P.K.University
Shivpuri (M.P.)

M.Sc. Physics Syllabus

Scheme of Examination

SEMESTER – I

Paper	Subject Code	Paper Title	Max. Marks
I	MSCP- 101	MATHEMATICAL PHYSICS	**100**
II	MSCP- 102	CLASSICAL MECHANICS	**100**
III	MSCP- 103	QUANTUM MECHANICS- I	**100**
IV	MSCP- 104	ELECTRONIC DEVICES	**100**
Lab	MSCP- 105	PRACTICAL BASED ON SYLLABUS	**100**
		Total	**500**

SEMESTER – II

Paper	Subject Code	Paper Title	Max. Marks
I	MSCP- 201	QUANTUM MECHANICS -II	**100**
II	MSCP- 202	STATISTICAL MECHANICS	**100**
III	MSCP- 203	ELECTRODYNAMICS AND PLASMA PHYSICS	**100**
IV	MSCP- 204	ATOMIC AND MOLECULAR PHYSICS	**100**
Lab	MSCP- 205	PRACTICAL BASED ON SYLLABUS	**100**
		Total	**500**

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SEMESTER – III

Paper	Subject Code	Paper Title	Max. Marks
I	MSCP- 301	COMPUTER ARCHITECTURE, NETWORKING & ASSEMBLY LANGUAGE PROGRAMMING	**100**
II	MSCP- 302	ENVIRONMENTAL PHYSICS	**100**
III	MSCP- 303	COMMUNICATION ELECTRONICS	**100**
IV	MSCP- 304	DIGITAL ELECTRONICS	**100**
Lab	MSCP- 305	PRACTICAL BASED ON SYLLABUS	**100**
		Total	**500**

SEMESTER – IV

Paper	Subject Code	Paper Title	Max. Marks
I	MSCP- 301	CONDENSED MATTER PHYSICS	**100**
II	MSCP- 302	NUCLEAR AND PARTICLE PHYSICS	**100**
III	MSCP- 303	COMPUTATIONAL METHODS AND PROGRAMMING	**100**
IV	MSCP- 304	MATERIALS SCIENCE	**100**
Lab	MSCP- 305	PRACTICAL BASED ON SYLLABUS	**100**
		Total	**500**

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER – I **PAPER - I**

MATHEMATICAL PHYSICS

Unit -I

Differential equations: Recursion relation, generating functions and orthogonality of Bessel functions of first and second kind, Hermite, Legendre, Associate Legcndre and Laguerre Polynomials.Curvilinear co-ordinate system with specific cases of Cartesian, Cylindrical, and Spherical coordinate systems.

Unit -II

Integral transforms. Fourier integral. Fourier transform and inverse Fourier transforms. Fourier transform of derivatives. Convolution theorem. Elementary Laplace transforms. Laplace transform of derivatives. Application to a damped harmonic oscillator.

Unit -III

Green's functions: Non- homogenous boundary value problems, Green's function for one dimensional problems, eigen function expansion of Green's function, Fourier transform.method of constructing Green's function, Green's function for electrostatic boundary value.problems and quantum-mechanical scattering problem.

Unit -IV

Complex variables: Analyticity of complex functions. Cauchy Riemann equations. Cauchy theorem. Cauchy integral formula. Taylors, Maclaurin, Laurent series & mapping. Theorem of residues. Simple cases of contour integration. Jordan's lemma Integrals involving multiple valued unctions(Branch points).

Unit –V

This unit will have a short *note* question covering all the four units. The students will have to answer any two questions out of the four.

Books Recommended :

1. L. A. Pipes — Mathematics of Engineers and Physicists
2. Arfken — Mathematical Methods for Physicists
3. P.K. Chattopadhyay — Mathematical Physics
4. H.K.Dass — Mathematical Physics
5. Ghatak, Goyal & Guha — Mathematical Physics
6. M.R Spiegel (Schaum Series) — Complex variable & Laplace Transform

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - I **PAPER - II**

CLASSICAL MECHANICS

Unit - I

Newtonin mechanics of one and many particles systems: Conservation laws, Constrains their classification, Principle of virtual work; D'Almbert's principle in generalized coordinates, The Lagrange's equation from D'Almbert's principle. Configuration space, Hamilton's principle deduction from D'Almberts principle, Generalized momenta and Lagrangian formulation of the conservation theorems, Reduction to the equivalent one body problem; the equation of motion and first integrals, the differential equation for the orbit.

