Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya

Chitrakoot, Distt. - Satna (M.P.)

Master of Science

in

Physics

Regulations, Scheme of Study and Syllabus

w.e.f. 2014-2015

Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot
Scheme of Study and Examination for the Degree in M.Sc.(Physics)
w.e.f. 2014-2015

Semester - I

Code	Name of Paper	Credits
SMP-501	Mathematical Physics	**3**
SMP-502	Classical Mechanics	**3**
SMP-503	Electronics Devices	**3**
SMP-504	Computer Architecture & Assembly Language Programming	**3**
SMP-505	LabA- Electronics Devices	**3**
SMP-506	LabB- Computer Architecture & Assembly Language Programming	**3**
	Total Credits	**18**

Semester - II

Code	Name of Paper	Credits
SMP-507	Quantum Mechanics-I	**3**
SMP-508	Statistical Mechanics	**3**
SMP-509	Electrodynamics and Plasma Physics	**3**
SMP-510	Condensed Matter Physics	**3**
SMP-511	LabA- Electrodynamics and Plasma Physics	**3**
SMP-512	LabB- Condensed Matter Physics	**3**
	Total Credits	**18**

Semester - III

Code	Name of Paper	Credits
SMP-601	Quantum Mechanics-II	**3**
SMP-602	Nuclear and Particle Physics	**3**
SMP-603	Special paper-I	**3**
SMP-604	Special paper-II	**3**
SMP-605	Lab A- Based on Special paper-I	**3**
SMP-606	Lab B- Based on Special paper-II	**3**
	Total Credits	**18**

Semester - IV

Code	Name of Paper	Credits
SMP-607	Atomic and Molecular Physics	**3**
SMP-608	Elective Paper	**3**
SMP-609	Special Paper-I	**3**
SMP-610	Special Paper-II	**3**
SMP-611	Lab A- Based on Special paper-I	**3**
SMP-612	Lab B- Based on Special paper-II	**3**
SMP-613	Project work	**8**
	Total Credits	**26**
	Grand Total Credits	**80**

The student should offer any two of the following special papers and one of the elective papers: Special papers in Semester IV will be the same as offered in semester III.

Sem-III-Paper III special papers-I	**Sem-IV Paper IV special papers-II**	**Sem-IV-Paper- II Elective Paper**
(A) Electronics - I (B) Informatics - I (C)Astrophysics-I	(A) Electronics – II (B) Informatics - II (C) Astrophysics-II	(A)Physics of Lasers and Laser Applications (B)Physics of Nano-materials (C)Computer Programming and Informatics

Note: Experiments should be based on syllabus.

Syllabus for M.Sc. (Physics)

First Semester

SMP-501	MATHEMATICAL PHYSICS	Credit-03

UNIT-I: Polynomials- Legendre, Hermite and Laguerre polynomials and their generating functions. Recurrence relations and special properties of Pn(x) as solution of Legendre differential equation, Rodrigues formula, orthogonality of Pn(x) , associated Legendre polynomials (Introdution only).

UNIT-II: Bessel function of first kind, generating function, recurrence relations, Jn(x) as solution of Bessel differential equation, Expansion of Jn(x) when n is half and odd integer, Integral representation.

UNIT-III: Complex Variable: Function of a complex variable, Cauchy Riemann conditions, Cauchy's integral theorem (without proof), Cauchy's integral formula, Cauchy's Residue theorem, singular points and evaluation of definite integrals of the type $\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)\, dx$, $\int_{-\infty}^{\infty} f(x)\, e^{iax}dx$

UNIT-IV: Integral Transforms: Laplace Transform, First and second shifting theorems,Inverse LT by partial fractions, LT of derivative and integral of a function, Solution of initial value problems by using LT,

UNIT-V: Fourier series and Fourier Transform: Fourier series, Half range expansion, Arbitrary period, Fourier integral and transforms, FT of delta and Gaussian function.

Text and References Books

1. Mathematical method for Physics by G. Arfken
2. Advanced Engineering Mathematics by E.Kreyszig
3. Special Functions by E.D Rainville
4. Special Functions by W.W Bell
5. Functions of complex variable by R.V.Churchill
6. Mathematical Method for Physicists and Engineers by K.F.Reily, M.P.Hobson and S.J.Bence

Syllabus for M.Sc. (Physics)
First Semester

SMP-502	CLASSICAL MECHANICS	Credit-03

UNIT-I: Preliminaries: Newtonnian mechanics of one and many particle systems, Simple Pendulum with rigid support, Two connected masses with string passing over a pully, Virtual work, Rolling mass inside or outside a circular ring, Constraints; their classification, D'Alembert's principle, generalized coordinates.

UNIT-II:. Hamilton's principle: Derivation of Lagrange's equation from Hamilton's principle, advantages of variational principle formulation, Principle of least action.

