Semester-III

BSc/Phy/SM/3/DSC201: Mathematical Physics – I

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Objective: The course covers basics of differential equation, vector calculus, vector algebra, vector differentiation, vector integration, probability and errors. These topics are useful for the mathematical basis of electromagnetism, quantum mechanics and other courses.

Course Outcomes: After completing this course, students would be able to deal with mathematics that appears in other papers such as Classical Mechanics, Quantum Mechanics, Nuclear Physics, Condensed Matter Physics, etc.
CO1: Understanding of vector calculus and differentiation of physical quantities.
CO2: Understanding of vector integration and calculus of functions of more than one variable.
CO3: Understanding1stand 2nd order differential equations as well as plotting of curves, Taylor and Binomial series.
CO4: Understanding theory of probability and errors.

Note for the Paper Setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of seven short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations, Scalar product and its invariance under rotations, Vector product, Scalar triple product and their interpretation in terms of area and volume respectively, Scalar and Vector fields.
Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field, De and Laplacian operators, Vector identities.

UNIT-II

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of infinitesimal line, Surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss's divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs)
Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials, Constrained Maximization using Lagrange Multipliers.

UNIT-III

Calculus: Recapitulation: average and instantaneous quantities Intuitive ideas of continuous, differentiable, functions and plotting of curves, Approximation: Taylor and binomial series (statements only).
First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor, Homogeneous Equations with constant coefficients, Wronskian and general solution, Statement of existence and Uniqueness Theorem for Initial Value Problems, Particular Integral.

UNIT-IV

Introduction to probability: Independent random variables, Probability distribution functions; Binomial, Gaussian, and Poisson distributions (with examples), Mean and variance, Dependent events: Conditional Probability, Bayes' Theorem and the idea of hypothesis testing.

Theory of Errors: Systematic and Random Errors, Propagation of Errors, Normal Law of Errors, Standard and Probable Error, Least-squares fit, Error on the slope and intercept of a fitted line.

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn., Elsevier.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
3. Mathematical Physics, H K Das, 2008, S Chand.
4. Mathematical Physics, B.S. Rajput, 2017, PragatiParkashan, Meerut.
5. Mathematical Methods in Physical Sciences, M.L. Boas, 2005, Wiley, New York.
6. Mathematical Methods for Physicists, G.B. Arfken, 2012, Elsevier, Netherlands.
7. Mathematical Physics, P.K. Chatopadhyay, 2004, New Age, New Delhi.

BSc/Phy/SM/3/DSC/202: Elements of Modern Physics

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Objective: The aim of this course is to aware the students about the developments in physics in the last century by introducing the concepts of quantization, dual nature of matter, basic quantum mechanics and cosmology.

Course Outcomes: Students will be awared on foundations of modern physics, experiments forming basis of quantum mechanics, atomic structure, wave concepts, uncertainty principle and basic idea of cosmology.

Note for the Paper Setter: *The question paper will consist of nine questions in all. All questions carry equal marks. The first question will be compulsory and will consist of seven short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT – I

Introduction to electromagnetic spectra, Properties of Thermal Radiation, Spectral Distribution of Blackbody Radiation, Kirchhoff's Law, Stefan-Boltzmann Law and Wien's Distribution and Displacement law, Rayleigh-Jean's Law, Ultraviolet Catastrophe, Planck's postulates of black body radiation, Planck's Law of Blackbody Radiation and its experimental verification. Photoelectric effect, Einstein's explanation and its experimental verification (R. Millikan). Compton scattering, Pair production and annihilation, Bremsstrahlung effect, Cherenkov radiation. X-ray Spectra of atoms and its production.

UNIT – II

Atomic structure: Rutherford scattering, Rutherford's model and its drawbacks, Bohr atomic model; quantization rule, atomic stability, calculation of energy levels for hydrogen like atoms and their spectra, effect of nuclear mass on spectra, Correspondence principle, Franck-Hertz experiment. Wave properties of matter: De-Broglie wavelength and matter waves; Wave-particle duality, Davison and Germer experiment, wave packets, phase velocity, group velocity and their relations. Electron microscope. Uncertainty principle: Heisenberg's uncertainty principle; Estimating minimum energy of a confined particle using uncertainty principle, Energy-time uncertainty principle. Applications.