Unit - II

The equations of canonical transformation and generating functions; The Hamilton-Jacobi Action and Angel variables. Poisson's brackets; simple algebraic properties of Poisson's brackets. The equation of motion in Poisson's Brackets notation. Poisson theorem; principle of least action. The Kepler problem, Inverse central force field, Rutherford scattering.

U n i t - III

Theory of small oscillations, Equations of motion, Eigen frequencies and general motion, normal modes and coordinates, Applications to coupled pendulum and linear bistable molecule. Rotating coordinate systems. Acceleration in rotating frames. Coriolis force and its terrestrial astronomical applications, Elementary treatment of Eulerian co-ordinates and transformation matrices. Angular momentum inertia tensor. Eular equations of motion for a rigid body. Torque free motion for a rigid body.

Unit - IV

Symmetries of space and time. Invariance under galilion transformation, Covariant four-dimensional formulation, 4 -Vectors and 4 - scalers. Relativistic generalization of Newton's laws, 4 - momentum and 4 - force, variance under Lornetz transformation relativistic mechanics. Covariant Lagrangian, covariant Hamiltonian, Examples.

Unit -V

This unit will have a short note question covering all the tour units. The students will have to answer any two questions out of the four.

Books Recommended

1. H.Goldstein (Addison Wesley) Classical Mechanics
2. N.C.Rana & P.S.Jog Classical Mechanics
3. Landu & Lifshitz (Pergamann Press) Classical Mechanics
4. A. Sommarfield (Academic Press) Classical Mechanics
5. R.G.Takwale & P.S. Puranik Introduction to Classical Mechanics

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - I **PAPER - II**

QUANTUM MECHANICS- I

Unit – I

Basic Postulates of quantum Mechanics, equation of continuity, Normality, orthogonality and closure properties of eigen functions, expectation values and Ethrentest theorems, solution of Schrodinger equation for one dimensional (a) potential well (b) potential step and (c) Potential barrier.

Unit – II

Linear vector space, concept of Hibert space, bra and ket notation for state vector, representation of state vectors and dynamical variables by matrices and unitary transformation (Translation and rotation), creation and annihilation operators, matrices for x and p. Heisenberg uncertainty relation through operators (Schwartz inequality).

Unit -III

Solution of Schrodinger equation for (a) linear harmonic oscillator (b) hydrogen - like atom (c) square well potential and their respective application to atomic spectra, molecular spectra and low energy nuclear states (deutron).

Unit - IV

Angular momentum in quantum mechanics, Eigen values and Eigen function of L^2 and L_z in term of spherical harmonics, commutation relation. Time independent perturbation theory. Non-degenerate and degenerate cases.

Unit -V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference-book:

1. L I Schiff, Quantum Mechanics
2. S Gasiorovvicz, Quantum Physics
3. B Craseman and J D Powell Quantum Mechanics
4. A P Messiah Quantum Mechanics
5. J. J. Sakurai Modern Quantum Mechanics
6. Mathews and Venkatesan Quantum Mechanics

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - I **PAPER - IV**

ELECTRONIC DEVICES

Unit – I

Transistors: JFET, BJT, MOSFET and MESFET, structure derivations of the equations for I-V characteristics under different condition, microwave devices, tunnel diode, transfer electron devices (Gunn diode), avalanche transits time devices, Impatt diodes and parametric devices.

Unit - II

Photonic devices: radiative and non-radiative transitions, optical absorption, bulk and. thin film photo conductive devices (LDR), diode Photo detectors, Solar cell (open circuit voltage and short circuit current, fill factor), LED (high frequency limit, effect of surface and indirect recombination current, operation of LED), semi-conductors; diode lasers (conditions for population inversion in active region, light confinement factor, optical gain and threshold current for lasing.

Unit - III

Memory Devices: Read Only Memory (ROM) and Random Access Memory(RAM).Types of ROM: PROM, EPROM, EEPROM and EAPROM, Static and dynamic RAMs (SRAM & DRAM), characteristics of SRAM and DRAM.Hybrid Memories : CMOS and NMOS memories, Nonvolatile RAM, ferro-electric memories, charge coupled devices (CCD), storage devices: Geometry and organization of magnetic (FDD & HDD) and Optical **(CD-ROM, CD-R, CD-R/W,** DVD) Storage devices.

Unit - IV

Electro-optics, Magneto-optic and Acousto-optic effects, materials properties related to get these effect,important ferro electric, liquid crystal and polymeric materials for these devices, piezoelectric, electrostrictive and magnetostrictive effects. Important materials for these properties and their applications in sensors and actuator devices, acoustic delay lines, piezoelectric resonators and filters, high frequency piezoelectric devices-surface, acoustic wave devices,

Unit - V

This unit will have a short note question covering all the four units. 'The students will have *to* answer any two questions out of the four.