UNIT-III: Two body central force problem: Motion in a central force field, The virial theorem, The inverse square law of force, The motion in central force in the Kepler problem.

UNIT-IV: Hamiltonian equations of motion: Legendre transformations and Hamilton equations of motion, Cyclic coordinates and conservation theorem, Canonical transformation generating functions, Properties, Poisson bracket, Poisson theorem, Relation of Poisson brackets . Hamilton Jacobi method

UNIT-V: Small oscillations: Concept of small oscillations, Expression of kinetic energy and potential energy for the problem of small oscillations, Frequencies of free vibration, and Normal coordinates.

Text and Reference Books

1. H. Goldstein : Classical Mechanics
2. N.C. Rana and P.S. Joag : Classical Mechanics
3. A. Sommerfiel : Mechanics
4. Perceival and D. Richards: Introduction to Dynamics

Syllabus for M.Sc. (Physics)
First Semester

SMP-503	ELECTRONIC DEVICES	Credit-03

UNIT-I: Conduction Mechanism in Metals: Mobility and conductivity, Bound and free electrons, Energy distribution of electrons, Fermi level, The density of states, Thermionic emission.

UNIT-II: Conduction Mechanism in Semiconductors: Direct and indirect semiconductors, charge carriers concentrations, Drift of carriers in electric and magnetic fields, Diffusion of carriers, The contact potential.

UNIT-III: Semiconductor-diode characteristics: Qualitative theory of P-N junction, Space charge at a junction, Forward and reverse bias junctions, Reverse bias breakdown, Zener diode.

UNIT-IV: Bipolar Junction Transistors: Transistor current components, CB, CE, CC configurations, Input output characteristics, Early Effect, Graphical analysis of the CE configuration, Transistor hybrid model, h parameters, Analysis of a Transistor amplifier circuit using h parameters, Measurement and graphical determination of h parameters, Hybrid π model, The re transistor model, Ebers-Moll model, Transistor biasing and thermal stabilization, The operating point, Bias stability.

UNIT-V: Field Effect Transistors: Construction and characteristics of JFET, transfer characteristic, The FET small signal model, Measurement of gm and rd, JFET fixed bias, Self bias and voltage divider configurations, Use of FET as voltage controlled resistor, JFET source follower (common-Drain) configuration, JFET Common – Gate configuration, Depletion and enhancement type MOSFETs.

Text and Reference Books

1. Solid State Electronic Devices by B.G. Streetman
2. Electronic Devices and Circuit Theory by R.L. Boylested and L. Nashelsky
3. Integrated Electronics by J. Millman and C.C. Halkias
4. Introduction to Semiconductor Devices by M. S. Tyagi
5. Electronic Devices and Circuits by Balbir Kumar and S.B. Jain
6. K. Thygarajan (Cambridge Univ.Press.).

Syllabus for M.Sc. (Physics)
First Semester

SMP-504	Computer Architecture & Assembly Language Programming	Credit-03

UNIT-I: Basic Computer Organization: Block diagram, Evolution and Classification *of* computers, Data representation in computers - Binary, Octal and Hexadecimal numbering systems and their interconversion, Binary codes BCD, EBCDlC, Gray, Parity, Error correction codes, Concepts *of* Boolean Algebra: Basic Postulates, canonical form, Minimization Techniques, Karnaugh Map .Logic gates, Flip-Flops (RS, D, JK, T),

UNIT-II: Basic Building Blocks of Computers: Registers (Shift Register), Counters (Binary, Up, Down, Ripple),Register transfer, Bus and Memory transfer, Arithmetic ,shift and logic Micro-operations, CPU: introduction, general register organization ,addressing modes, Memory organization- Memory hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, Virtual memory, Data transfer: Modes *of* transfer, Asynchronous and Synchronous data transfer, DMA.

UNIT-III: Internal architecture of 8086/8088 Microprocessor: Software model *of 8086/88,* Memory Address Space and Data Organization, Data types, Segment registers and Memory Segmentation, Instruction pointer, Data registers, Pointer and Index registers, Status register, The Stack, I/O Address Space, Addressing modes *of* the *8086/88,* Converting Assembly Language instruction to Machine Code, The IBM PC and its DEBUG program.

UNIT-IV: Introduction to 8086/88 programming: The instruction set *of* the *8086/88,* Data transfer, Arithmetic, Logic, Shift and Rotate instructions, Flag control instructions. Compare instruction; Jump instructions, Subroutines and subroutine handling instructions. The loop and loop-handling instructions, Strings and String handling instructions, Interrupts in *8086,* Introduction to DOS/BIOS interrupt programming.

