu's method.

SEMESTER-IV

LAB. II

Projects

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M.Sc.Part-I & Part-II (Semester I to IV) Examinations in Physics (Prospectus No.2009128)

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