Text books and reference books:

1.	SM Sze Willey (1985)	Semiconductors devices - physics technology
2.	M S tyagi	Introduction to semiconductors devices
3.	M Sayer and A Manisingh	Measurement instrumentation and experimental design in physics and engineering
4.	Ajoy Ghatak and Thyagrajam	Optical Electronics

Physics Practial

LAB

The following experiments to be performed by the students. (Similar experiments of equal standard may be added)

List of Experiments:

1. Mean variance, standard deviation, correlation coefficient and equations of lines of regression for a bivariate data.
2. Solution of simultaneous linear algebra equations by Gauss elimination method.
3. Solution of simultaneous linear algebra equations by Gauss iteration method.
4. Solution of simultaneous first order differential equations by Runge Kutta method.
5. Evaluation of an integral by Gaussian quadrate.
6. Solution of Laplace equation.

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - II **PAPER - I**

QUANTUM MECHANICS –II . ,

Unit - I

Approxmination method for bound states : Rayleigh- Schrodinger Perturbation theory of non- degenrate and degenrate levels and their application to perturbation of an oscillator, normal helium atom and first order stark effect in hydrogen. Variation method and its application to ground state helium, W K B Approximation method, connection formulae, ideas on potential barrier with applications to theory of alpha decay.

Unit - II

Time dependant perturbation theory: Methods of variation of constants and transition probability, adiabatic and sudden approximation, wave equation for a system of charged particles under the influence of external electromagnetic field, absorption and induced emission, Einstein's A and B coefficients and transition probability.

Unit- III

Theory of Scattering, Physical concepts, scattering amplitude, scattering cross section. Born Approximation and partial waves, scattering by perfectly rigid sphere, complex potential and absorption, scattering by spherically symmetric potential, identical particles with spin, Pauli's spin matrices.

Unit- IV

Schrödinger's relativistic equation (Klein-Gordon equation), Probability and current density, Klein - Gordon equation in presence of electromagnetic field, hydrogen atom, short comings of Klein-Gordon equation, Dirac's relativistic equation for free electron, Dirac's Matrices. Dirac's relativistic equation in electromagnetic field, negative energy states and their interpretation hydrogen atom, hyperfine splitting.

Unit - V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference book:

1. LI Schiff — Quantum Mechanics
2. S Gasiorowicz — Quantum Physics
3. B Craseman and J J Powell — Quantum Mechanics (Addison Wessley)
4. A .Messiah — Quantum Mechanics
5. J.J. Sakurai — Modern Quantum Mechanics
6. Mathews and Venkatessan — Quantum Mechanics
7. A .K.Ghatak and Loknathan — Quantum Mechanics

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CLASS - M.Sc.

SUBJECT - PHYSICS

SEMESTER - II

PAPER - II

STATISTICAL MECHANICS

Unit - I

Foundation of statistical mechanics, specification of states of a system contact between statistics and thermodynamics, classical ideal gas entropy of mixing and Gibb's paradox.Microcanonical ensemble, phase space, trajectories and density of states, Liouville theorem, canonical and grand canonical ensembles, partition function, calculation of statistical quantities, energy and density fluctuations.

Unit-II

Statistics of ensembles, statistics of indistinguishable particles, density matrix, Maxwell -- Boltzmann, Fermi Dirac and Bose- Einstein statistics, properties of ideal Bose gases, Bose — Einstein condensation, properties of ideal Fermi gas, electron gas in metals, Boltzman transport equation.

Unit-III

Cluster expansion for a classical gas, virial equation of state, mean field theory of Ising model in 3,2 and 1 dimension. Exact solution in one-dimension.

Unit –V

Thermodynamics fluctuation spatial correlation Brownian motion, Langevin theory, fluctuation dissipation theorem, the Fokker-Planck equation, Onsager reciprocity relations

Unit – V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference book:

1. F Reif — Statistical and thermal Physics
2. K Huang — Statistical Mechanics
3. R K Pathria — Statistical Mechanics
4. R Kubo — Statistical Mechanics
5. Tandan — Statistical Physics

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SUBJECT - PHYSICS

CLASS - M.Sc.