UNIT-V: **Introduction to C++ :** General concepts, structure of C++ program, variables and constants, operators and expression, Flow of control, conditional and unconditional loops, Data types, Array, functions, standard Library functions, Programming methodology, type of errors, Scientific programmers with examples, organization and handling of files in C++.

Text and Reference Books:

1. M. Moris Mano: Computer System Architecture, PHI
2. Waiter A. Triebel and Avtar Singh: *8088* and *8086* microprocessors: Programming, interfacing software, hardware and applications, PHI.

Reference Books:

1. John P. Hayes: Computer Architecture and Organization, MGH
2. Andrew S. Tannenbaum: Structured Computer Organization, PHI
3. Albert Paul Malvino: Digital Principles, TMH
4. B. Ram: Microprocessors & Microcomputer, Dhanpat Rai & Sons
5. Computational Physics - R.C. Verma, P.K. Ahluwalia and K.C.Sharma, New Age Publishers (1999)
6. Object Oriented Programming with C++ - E. Balaguruswami Tata Mc Graw Hill(1994)

Syllabus for M.Sc. (Physics)

Second Semester

SMP-507	QUANTUM MECHANICS – I	Credit-03

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

Syllabus for M.Sc. (Physics)
Second Semester

SMP-508	STATISTICAL MECHANICS	Credit-02

UNIT-I: Foundation of Statistical Mechanics & Ensembles: Phase space, concept of Ensemble, Ensemble average, Liouville's theorem, equation of motion and Liouville's theorem, Canonical Ensemble, Microcanonical Ensemble, Grand Canonical Ensemble, partition functions.

UNIT-II: Statistical Quantities: Calculation of statistical quantities, Energy and density fluctuations, Entropy of an ideal gas using microcanonical Ensemble, Gibb's paradox, Sackur- Tetrode equation.

UNIT-III: Postulates of quantum statistical mechanics, Density matrix, Statistics of indistinguishable particles, Maxwell-Boltzmann, Fermi- Dirac and Bose- Einstein Statistics, properties of ideal Bose and Fermi gases, Bose- Einstein condensation.

UNIT-IV: Cluster expansion for a classical gas, virial equation of state, ising model, mean-field theories of the ising model in three, two and one dimentions, Exact solutions in one-dimension. Landau theory of phase transition, critical indices, scale transformation

UNIT-V: Fluctuations: Correlation of space-time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, Langevin theory, fluctuation dissipation theorem, The Fokker-Plank equation.

Text and Reference Books

1. Statistical and Thermal Physics by F. Reif
2. Statistical Mechanics by K. Huang
3. Statistical Mechanics by R. K. Pathria
4. Statistical Mechanics by R. Kubo
5. Statistical Physics by Landau and Lifshitz
6. Statistical Mechanics and properties of matter, theory and application by E.S.R. Gopal

Syllabus for M.Sc. (Physics)
Second Semester

SMP-509	ELECTRODYNAMICS AND PLASMA PHYSICS	Credit-03

UNIT-I: Electrostatics: Electrostatic field E due to a charge distribution, Values of div E curl E, scalar potential Φ, Poisson's and Laplace's equations, Electrostatic potential energy and energy density, Dielectrics, displacement vector D , electrostatic energy in dielectric media, formal solution of boundary value problems with Green function; Methods of images, point charge near an infinite conducting plane, Point charge in the presence of grounded conducting sphere, Point charge in presence of charged insulated sphere, Conducting sphere in uniform electric field.

UNIT-II: Magneticstatics: Magnetic induction B due to current distribution, Equation of continuity, div B and curl B , Vector potential A, Macroscopic equations, Magnetization M and magnetic field H.

UNIT-III: Time- Varying Fields: Faraday's law of induction, Energy in the magnetic field, Maxwell's displacement current, Maxwell's equations, Maxwell's equations in terms of vector and scalar potentials, Poyntings theorem, Relativistic properties of E and H and covariance of Maxwell's equations, Lienard- Wiechert potentials due to a point charge, Electric and magnetic fields produced by a charged particle in uniform and arbitrary motion, Power radiated by an accelerated charge, Larmor's formula and its relativistic generalization and angular distribution of radiation from a charged particle with collinear velocity and acceleration, Synchrotron radiation.

UNIT-IV: Plane Electromagnetic Wave: Plane electromagnetic waves in a nonconducting medium, Linear and circular polarization, Reflection, Refraction of electromagnetic waves at a plain interface between dielectrics, Fresnel relation polarization by reflection and total internal reflection, Waves in a conducting medium.