UNIT – III

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. Concept of wave function: Origin and probability interpretation of wave function, properties of wave-function. One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example.

UNIT – IV

Cosmology: The Expansion of the Universe, The Cosmic Microwave Background Radiation, Dark Matter, The General Theory of Relativity, Tests of General Relativity, Stellar Evolution and Black Holes, Cosmology and General Relativity, The Big Bang Cosmology, The Formation of Nuclei and Atoms, Experimental Cosmology.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Modern Physics, KnnethS.Krane, John Wiley & Sons, Inc.
4. Modern Physics, Raymond A. Serway, Clement J. Moses, Curt A. Moyer, 2005, CENGAGE Learning.
5. Principles of Modern Physics, A.K. Saxena, 2007, NarosaPubli

BSc/Phy/SM/2/SEC/101 Electrical Circuits & Networks

BSc/Phy/SM/3/DSC/203–Physics Lab-V

Credits: 2 (Practical) **Max. Marks: 50**
Teaching per week: 4 Hrs. **Duration of Exam: 3 Hrs.**

Objective: The objective of this course is to impart practical knowledge through design and performance of experiments.

Course outcomes: After successfully completing the course, student will be able to:

CO1: get hands on experience with different instruments by measuring related physical quantities.

CO2: verify some fundamental principles, effects and concepts of physics through experimentation.

CO3: basic understanding on instruments, data observation, errors, along with practical's training to use and learn techniques, skills and tools for professional practices.

CO4: learn to present observations, results and analysis in suitable and presentable form.

List of Experiments

1. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
2. To determine the Planck's constant using LEDs of at least 4 different colours.
3. To determine the wavelength of laser source using diffraction of single slit.
4. To determine the wavelength of laser source using diffraction of double slits.
5. Comparing intensity of light sources and verify inverse square law.
6. Study the characteristics of photodiodes.
7. To determine the particle size of lycopodium powder.
8. To find the horizontal distance between two points using a sextant.
9. To compare the capacitances of two capacitors by deflection method.
10. To find the capacitance of a capacitor by discharging it through a voltmeter.
11. To compare the luminous intensities of two light sources using a photo-voltaic cell.
12. To determine the thermionic work function of tungsten using a directly heated diode.

Reference Books:

1. B.Sc. Practical Physics, C.L. Arora, 2005-2006, S. Chand Publisher, New Delhi
2. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition reprinted 1985, Heinemann Educational Publishers
4. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011,Kitab Mahal
5. A Course of Experiments with He-Ne laser, R.S. Sirohi, 2001, New Age International Publicaiton.
6. Experimental Physics, Gyan Prakash, 2012, Studium Press (India) Pvt. Ltd.

BSc/Phy/SM/3/DSC/204–Physics Lab-VI

Credits: 2 (Practical) **Max. Marks: 50**
Teaching per week: 4 Hrs. **Duration of Exam: 3 Hrs.**

Objective: The objective of this course is to impart practical knowledge through design and performance of experiments.

Course outcomes: After successfully completing the course, student will be able to:
CO1: get hands on experience with different instruments and measurements related physical quantities.
CO2: verify some fundamental principles, effects and concepts of physics through experimentation.
CO3:get basic understanding on instruments, data observation, errors, along with practical's training to use and learn techniques, skills and tools for professional practices.

CO4: learn to present observations, results and analysis in suitable and presentable form.

List of Experiments

1. Study of Franck-Hertz experiment.
2. To study the characteristics of solar cell.
3. Study of Zeeman Effect.
4. Determine wavelength of laser light by using vernier calipers/ engraved metal scale.
5. Distance measurement by triangularization method using laser.
6. To measure the divergence of laser beam.
7. To determine Boltzmann constant.
8. To determine the angular diameter of the Sun with the help of a sextant.
9. To determine the amplitude or the angular elevation of the Sun using a sextant.
10. To find the capacitance of a capacitor using flashing and quenching of a neon lamp.
11. To find the band gap of a semiconductor material.