SEMESTER - II PAPER - III

ELECTRODYNAMICS AND PLASMA PHYSICS

Unit – I

Review of Basics *of* electrostatics and magnetostatics (electric field, Gauss's law, Laplaces and Poisson equations, method of images, Biot-Sawart law, Ampere law, Maxwell's equations, scalar and vector potentials, gauge transformation, Lorentz gauge, Coulomb Gauge, Solution of Maxwell equations in conducting media radiations by moving charges, retarded potentials, Lienard Wiechrt potentials, fields of charged particles in uniform motion, fields of arbitrarily moving charge particle.

Unit-II

Fields of an accelerated charged particles at low velocity and high velocity, angular distribution of power radiated, Review of four vector and Lorentz transformation in 4-dimensional spaces, Invariance of electric charge, relativistic transformation properties of E and H fields. Electromagnetic fields tensor in 4-dimensional Maxwell equation, Four Vector current and potential and their invariance under Lorentz transformation, covariance of electrodynamics.

Langragian and Hamiltonian for a relativistic charged particle jn External EM field; motion of charged particles in electromagnetic fields, uniform and non-uniform E and B fields.

Unit -III

Elementary concept of occurrence of plasma. Gaseous and solid state plasma. Production of gaseous and solid state plasma. Plasma parameters. Plasma confinement pinch effect instability in a pinched- plasma column. Electrical neutrality in a plasma. Debye screening distance. Plasma oscillations: Transverse oscillations and longitudinal oscillations.

Unit – IV

Domain of Magnetohydrodynamics and plasma Physics : Magneto-hydrodynamic equations, magnetic hydro- static pressure hydrodynamic waves: Magneto-sonic and Alfven waves, particle orbits and drift motion in a plasmas, Experimental study of Plasma, the theory of single and double probes.

Unit - V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference book:

1. Bitteneerort — Plasma Physics
2. Chen — Plasma Physics
3. Gupta, Kumar, Singh — Electrodynamics ;
4. Sen — Plasma state and matter
5. Jackson — Classical electrodynamics
6. Pamolsky & Philips — Classical electricity and Magnetism

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - II **PAPER - IV**

ATOMIC AND MOLECULAR PHYSICS

UNIT -I

Quantum states of one electron atom. Atomic orbitals. Hydrogen spectrum, Paulis principle, Spectra of alkali elements, Spin orbit interaction and line structure of alkali Spectra . Methods of molecular quantum mechanics, Thomas Fermi statistical model, Hartree and Hartree fock method, Two electron system. Interaction energy in L-S and J-J coupling, hyperfine structure (qualitative), line broadening mechanisms(general ideas).

UNIT - II

Types of molecules. Diatomic linear. Symmetric top, asymmetric top and spherical top molecules. Rotational spectra of diatomic molecules as a rigid rotator, Energy level and Spectra of non-rigid rotator, intensity of rotational lines,

UNIT- III

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

UNIT-IV

Introduction to ultraviolet, visible and infra-red spectroscopy, Raman spectroscopy: Introduction, pure rotational and vibrational spectra, Techniques and instrumentation, Photo electron spectroscopy, elementary idea about photoacoustic spectroscopy and Mossbauer spectroscopy(principle).

UNIT-V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text **and** reference Books:

1. H.E. White — Introduction to atomic spectra
2. C.B. Banwell — Fundamental of molecular spectroscopy
3. Walker and Strnghem — Spectroscopy vol. I, II and 111
4. G.M.Barrow — Introduction to molecular spectroscopy
5. Herzberg — Spectra of diatomic molecules
6. Jeanne L and McHale — Molecular Spectroscopy
7. J.M.Brown — Molecular Spectroscopy
8. P.F.Bemath — Spectra of atoms and molecules
9. J.M. Halian — Modern Spectroscopy '

Physics Practial

LAB

The following experiments to be performed by the students. (Similar experiments of equal standard may be added)

List of Experiments:

1. Determination of energy band gap of Germanium diode
2. Study of Hall Effect.
3. Study of sampling theorem.
4. Study of luminescence properties of materials
5. Study of JFET – characteristics and its applications using Multisim software.
6. MOSFET - characteristics using Multisim Software.
7. Design of simple circuits using Multisim Software.
8. Design of simple amplifier by using Multisim Software and study of biasing.

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - II **PAPER - IV**

Computer Architecture, Networking & Assembly Language Programming

Unit – 1

Graphical User Interface: Common Graphical User Interfaces & its Functionality, *GUI Design Consideration:* Psychological factors & Standards; GUI Examples: Microsoft Windows, Macintosh Toolbox, X-windows, NeXt, etc.