UNIT-V: Plasma: Definition of plasma ,Concept of temperature, Debye shielding, Criteria for plasma, Single-particle motions in E and B fields, Magnetic mirrors and plasma confinement, Plasma as fluid, the fluid equation of motion , The stress tensor, Equation of continuity and equation of state, Waves in plasmas, Plasma oscillations, Plasma frequency ωp, Electron plasma waves, ion waves, Electron and ion oscillations perpendicular to B, Electromagnetic waves perpendicular to B and parallel to B, Cutoffs and resonances. Kinetic theory and plasma, Boltzmann equation, Derivation of the equation of continuity and fluid equation of motion by taking moments of Boltzmann equation.

Text and Reference Books

1. Classical Electrodynamics by J.D. Jackson
2. Foundations of Electromagnetic theory by J.R. Reitz, F.J.Milford and R.W.Christy
3. Introduction to Electromagnetic by David J. Griffiths
4. Introduction to Plasma Physics and Controlled Fusion, Vol-1: Plasma Physics by Francis F.Chen
5. Plasma Physics by S.N. Sen.

Syllabus for M.Sc. (Physics)
Second Semester

SMP-510	CONDENSED MATTER PHYSICS	Credit-03

UNIT-I: Crystal Physics and Defects in Crystals: Crystalline solids, unit cell and direct lattice, Bravais lattice in two dimensions (plane lattice) and three-dimensional (space lattice), Closed packed structures.

UNIT-II: Interaction of X-rays with matter, Absorption of X-rays, X-ray diffraction, The Laue, powder and rotating crystal methods, The reciprocal lattice and its important properties and applications, Diffraction intensity, Atomic scattering factor, Geometrical structure factor.

UNIT-III: Crystal imperfections: Point defects, line defects and planer (stacking) faults. Estimation of dislocation density from X-ray diffraction measurements. The observation of imperfections in crystals: electron microscopic techniques.

UNIT-IV: Electronics Properties of Solids: Electrons in a periodic lattice: Bloch theorem, The Kronig-Penny Model, Effective mass of an electron, Tight-binding approximation, Cellular and pseudopotential methods, Fermi surface: Fermi surface and Brillouin zones, Anomalous skin effect, Cyclotron resonance, de Hass van Alphen effect, Magneto resistance, Hall effect in semiconductors Superconductivity: Elements of BCS theory, Flux quantization, Meissner effect, Critical temperature, Persistent current.

UNIT-V: Ferromagnetism: Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, Ferromagnetic domains, The Bloch-wall, Spin waves and magnons, Curie- Weiss law for susceptibility, Ferri and antiferro-magnetic order.

Text and References Books

1. Verma and Srivastava: Crystallography for Solid State Physics
2. Azaroff: Introduction to Solids
3. Omar: Elementary Solid State Physics
4. Aschroff & Mermin: Solid State Physics
5. Kittel: Solid State Physics
6. Chaikin and Lubensky: Principles of Condenced Matter Physics

Syllabus for M.Sc. (Physics)
Semester III

SMP-601	QUANTUM MECHANICS – II	Credit-03

UNIT-I: Time dependent Perturbation Theory : First order perturbation, Integration of an atom with electromagnetic field, Transition probabilities, Fermi Golden rule, Dipole approximation.

UNIT-II: Induced and Spontaneous radiations: Einstein A and B coefficients, Induced and spontaneous emissions of radiations, their applications in the construction of gas and solid lasers.

UNIT-III: Quantum Theory of Radiation: Classical radiation field, Fourier decomposition and radiation oscillators, Creation, annihilation and number operators, Photon states, Quantized radiation field, Basic matrix elements for emission and absorption, Spontaneous emission in the dipole approximation, Plank's radiation law.

UNIT-IV: Relativistic Equations: Klein-Gordon equation and its plane wave solution, Probility density in KG theory, Difficulties in KG equation, Dirac equation for a free electron, Dirac matrices and spinors, Plane wave solutions, Charge and current densities, Existence of spin and magnetic moment from Dirac equation of electron in an electromagnetic field.

UNIT-V: Dirac Equation: Dirac equation for central field with spin orbit intraction, Energy levels of Hydrogen atom from the solution of Dirac equation, Covariant form of Dirac equation.

Text and Reference Books

1. Quantum Mechanics by L.I. Schiff
2. Modern Quantum Mechanics by J.J. Sakurai
3. A Text Book of Quantum Mechanics by P.M. Mathews and K.Venkatesan
4. Quantum Mechanics by A. P. Messiah

Syllabus for M.Sc. (Physics)
Semester III

SMP-602	Nuclear and Particle Physics	Credit-03

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, protonsynchrotron, 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.

UNIT-V: **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- Hitler theory of cascade showers.