Reference Books:

1. B.Sc. Practical Physics, C.L. Arora, 2005-2006, S. Chand Publisher, New Delhi
2. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition reprinted 1985, Heinemann Educational Publishers
4. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011,Kitab Mahal.
5. A Course of Experiments with He-Ne laser, R.S. Sirohi, 2001, New Age International Publication.
6. Experimental Physics, Gyan Prakash, 2012, Studium Press (India) Pvt. Ltd.

BSc/Phy/SM/3/MIC/201: Analog Systems and Applications

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Note: *The question paper will consist of nine questions inall. Questionno.1 will contain seven short answer type questions without any internal choice covering the entire syllabus and shall be compulsory. The remaining eight questions will be set from the four units with two questions from each unit. Candidate is required to attempt five questions in all with one compulsory question and one question from each unit.*

UNIT-I

Ideal constant-voltage and constant-current Sources, Kirchhoff's Current Law & Kirchhoff's Voltage Law, Mesh& Node Analysis, Thevenin theorem, Norton theorem, StarDelta Transformation, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem, Applications to dc circuits.

UNIT-II

Concept of feedback in amplifier, Type of feedback, Small signal amplifiers, Analysis of stage amplifier by Graphical and Equivalent Circuit methods, Requirement of multistage amplifiers, Gain of multistage amplifier, Coupling of two stages, Frequency response of RC-coupled amplifiers, Distortion in amplifier, Classification of amplifiers, Power amplifier, Push-pull amplifier,

UNIT-III

Graphical Analysis of the CE Configuration, Two-port Devices and the Hybrid Model, Transistor Hybrid Model, Conversion Formulas for the Parameters of the Three Transistor Configurations, Analysis of a Transistor Amplifier Circuit Using h Parameters, The Emitter Follower, Comparison of Transistor Amplifier Configurations ,Linear Analysis of a Transistor Circuit, Cascading Transistor Amplifiers, Simplified Common- emitter Hybrid

UNIT-IV

Integrated Circuits(IC): Fabrication and Characteristics: Integrated circuit Technology, Basic monolithic IC, Epitaxial Growth, Masking and Etching, Diffusion of impurities, Transistors for Monolithic circuits, Monolithic diodes, Integrated resistors, Integrated capacitors and inductors,

Reference Books:

1. Basic Electronics and Linear Circuits, N. N. Bhargava et. al., 2nd Edition,McGraw Hill Education, India
2. A text book in ElectricalTechnology, B.L.Theraja,S.Chand&Co.
3. Circuitand Networks,2ndEdition, ASudhakarandShyammohanSPalli,TataMcGraw-Hill
4. Integrated electronics by Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education, India

BSc/Phy/SM/3/MIC/202: Solid State Physics

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Objective: The aim of the course is to familiarize the students with the concepts of crystal structure, reciprocal lattice, bonding in solids, elastic constants and magnetic properties of solids. Course Outcomes: After completion of this course, students will be able to understand the basics of crystal structure, reciprocal lattice, bonding in solids, elastic constants and magnetic properties of solids. Students get knowledge on

CO1: elements of crystal structure.
CO2: reciprocal lattice and X-ray diffraction methods.
CO3: bonding in solids and elastic constants.
CO4: theory of magnetism, magnetic properties and superconductivity of materials.

Note for the Paper Setter*: The question paper will consists of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Crystal Structure: Introduction to crystalline & amorphous solids, Crystal lattice and Translation Vectors, Unit cell and basis, Primitive and non-primitive lattices, Symmetry operations, Point groups and space groups, Bravais lattices in 2D and 3D, Lattice planes, Miller Indices, Interplanner spacing, Crystal structures: sc, bcc, fcc and hcp, Examples: NaCl, CsCl, Diamond and ZnS structure.

UNIT-II

Reciprocal lattice: Bragg's law, Fourier analysis of electron density, reciprocal lattice, Diffraction condition in reciprocal space, Laue's equations, Ewald construction, Brillioun zones and Weigner Seitz cell concepts, Brillioun zones construction, Reciprocal lattice (sc, bcc, fcc), Fourier analysis of basis, Atomic scattering factors, Geometrical structure factor, X-ray diffraction method: Laue, Rotating and powder crystal methods.