Operating System: *Evolution of Operating System* – Serial Processing, Batch Processing, Multiprogramming; *Operating System Structure* – Layered Structure Approach, Virtual Machine, Client-Server Model & Kernel Approach.

Unit - 2

Introduction to Networking Concepts: Computer Networks, Topologies, Characteristics of the OSI Layers, OSI Models and Communication between Systems, Interaction between OSI Model Layers; *Protocols Types of Networks* - Local Area Networks (LANs), Metropolitan Networks (MANs) & Wide Area Network (WANs); Medium, Data Flow, Physical Connection, Transmission Media, *General idea of Connecting Devices* – Repeaters, Hubs, Bridges, Routers, Gateways.

Internetworking:

***Concept, Architecture and Protocols*:** History of Internetworking, Packet Switching, Internetworking Concepts, Internet Addresses Object-Based Programming, Configuring IP Addresses, TCP/IP & Related Protocols, *Application Layer Protocols* – File Transfer Protocols, Trivial File Transfer Protocol (TFTP), TELNET, Remote login, Electronic Mail (Email), World Wide Web, Domain Name System, SNMP and UDP.

Unit - 3

Logic Circuits - Logic Gates, Logic Circuits, *Combinational Circuits* – Canonical and Standard Forms, Minimization of Gates; Design of Combinational Circuits; *Examples of Logic Combinational Circuits* – Adders, Decoders, Multiplexer, Encoder, Programmable Logic Array, Read Only Memory (ROM).

Sequential Circuit's Definition, *Flip Flops* – Basic Flip -Flops, Excitation Tables, Master Slave Flip Flops, Edge Triggered Flip-flops; *Sequential Circuit Design & its examples* – Registers, Counters (Asynchronous & Synchronous), RAM; Design of a Simple Counter

Unit - 4 Assembly Language Programming (ALP)-I:

***Microprocessor Architecture*:** Microcomputer Architecture; Structure of 8086 CPU [The Bus Interface Unit, Execution Unit (EU)]; Register Set of 8086; *Instruction Set of 8086* – Data Transfer Instructions, Arithmetic Instructions, Bit Manipulation Instructions, Program Execution Transfer Instructions, String Instructions, Processor Control Instructions; *Addressing Modes* – Register, Immediate, Direct & Indirect Addressing Modes.

Introduction to ALP: Need and use of ALP; Assembly Program Execution; *An Assembly Program and its components* - The Program Annotation & Directives; *Input Output in ALP* - Interrupts, DOS Function Calls (Using INT 21H); *The Types of Assembly Programs* – COM Programs, Exe Programs & Bin Programs.

Unit - 5 Assembly Language Programming (ALP)-II:

Simple Assembly Programs – Data Transfer, Simple Arithmetic Application, Application Using Shift Operations, Larger of the Two Numbers; *Programming With Loops and Comparisons* – Simple Program Loops, Find the Largest and the Smallest Array Values, Character Coded Data, Code Conversion;

Programming for Arithmetic and String Operations – String Processing, & Arithmetic Problems.

Use of Arrays in Assembly; Modular Programming – The stack, FAR and NEAR Procedures, Parameter Passing in Procedures, External Procedures.

Interfacing Assembly Language Routines to High Level Language *i.e.* **C**.

Suggested Readings:

1. Computer Architecture : Morris Mano
2. Operating System Concepts : Silberchatz Galwin Gagne
3. Web Technology : A.S. Godbole & Atul Kahate
4. Digital Electronics : Malvino & Leech
5. Advance Microprocessor & Peripherals : A.K. Ray & Bhurchandi
6. Introduction to Microprocessor : Mathur

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - II **PAPER - IV**

Environmental Physics

Unit - 1 **Essentials of Environmental Physics:-** Structure and thermodynamics of the atmosphere. Composition of air. Greenhouse effect. Transport of matter, energy and momentum in nature. Stratification and stability of atmosphere. Laws of motion, hydrostatic equilibrium.

Unit - 2 **Solar and Terrestrial:-** Physics of radiation. Interaction of light with matter. Rayleigh and Mie scattering. Laws of radiation (Kirchoffs law, Planck's law, Wien's displacement law, etc.). Solar and terrestrial spectra. UV radiation. Ozone depletion problem. IR absorption

Unit - 3 **Environmental Pollution and Degradation:-** Elementry fluid dynamics. Diffusion. Turbulence and turbulent diffusion. Factors governing air, water and noise pollution. Air and water quality standards. Waste disposal. Gaseous and particulate matters. Wet and dry deposition

Unit - 4 **Environmental Changes and Remote Sensing:-** Energy sources and combustion processes. Renewable sources of energy: Solar energy, wind energy, bioenergy, hydropower, fuel cells, nuclear energy.