Text and Reference Books:

1. Introductory Physics : Kenneth S. Kiano
2. Introduction to Nuclear Physics : H A einge
3. Nuclear Physics : E Kaplon
4. Nuclear Physics : R.D. Evans
5. Nuclear Physics : Ram & Waghmore
6. Int. Nuclear Physics : S.B. Patel

Syllabus for M.Sc. (Physics)
Semester III

SMP-603	SPECIAL PAPER-I: ELECTRONICS – I	Credit-03

UNIT-I: Operational Amplifier Basic and Application: Review of Feedback, Linear Circuit, Op-Amp Basic, Inverting and Non-inverting amplifiers, Unity follower, Summing amplifiers,Integrator, Differentiator, Op- Amp Specifications- DC Off-set parameter, Frequency parameters, Imperfection in Op- Amplifier application- multiple stage gain, Voltage summing and subtraction, Current controlled voltage source, Voltage controlled current source, Rectifiers and Limiters, Comparators and Schmitt Triggers, Active filters.

UNIT-II: Digital Logic Gates: Symbols and truth tables, Classes of digital integrated circuits (Diode logic, DTL, TTL, ECL, MOSFET, CMOS), Transistor- Transistor Logic (TTL), Single Input TTL Inverter (transfer characteristic), Multi- collector transistors, Propagation delays, Diode Logic, DTL NAND Gate (transfer characteristic, noise immunity, fan out), Emitter Coupled Logic (transfer characteristic of OR/NOR gate, practical implementation, MOSFET Logic- Review of MOSFET, MOSFET Inverter with active load, MOSFET NOR and NAND gates, Complementary MOS (CMOS)- CMOS inverter, CMOS NOR and NAND, Power dissipation in CMOS, Advantages/Disadvantages of CMOS.

UNIT-III: Digital Electronics and Logic Gate: Binary, Octal, Hexadecimal number system, Base conversion system, Bipolar junction and Field Effect transistor as switches, Basic digital logic gates (OR, AND and NOT, NOR, NAND and Exclusive OR), XOR gate, Boolean laws and theorem, Sum of Product (SOP) and Product of Sum (POS) method, Karnaugh map, pair, quad and octave, POS simplification, min-term, max-term.

UNIT-IV: Application of Digital Logic Gate: Half adder and Full adder circuit, multiplexers, demultiplexer, Flip- Flop and Registers- RS Flip Flop, D- Flip Flop, T- Flip Flop, JK- Flip Flop, JK Master- Slave Flip Flop, Astable, Monostable and Bi-stable multivibrator, types of registers, serial-in-serial out, serial-in-parallel out, parallel-in-serial out, parallel-in parallel out, Counters and Convertors- asynchronous and synchronous counter, Mod-3 and Mod-5 counters, shift counters, Digital-to Analog Converters-D/A converter, ladder network, A/D converters.

UNIT-V: Microprocessor-Intel 8085 microprocessor architecture, interfacing devices, BUS timing, instruction set, simple illustrative program.

Text and Reference Books

1. Electronic Device and Circuit: R. Boylested and L. Nashdsky
2. Analysis and Design of Digital Integrated Circuit: Hodges, Jackson and Saleh
3. Digital Principles and Implementation: A.P. Malvino and D.P. Leach
4. Op- Amp and Linear Integrated Circuit: Ramakant A. Gayakwad

Syllabus for M.Sc. (Physics)
Semester III

SMP-604	SPECIAL PAPER-II: IFORMATICS – I	Credit-03

UNIT-I: Introduction to Probability and Random variables, Introduction to Information theory and queuing theory. Fourier series and transform and their applications to data communication.

UNIT-II: Introduction and evolution of Telecommunication, Fundamentals of electronic communication: Wired, Wireless, Satellite and Optical Fiber, Analog/Digital, Serial/Parallel, Simplex/half and full duplex, Synchronous/ Asynchronous, Bit/baud rates, Parity and error control, Signal to Noise ratio.

UNIT-III: Transmission types, Codes, Modes, Speed and throughput. Modulation types, Techniques and standards. Base band and carrier communication, Detection, Interference, Noise signal and their characteristics, Phase locked loops. Modems, Transmission media (guided and unguided), common Interface standards.

UNIT-IV: Introduction to Unix/Linux and shell scripting. Introduction to C/ C++. Data types and operators, Statements and Control flow, Functions and Program structures, Strings, The preprocessor, Pointers, Memory allocation, Input and output, Sub program, Recursion, File access.

UNIT–V: Object orientation concepts: Classes, objects, methods and messages, encapsulation and inheritance, interface and implementation, reuse and extension of classes, inheritance and polymorphism, analysis and design; Notations for object-oriented analysis and design, Application of some object oriented programming languages. Introduction to web enabling technologies and authoring tools/ languages, (web casting data base integration, CGI, Peri, Java, HTML, C#)

Text and References Books

1. Data Networks – Gallager
2. Data Communication - William stalling
3. Analog and Digital communication - S. Haykins
4. Object oriented Analysis and Design with Application - G. Booch, Addison Wesley, 2nd
5. Edition, 1994 Beginning Object Oriented Analysis and Design using C ++, - Jesse Liberty Wrox Press, 1998.
6. Multimedia Networking - Bohdan O. Szuprowic, McGraw
7. Hill, Snigapore, 1995 (ISE) Computer Networks - William Stalling, PHI
8. Computer Networks - A.S. Tanenbaum Prentice Hall of India.