UNIT – III

Bonding in solids: Force between atoms, Cohesion of atoms and cohesive energy, Crystal of inert gases, Van der Waal interaction, Repulsive interaction, Equilibrium lattice constants, Ionic crystals, Lattice energy of ionic crystal, Madelung constant of ionic crystal, Covalent crystals, Metals, Hydrogen Bonds, Atomic radii. Elastic constants: Elastic strains, Stress components, Stiffness constants for cubic crystals, Elastic energy density, Bulk Modulus and Compressibility, Elastic waves.

UNIT – IV

Magnetic Properties: Origin of magnetism, Types of magnetism,Dia-, Para-, Ferri-, Ferro and anti-ferromagnetic materials, Langevin's Classical and quantum Theory of Dia– and Paramagnetic, Curie's law, Weiss's Theory of Ferromagnetism, Exchange interactions, Spin Hamiltonian and the Heisenberg model; Spin waves- magnons, Ferromagnetic domains: Magnetization curve, Bloch wall, Origin of domains. Superconductivity: Critical temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors, London's equation and Penetration depth, energy gap, BCS theory, Josephson effect.

ReferenceBooks:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. K.V. Keer, Principles of solid state physics, Wiley - Eastern, 1993.
3. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning.
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.
5. Introduction to Solid State Physics, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.
6. Solid State Physics: An Introduction to Theory and Experiment by H. Ibach and H. Luth
7. Neil W Ashcroft and N David Mermin, Solid State Physics, Holt Saunders International Edn, 1976.
8. BD Cullity, Introduction to Magnetic Materials, Addison-Wesley, 1

BSc/Phy/SM/3/MDC/201

Basic of Mathematics

Marks (Theory) : 50 **Marks (Total) : 75**
Marks (Internal Assessment) : 25 **Time : 3 Hrs**
Credits: 03

Note for the Paper Setter: *The question paper will consist of* ***seven*** *questions in all. The first question will be compulsory and will consist of* ***four*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***six*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***three*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***three more questions*** *selecting at least one question from each unit.*

Course Outcomes: This course will enable the students to:

1. Understand types of matrices, algebra of matrices, properties of determinants, adjoint of a matrix, inverse of a matrix, solution of a system of linear equations.
2. Know about the Characteristic equation, rank, eigen vectors and eigen values of a matrix.
3. Know about the differentiation of standard functions, derivatives of higher order and their use in finding maxima and minima of certain functions.
4. Find Integration as an inverse of differentiation summation, area under a curve, indefinite integrals of standard form, reduction formulae.

Unit: I

Matrices & Determinants: Definition of a matrix. Types of matrices; Algebra of matrices; Properties of determinants; Calculation of values of determinants upto third order, Adjoint of a matrix, elementary row or column operations; Finding inverse of a matrix through adjoint and elementary row or column operations. Solution of a system of linear equations.

Matrices & Determinants: Characteristic equation, Statement of Cayley Hamilton theorem. Rank of matrix, Eigen vectors and eigen values using matrices, Diagonalization, similarity transformation of matrices.

Unit: II

Differential Calculus: Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions, derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implicit functions, logarithmic differentiation, derivative of functions, expressed in parametric form, derivatives of higher order. (Only formulae to be given and applications to be emphasized).Maxima and minima.

Unit: III

Integral Calculus: Integration as an inverse of differentiation summation, area under a curve, indefinite integrals of standard form, method of substitution, method of partial fractions, integration by parts, definite integrals, reduction formulae, definite integrals of limit of sum and geometrical interpretation.

Books Recommended:

1. Seymour Lipschutz; Linear Algebra, Schaum's series publications.
2. Santi Narayan; Differential Calculus.
3. Santi Narayan; Integral Calculus.