Unit - 5 **Global and Regional Climate:-** Elements of weather and climate. Stability and vertical motion of air. Horizontal motion of air and water. Pressure gradient forces. Viscous forces. Inertia forces. Reynolds number. Enhanced Greenhouse Effect. Global climate models.

Suggested Readings:

1 Environmental Physics (JohnWiley) — Egbert Boeker & rienk Van Groundelle

2 The Physics of Atmosphere (Cambridge University Press, 1977) — J.T. Hougtion

3 Renewable Energy Resources (Eibs, 1988) — J.Twidell and J. Weir

4 An Introduction to Solar Energy for Scientists and Engineers — John Wiley, Sol Wieder 1982

5 The Physics of Monsoons (Allied Publishers 1992). — R.N. keshavamurthy and M. Shanker Rao

6 Numerical Weather Prediction (John Wiley, 1980) — G.J. Haltiner and R.T. Williams

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - II **PAPER – IV**

Communication Electronics

Unit - 1 **Binary Logic, Digital Switching Circuits, Counter:** Binary number systems and other codes, Binary arithmetic, Boolean theorem, syntheses of Boolean functions, Karnaugh diagram, Half and full adders, demultiplexers, Multiplexers, D/A and A/D converters. Transistor as a switch, Clock generator, RS flip flip-flop, T flip flop, JK flip flop, Master-Slave flip flop, Shift Register, ripple counter, Decade counter, up-down counter, divide by n counters, Synchronous counters, Application of counters.

Unit - 2 **OP-AMP:-** Differential amplifier circuit configurations: dual input balanced output dual input, single input unbalanced output (ac analysis) only, block diagram of a typical op amp analysis, schematic symbol of an op- amp., Ideal op-amp., Op-amp parameters; input offset voltage, input offset current, input bias current, CMRR, SVRR, large signal voltage gain, Slew rate, Gain band width product, output resistance, supply currents power consumption, inverting and non-inverting inputs.

Unit - 3 **Application of OP- AMP:** Inverting and non-inverting amplifier, summing, scaling and averaging amplifier, integrator and differentiator. Oscillator Principles: oscillator types, frequency, stability response, the phase shift oscillator, Wein-bridge oscillator, L-C tunable oscillator, square wave generator.

Unit - 4 **Digital Communications:** Pulse- Modulation system, sampling theorem, Low pass and Band pass signals, PAM, channel BW for a PAM signal, Natural Sampling, Flat top sampling, signals Recovery through Holding, Quantization of signals, Quantization, Differential PCM Delta Modulation, Adaptive Delta Modulation, CVSD.

Unit - 5 **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, differential PSK, QPSK, calculation of error probability for BPSK, BFSK, and QPSK .

Suggested Readings:

1. Digital Principles and Application : A. P. Melvino & D. P. Leech
2. Op-Amps & Linear Integrated circuits : R. A. Gayakwad
3. Electronics : D. S. Mathur
4. Digital Communications : W. Tomasi

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - II **PAPER – IV**

Digital Electronics

Unit - 1 **Communication Electronics:** Amplitude modulation – generation of AM waves demodulation of AM waves, DSBSC modulation, Generation of DSBSC waves, coherent detection of DSBSC waves, SSB modulation, generation and detection of SSB waves, vestigial sideband modulation.

Unit - 2 **Propagation of Waves:** Ground Waves, sky wave, space wave, propagation, maximum usable frequency, skip distance, virtual height, fading of signals, Satellite communication: orbital satellite, geostationary satellites, orbital pattern, look angles, orbital spacing, satellite system, link modules.

Unit - 3 **Microwave:** Advantages and disadvantages of microwave transmission loss in free-space, propagation of microwaves, atmospheric effects on propagation, Fresnel Zone problem, used in microwave communication systems.

Unit - 4 **Microprocessors and Micro Computers:** Microprocessor and Architecture: Intel 8086, Microprocessor architecture modes of memory addressing, 8086/8088 Hardware specification: Pin-outs and pin functions, clock generator (8284A) Bus buffering and latching, Bus timing, Ready and wait state, Minimum mode versus maximum mode.

Unit - 5 **Programming the Microprocessors:** Addressing modes: Data addressing modes, program memory addressing modes, stack memory-addressing modes. Instruction set: data movement Instructions, Arithmetic and login instructions, program control instructions. Programming example: Simple assembly language programs table handling direct table addressing, searching a table sorting a table using pseudo ops.