Syllabus for M.Sc. (Physics)

Semester IV

SMP-607	ATOMIC AND MOLECULAR PHYSICS	Credit-03

UNIT-I: Quantum Mechanical Treatment of one-electron Atom, Spin-Orbit interaction and fine structure of hydrogen atom, Spectra of alkali elements. Singlet and triplet States of Helium,

UNIT-II: Many electron atoms: Central field approximation, Thomas-Fermi field, Atomic wave function, Hartree and Hartree –Fock approximations, Spectroscopic Terms: L S and J J coupling schemes for many electron atoms, wavefunctions and energies of multiplets, Electric dipole and Electric Quadrupole.

Molecular Physics

UNIT-III: Born - Oppenheimer approximation, Heitler-London theory of H2, LACO treatment of H2+ and H2 .Classification of Molecules,Types of Molecular Spectra and Molecular Energy States: Pure Rotational Spectra, Vibrational-Rotational Spectra, Raman Scattering, Selection rules , Nuclear spin and intensity alternation , Isotope effect, Classification of electronic states , Coupling of rotational and electronic motions, Electronic spectra: Franck-Condon principle.

UNIT-IV: Infrared Spectroscopy, Raman spectroscopy, Photoelectron Spectroscopy, Nuclear Magnetic Resonance , Chemical Shift, and Electron Spin Resonance (Introduction and their principles only).

Spectroscopic Techniques:

UNIT-V: General description and working of infra-red Spectrophotometer, Photoelectron Spectrometer, Simple Raman Spectrometer, NMR Spectrometer and ESR Spectrometer.

Text and Reference Books

1. Introduction to atomic spectra by H.E. White
2. Spectra of diatomic molecules by Herzberg
3. Atoms and molecules by M. Weissbluth
4. Quantum theory of Atomic Structure Vol I by Slater
5. Quantum theory of molecules and Solids by Slater
6. Fundamentals of molecular spectroscopy by C.B.Banwell
7. Introduction to molecular spectroscopy by G.M.Barrow
8. Molecular spectroscopy by Jeanne L.McHale
9. Molecular spectroscopy by J.M.Brown
10. Spectra of atoms and molecules by P.F. Bemath
11. Modern spectroscopy by J.M. Holias

Syllabus for M.Sc. (Physics)
Semester IV

SMP-608A	Elective Paper : Lasers and Laser Applications	Credit-03

UNIT–I: Working principle of laser, threshold condition characteristics of laser, Gaussian beam and its properties, optical Resonators, longitudinal and transverse modes of laser cavity, mode selection, gain in a Regenerative Laser cavity. Rate equations and threshold for 3 and 4 level systems. Q switching, mode locking and obtaining altra short pulses. Spectral narrowing.

UNIT-II: Ruby laser, He-Ne laser, Nd based lasers, semiconductor lasers, Nitrogen laser, CO2 laser, ion laser Dye laser, chemical laser, excimer laser, Higher power laser systems.

UNIT-III: Laser fluorescence and Raman scattering and their use in ranging and pollution studies; ultra high resolution spectroscopy with laser, and its application in isotope separation, single atom detection and rotational and vibration level of molecules.

UNIT-IV: Optical fibers, use of lasers in light waves communication. Qualitative treatment of medical and engineering applications of lasers.

UNIT-V: Crystal optics, propagation of light in a medium with variable refractive index, Electro, optical effect. Non-linear interaction of light with matter, laser induced multi-photon processes, second harmonic generation phase matching, third harmonic generation optical mixing, Parametric generation of light self focusing of light, Frequency mixing in gases and vapors, Optical instability and optical phase conjugations, Frequency up co version.

Text and Reference Book

1. Svelte: Lasers
2. Yare: Optical Electronics.
3. Destroyer: Laser spectroscopy
4. Letekhov: Non-Linear Laser spectroscopy
5. Lasers : A.L. Siegman
6. Optical Electronics: K.Tyagrajan & A.K. Ghatak.

Syllabus for M.Sc. (Physics)
Semester IV

SMP-608B	ELECTIVE PAPER II- PHYSICS OF NONOMATERIALS	Credit-03

UNIT-I: Introduction to Nonostructure Materials: Nanoscience & nanotechnology , Size dependence of properties, Moor's law, Surface energy and Melting point (quasi melting) of nanoparticles,

UNIT-II: Band structure of solids: Free electron theory (qualitative idea) and its features, Idea of band structure, insulators, semiconductors and conductors, Energy band gaps of semiconductors, Effective masses and Fermi surfaces, Localized particles, Donors, Acceptors and Deep traps, Mobility, Excitons, Density of states, Variation of density of states with energy and Size of crystal.