CDLU/VAC/105

Vedic Mathematics

Marks (Theory): 35 **Marks(Total): 50**
Marks (Internal Assessment):15 **Time:2Hrs**
Credits:02

Note for the Paper Setter: *The question paper will consist of* ***five*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***1*** *mark each covering the whole syllabus. In addition,* ***four*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***two*** *units. The candidates are required to attempt* ***one compulsory question****and* ***two more questions*** *selecting atleast one question from each unit.*

Course Outcomes(COs): At the end of the course, the students will be able

CO1: Discuss the rich heritage of mathematical temper of Ancient India Learning Outcomes: Overcome the fear of maths, Improved critical thinking

CO2: Familiarity with the mathematical under pinnings and techniques, Ability to do basic maths faster and with ease.

UNIT-I

Vedic Maths- High Speed Addition and Subtraction Sessions/Lectures, Vedic Maths: History of Vedic Maths and its Features, Vedic Maths formulae: Sutras and Upsutras, Addition in Vedic Maths: Without carrying, Dot Method, Subtraction in Vedic Maths:NikhilamNavatashcaramamDashatah,Fraction–AdditionandSubtraction.

UNITII

VedicMath-MiracleMultiplicationandExcellentDivision,Multiplication in Vedic Maths: Base Method (any two numbers upto three digits), Multiplication by Urdhva Tiryak Sutra, Miracle multiplication: Any three-digit number by series of 1's and 9's,Division by Urdhva Tiryak Sutra(Vinculummethod).

Bookssuggested:

1. TheEssentialofVedicMathematics,RajeshKumarThakur,RupaPublications,NewDelhi2019.
2. VedicMathematicsMadeEasy,DahavalBathia,JaicoPublishing,NewDelhi2011
3. VedicMathematics:SixteenSimpleMathematicalformulaefromtheVedas,JagadguruSwamiSriBharatiKrishnaTrithaji,MotilalBanarasidas,NewDelhi2015.
4. LearnVedicSpeedMathematicsSystematically,ChaitnayaA.Patil2018.17SuggestedReadings
5. AModernIntroductiontoAncientIndianMathematics,TSBhanumurthy,WileyEasternLimited, NewDelhi.

Semester-IV

BSc/Phy/SM/4/DSC/204: Physics of Semiconductor Devices

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Objective: The course enables students to develop an in-depth understanding about the physics of semiconductors through an exposure of various types of semiconductor diodes, transistors, binary number systems and logic gates.

Course Outcomes: After completion of this course, students will be able to understand:

Note for the Paper Setter: *The question paper will consists of nine questions in all. The first question will be compulsory and will consist of seven short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the two units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT – I

Physics of Semiconductors: The Energy-Band theory of Crystals, Classification of materials,Direct and indirect band gap semiconductors, Intrinsic and extrinsic semiconductors, concept ofeffective mass, Donor and Acceptor impurities, mass action law, Carrier Concentrations; The FermiLevel, Charge densities in semiconductors, Electrical properties of Ge and Si, Generation andrecombination of charges, Carrier diffusion, Continuity equation, Injected minority-carrier charge,The Potential variation within a graded semiconductor.

UNIT – II

Semiconductor Diodes: Open circuit p-n junction, V-I characteristics and their dependence, IdealDiode, The Diffusion capacitance, Breakdown Diodes, Tunnel Diode, Semiconductor Photodiode,LED, Diode as circuit element, Load line, Piecewise linear diode model, p-n junction as rectifier(half, full and bridge rectifier), Ripples, Filters (capacitor, inductor and π-filters), Clipping andclamping circuits.

UNIT – III

Bipolar Junction Transistors (BJT): The junction transistor and its current components, I-V characteristics, Transistor as an amplifier, Type of transistors, Common-Base (CB), Common-Emitter (CE), Common-Collector (CC) configuration, characteristics of CE, CB and CC configurations, Ebers-Moll BJT Model, Phototransistor, Switching Transistor, Biasing for transistor, load line and Q point. Types of biasing, Fixed Bias circuits, Collector to base biascircuits, Bias circuit with emitter resistance, Voltage divider bias circuits.

UNIT – IV

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code.Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators: De Morgan's Theorems, Boolean Laws, simplifications of Logic Circuits using Boolean Algebra,

Positive and negative logic, Truth Tables of OR, AND, NOT, construction and symbolic representation of XOR, XNOR, Universal NOR and NAND gates (DTL, TTL gates).