Suggested Readings:

1. Microwave : K. C. Gupta
2. Microwave Devices & Circuits : S.Y. Lio
3. Microwave Devices & Radar Engineering : Kulkarni
4. Digital Principles & Applications : Malvino & Leech
5. Microprocessor Architecture, Programming & Applications with 8085/8086 : R.S. Gaonker
6. Microprocessor & Digital Systems : D.V. Hall
7. Fundamentals of Electronics : Borker

Physics Practial

LAB

The following experiments to be performed by the students. (Similar experiments of equal standard may be added)

List of Experiments:

1. Study of characteristics of LED.
2. Study of characteristics of photo-transistor.
3. Study of characteristics of light dependent resister (LDR).
4. Study of characteristics of solar cell.
5. Study of characteristics of diode LASER and determine the absorption coefficient of glass using diode LASER.
6. Study of characteristics of thermister.
7. Study of characteristics of optical fiber.

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - IV **PAPER - I**

CONDENSED MATTER PHYSICS

Unit - I

Interaction of X-ray with matter, absorption of X-rays, Elastic scattering from a perfect lattice. The reciprocal lattice and its application to diffraction techniques, the Lave, power and rotating crystal methods. Crystal structure factor and intensity diffraction maxima. Extinction due to lattice centering.Point defeats, line defects and planer (stacking) faults. The role of dislocation in plastic deformation and crystal growth. The observation of imperfections in crystals. X-ray and electron microscopic techniques

Unit – II

Free electron Fermi gas, Energy levels of orbital in one and three dimensions. Electrons in a periodic lattice. Bloch theorem, band theory of solids, Classification of solids effective mass. Tight binding, cellular and pseudopotential methods. Fermi surface. De Hass von Alfen effect, Super conductivity, critical temperature persistent current. Meissner effect,general idea about high temperature superconductors.

Unit-III

Atomic and molecular Polariziblity, Claussius-Mossotti relation, types of polarzibility, dipolar polarizibility and frequency dependence of dipolar polarizibility, ionic and electronic polarizibilty, Hall effect. Quantum Hall Effects, Magnetoresistance.

Unit – IV

Weiss Theory of Ferromagnetism. Heisenberg model and molecular field theory, spin waves and magnous, Curie-waves law for susceptibility, ferri and anti-Ferro- magnetic order. Domains and Bloch-wall energy.

Unit - V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text **and** reference Books :

1. Kittle — Solid State Physics
2. Aschroft & Mermin — Solid State Physics
3. L.V. Azaroff — Introduction to Solid State Physics
4. Verma & Srivastava — Crystellographic Solid State Physics
5. A.J. Dekker — Solid State Physics
6. P.M. Chaiken& T.C. Lubensky — Principles of Condense Matter Physics

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - IV **PAPER - II**

NUCLEAR AND PARTICLE PHYSICS

Unit-I

Nuclear Interactions and Nuclear Reactions: Nucleon- nucleon interaction, Exchange forces and tensor forces, Meson theory of Nuclear forces, Nucleon - nucleon scattering, Effective range theory, Spin dependence of nuclear forces, Charge independence, Yukawa interaction. Direct and Compound nuclear reaction mechanisms, cross sections in terms of partial wave amplitude, Compound nucleus. Scattering matrix, reciprocity theorem, Breit-Winger one-level formula, Resonance scattering.

Unit - II

Nuclear Models : Liquid drop model, Bohr Wheeler theory of fission, Experimental evidence for shell effects, Shell model, Spin orbit coupling, Magic numbers, Angular momenta and parities of nuclear ground states, qualitative discussion and estimates of transition rates, Magnetic moment and Schmidt lines, collective model of Bohr and Mottelson.

Unit – III

Nuclear Decay :Beta Decay, Fermi theory of beta decay, comparative half lives, parity violation, two component theory of neutrino decay, detection and properties of neutrino, gamma decay, multiple transitions in nuclei, shape of the beta spectrum, total decay rate, Angular momentum and parity selection rules, General ideas of nuclear radiation detectors, linear accelerator, betatron, proton-synchrotron, electron synchrotron.