UNIT-III: Quantum Size Effect: Quantum confinement, Nanomaterials structures, Two dimensional quantum system, Quantum well, Quantum wire and Quantum dot, Fabrication techniques.

UNIT-IV: Characterization techniques of Nanomaterials: Determination of particle size, XRD (Scherrer's formula), Increase in width of XRD peaks of nanoparticles, Shift in absorption spectra peak of nanoparticles, Shift in photoluminescence peaks, Electron Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM), Scanning Tunneling

UNIT-V: Synthesis of Nanomaterials: Key issue in the synthesis of Nanomaterials, Different approaches of synthesis, Top down and Bottom up approaches, Cluster beam evaporation, Ball Milling, Chemical bath deposition with capping agent, Carbon nanotubes (CNT)- Synthesis, Properties and Applications.

Text and References Books

1. Nanostructures & Nanomaterials, Synthesis, Properties & Applications by Guozhong Cao, Imperial College Press.
2. Introduction to Nanotechnology, by Charles P. Poole, Jr. Frank J. Owens, John Wiley &
3. Sons Inc. Publication.
4. Quantum Wells, Wires and Dots by Paul Harrison, John Wiley & Sons Ltd.
5. Quantum Dot Hetrostructures, by D. Bimberg, M. Grundman, N.N. Ledenstov.
6. Introduction to Nanoscience and Nanotechnology by Hornyak G.L., Tibbals H.F., Dutta J.,
7. Moore J.J., CRC Press.
8. Carbon Nanotechnology by Liming Dai
9. Carbon Nanotubes: Properties and Applications by Michael J. O'. Connell.

Syllabus for M.Sc. (Physics)

Semester IV

SMP-609C	ELECTIVE PAPER II-COMPUTATIONAL METHODS AND PROGRAMMING	Credit-03

UNIT-I: Computational methods: Methods for determination of zeros of linear and nonlinear algebraic equations and transcendental equations, Bisection method, Muller's method, Quotient-difference method, Newton-Raphson method Solution of simultaneous linear equations, consistency of a system of linear equation, Gaussian elimination, LU decomposition method, matrix inversion, Jacobi iterative method, Gauss-Seidel method, convergence of Gauss-Seidel method

UNIT-II: Diagonalization of matrices, Eigen values and eigenvectors of matrices, Power and Jacobi method. Finite differences, Newton's formula for interpolation, Gauss, Stirling, Bessel's, Everett's formulae, Divided differences, Newton's general interpolation formula, Lagrange's interpolation formula.

UNIT-III: Numerical differentiation, Numerical integration, Trapezoidal rule, Simpson 1/3 and 3/8 rules, Boole's and waddles rules, Newton-Cote's formula, Euler- Maclaurin formula, Gauss quadrature formula. Method of Least square curve fitting, straight line and quadratic equation fitting, curve fitting of curves $y = ax^b$, $y = ae^{bx}$, $xy^a = b$ and $y = ab^x$, curve fitting by sum of exponentials, data fitting with cubic splines.

UNIT-IV: Numerical solution of ordinary differential equations, Euler, Picard and Runge- Kutta methods, Predictor and corrector method, elementary ideas of solutions of partial differential equations, solution of Laplace equation

UNIT-V: Programming: elementary information about digital computer principles, compilers, interpreters and operating systems, Fortran programming, flow charts, integer and floating point, arithmetic expressions, built in functions, executable and non executable statements, IF statements, GO TO statements, DO loop and implied DO loop, simple computer programmes.

Text and References Books

1. Introductory Methods of Numerical analysis by S.S. Shastri
2. Numerical Analysis by Rajaraman
3. Numerical Methods by E. Balagurusamy
4. Fortran Programming by Rajaraman
5. Numerical methods for scientific & Eng. Computatioans by Jain, Iyengar

Syllabus for M.Sc. (Physics)
Semester IV

SMP-609A	SPECIAL PAPER- I/ ELECTROINCS – II	Credit-03

UNIT-I: Digital communication: Pulse – Modulation systems, 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, Differential PCM, Delta Modulation, Adaptive Delta Modulation, CVSD . Digital Modulation techniques : BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK

UNIT-II: Mathematical representation of Noise: Sources of noise. Frequency domain representation of noise, effect of filtering on the probability density of Gaussian noise, spectral component of noise, effect of a filter on the power spectral density of noise. Superposition of noises. Mixing involving noise. Linear filtering. Noise Bandwidth, Quadrature components of noise, Power spectral density of nc(t), ns(t) and their time derivatives.