Unit - IV

Elementary particle: Types of interaction between elementary particles, Hadrons and Leptons symmetry and conservation laws, Elementary idea of CP and CPT invariance, classification of Hadrons, Lie algebra, SU(2), SU(3) mutiplets, Quark model, Cell-mann Okubo mass formula for octal and decuplet hadrons, charm, bottom and top quarks,

Cosmic Rays : Nature, composition, charge and energy spectrum of primary cosmic rays, production and propagation of secondary cosmic rays, soft, penetrating and nucleonic component, origin of cosmic rays, Rossi curve, Bhabha- Heitlr theory of cascade showers.

Unit - V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text and reference Books:

Kenneth S. Kiano,	Introductory Physics,
H A einge,	Introduction to Nuclear Physics,
I Kaplon	Nuclear Physics
Roy & Nigam	Nuclear Physics
R.D. Evans	Nuclear Physics
Ram & Waghmore	Nuclear Physics
S.B. Patel	Int. Nuclear Physics

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - IV **PAPER - I**

COMPUTATIONAL METHODS AND PROGRAMMING

Unit –I

Data type (int, float, double, char, long, long double etc.) operators (Unary. Binary and ternarys), input /output statement (scanf(), printf()), control statements (if, for, while, do while, switch -case -default), Function (type of Function, function definition, function calling, formal arguments, actual arguments, function prototype), program structure, string (Array, character array), string manipulation functions like strlens(), strcpy(), strcat(), strecmp() etc.)

Unit-II

Method for determination of zeros of linear and non-linear algebraic equation and transcendental equations, convergence of solutions, solutions of simultaneous linear equation, Gaussian elimination method, pivoting, iterative method, Matrix inversion.

Unit-III

Eigen Value and Eigen Vectors of Matrices, Power and Jacobi method, finite difference interpolation with equally and unequally spread points, curve fitting, polynomial least squares and cubic spline fittings.
Numerical differentiation and Integration, Newton-Cotes Formulae, error estimates, Gauss-Method.

Unit – IV

Numerical solution of ordinary differential equation, Eular and Runga-Kutta Methods, predicators and corrector method, Elementary ideas of solution partial differential equation.

Unit – V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

TextBooks and reference book:

1.	Sastry	Introduction method of numerical analysis
2.	Rajaraman	Numerical Analysis
3.	Gottfried	Programming with C
4.	Balagururswamy	Programming with C
5.	Balaguruswamy	Numerical Analysis
6.	Vetterming Teukolsky press and Flannery	Numerical recipes

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CLASS - M.Sc. **SUBJECT - PHYSICS**

SEMESTER - IV **PAPER - I**

Material Science

Unit –I

Classification of Materials: Types of materials: Crystalline, Polycrystalline, Amorphous (Introduction and their structure), Elementary idea of polymers (structure and properties methods of polymerization, Glasses: Structure and properties, Type of Glasses, Fracture in glasses, Composite Materials: Introduction, their types and properties, Different types of bonding, Medalung energy for ionic crystal.

Unit-II

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

Unit-III

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

Unit – IV

Elastic and Aenelastic Behaviour:- Atomic models for elastic behaviour, Elastic deformation in single crystals, Elastic anisotropy, Elastic constant and elastic module (Cubic system, isotropic body), Rubber like elasticity, anelastic behaviour, Thermo-elastic effect and relaxation process, Idea of viscoeastic behaviour (Spring-Dashpot model), Determination of elastic constant of cubic crystaly by ultrasonic wave propagation

resistivity.

Unit – V

Transport Properties of Solids:- Electrical conductivity of metals and alloys, Extrinsic, intrinsic semiconductors and amorphous semiconductors, Scattering of electrons by phonons, impurity, etc, Relaxation time, Carrier mobility and its temperature dependence, Mathiessio's rule for resistivity, temperature dependence of metallic resistivity.

Suggested Readings:

1. Introduction to Solids : L. V. Azaroff
2. Introduction to Solid State Physics : C. Kittle
3. Meterials and engineering : Raghawan
4. Diffusion Kinetics for Atoms in Crystals : Manning
5. Theoretical solid State Physics : Huang

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Physics Practial

LAB

The following experiments to be performed by the students. (Similar experiments of equal standard may be added)

List of Experiments:

1. Design and study of Op-Amp based inverting and non-inverting amplifier with frequency response.
2. Design of low pass Butterworth filter (I & II order) using Op-Amp.
3. Design and study of four bit binary counter and its truth table using C.R.O. tracing
4. Assembly Language Programming of 8085 Part I – Sum, Difference, Compare etc.
5. Assembly Language Programming of 8085 Part II –
    (a) Smallest number of a series
    (b) Largest number of a series
    (c) Block transfer scheme
6. C^{++} based object oriented programming.