UNIT-III: Data Transmission: Baseband 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.

UNIT-IV: Noise in pulse – code and Delta – modulation system: PCM Transmission, Calculation of Quantization noise, Output – signal power, Effect of thermal noise in D M, Output signal – to– noise ratio in PCM, DM, Quantization noise in DM, Effect of thermal noise in Delta modulation , Output signal to noise ratio in DM .

UNIT-V: Computer Communication Systems: Types of networks, Design features of a communication network, examples TYMNET, ARPANET, ISDN, LAN. Mobile Radio and Satellites: Time division multiple Access (TDMA), Frequency Division Multiple Access (FDMA), ALOHA, Slotted ALOHA, Carrier Sense Multiple Access (CSMA) Poisson distribution, Protocols, Cellular communications, Mobile communication via Satellites, Bandwidth consideration in INTERNET

Text and Reference Books

1. Principles of Communication Systems, second Edition by Taub and Schilling Communication
2. Systems, third edition, by Simon Haykin

Syllabus for M.Sc. (Physics)
Semester IV

SMP-609B	SPECIAL PAPER II: INFORMATICS – II	Credit-03

UNIT–I: Multiplexing (FDM, TDM), switching paradigms, Propagation delay, Clock Synchronization, Network access control, Overview of Satellite Communication, Broadcast channel, Optical Fibre Communication Systems, Power and energy spectra, Distortionless transmissions, Signal distortion over a channel.

UNIT–II: Bandwidth and Rate of transmission, Communication in Noisy channels, Optimum Signal Detection, Channel Capacity, Hartley Shannon Law, Error Correcting Codes, Error Control, Line Control, Rate Control, Repeaters, Concentrators, regenerators, Link behaviour, Elementary coding ideas, ATM as a transport mechanism, An overview of telecom network ISDN.

UNIT-III: Network types and architecture, Protocols, interfaces and services, X.25,ISDN, ATM, VPN, frame relay, Wireless transmission, Bridges, TCP/IP and ISOOSI models, Routing, Congestion and Flow control, Internetwork routing, Data link protocols, Multiple access protocols, TCP, UDP, Transport layer error recovery, Application layer services and protocols, IP addressing, Network Security.

UNIT-IV: Evolution of Internet, Internet architecture; goals and key issues related to internetworking technologies; Internet connectivity, Domain name scheme, Technology and tools relevant for web access (FTP, email, search tools).

UNIT-V: Internet Security, Fundamentals of Network Management. Multimedia, Technique of data compression, voice, video, Mbone and interactive video-on-demand over the internet, mobile Computing.

Text and References Books

1. Data communication - Reid and Bartskor
2. Data Networks – Gallager
3. Data Communication - William stalling
4. Communication networks - Leon Garcia and Widjaja
5. Introduction to communication system - S. Haykins
6. Analog and Digital communication - S. Haykins
7. Multimedia Networking - Bohdan O. Szuprowic, McGraw
8. Hill, Snigapore, 1995 (ISE)
9. Internetworking Technologies Handbook

Syllabus for M.Sc. (Physics)

Semester IV

SMP-609C	SPECIAL PAPER II: Astrophysics II	Credit-03

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.

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.

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.

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.

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.

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)

Syllabus for M.Sc. (Physics)

Semester III

SMP-609C	SPECIAL PAPER II: Astrophysics I	Credit-03

SPECIAL PAPER-III ASTROPHYSICS –I

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.

UNIT II: **Telescopes and Instrumentations:** Different optical configuration for astronomical telescope plate scale and diffraction limits-telescopes for ã-ray, X-ray, UV, IR, mm and radio astronomy- photometry with photometers and CCD- spectrometry and polarimetry with various instruments.

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-hydrostaticequilibrium equation of state-main sequence.

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.

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.

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)

Note : Break-up of marks for practical examination and project work:

(a) Laboratory Practical

(i) Experiment	——	40 Marks
(ii) Practical Record	——	20 Marks
(iii) Viva-voce	——	20 Marks
(iv) Internal Assessment	——	20 Marks
Total	**——**	**100 Marks**

(b) Project Work : 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 University.

(i) Theory / Experiment/ Computation	——	40 Marks
(ii) Project Report	——	20 Marks
(iii) Viva-voce	——	20 Marks
(iv) Internal Assessment	——	20 Marks
Total	**——**	**100 Marks**

Syllabus for M.Sc. (Physics)

Semester I

SMP-504	Computer Architecture & Assembly Language Programming	Credit-03

UNIT-I: **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-II: ***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.

UNIT-III: ***Introduction to ALP:*** Need and use of ALP; Assembly Program Execution; *An AssemblyProgram 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-IV: ***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;

UNIT-V: *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