Reference Book:

1. Semiconductor Physics and Devices: Donald A Neaman and Dhrubes Biswas, 4thEdition, McGraw Hill, India
2. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
3. Basic Electronics and Linear Circuits, N. N. Bhargava et. al., 2ndEdition, McGraw Hill, India
4. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
5. Solid State Electronic Devices, B. G. Streetman & S. K. Banerjee, 6thEdn.,2009, PHI Learning

BSc/Phy/SM/4/DSC/205: Classical and Statistical Mechanics

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Objective: The objective of the course is to provide a basic knowledge of constraints, planetary motion, Langrange's formulation of classical system of particles. The course also includes the basics of classical and quantum statistics.

Course Outcomes: After completion of this course, students will be able to understand the basics of classical and statistical mechanics. They will be having basic knowledge of.

CO1:two-body central force problem and Lagrangian dynamics.
CO2: rigid bodies- kinematics and dynamics.
CO3:introductory topics in statistical physics.
CO4:topics inclassical and quantum statistics.

Note for the Paper Setter: *The question paper will consists of nine questions in all. The first question will be compulsory and will consist of seven short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT – I

Two-body central force problem and Lagrangian Dynamics: Constraints & their classification, Generalized coordinates, D'Alembert's principle and Lagrange's equations, Simple applications of the Lagrangian formulation, Velocity-dependent potentials and the dissipation function, Hamilton's principle, Derivation of Lagrange's equations from Hamilton's principle, Cyclic coordinates, Conservation theorems and symmetry properties. Two –body central force problem: Reduction to the equivalent one-body problem, Equations of motion and first integrals, Equivalent 1-D problem and classification of orbits.

UNIT –II

Rigid Bodies- Kinematics and Dynamics: Independent coordinates of the rigid bodies, orthogonal transformations, Euler angles and Euler's theorem, Infinitesimal rotation, rate of change of a vector, Coriolis force, angular theorem, infinitesimal rotation, angular momentum and kinetic energy of a rigid body, the inertia tensor, principal axis transformation, Euler equations of motion, Torque free motion of rigid body, motion of asymmetrical top.

UNIT- III

Introduction to Statistical Physics: Laws of Thermodynamics, Entropy and Disorder, Statistical Definition of Entropy, Macroscopic and Microscopic Systems, Events (dependent, independent and mutually exclusive), statistical Probability, a-priori probability, probability theorems, Tossing of Coins, Permutations and Combinations, Distribution of N distinguishable and indistinguishable particles in boxes, Macro and Micro states, Thermodynamic potentials and Thermodynamic equilibriums, phase space, Liouville's Theorem, Density Matrix, Fluctuations, Three kinds of Statistics 75.

UNIT-IV

Classical and Quantum Statistics: Maxwell- Boltzmann Statistics applied to an ideal gas, M.B. velocity distribution law, Thermodynamical quantities, ideal Boltzmann gas, Monoatomic and Diatomic ideal gases, ideal paramagnetism, Bose- Einstein energy distribution law, Planck's Radiation Law, B-E Gas, Degeneracy and B.E. Condensation, Fermi- Dirac energy distribution Law, F.D. Gas and Degeneracy, Fermi Energy and Fermi Temperature, Zero point Energy, Zero point Pressure and average speed (at 0K) of electron gas, Specific heat Anomaly of metals and its solution, M.B. distribution as a limiting case of B.E. and F.D. distributions, Comparison of three Statistics.

Reference Books:

1. Classical Mechanics, 3rded.,2002 by H.Goldstein, C. Poole and J. Safko, Pearson Edition
2. Classical Mechanics of Particles and Rigid Bodies by K. C. Gupta, 2008, New Age International.
3. Classical Mechanics, N.C. Rana & P.S. Jaog, 2017, Tata MC Graw Hill, New Delhi.
4. Statistical Mechanics, R.K. Pathria& D. Beale, 2021, Elsevier Publication.
5. Statistical Mechanics, B.K. Agarwal & M. Eisner,2020, New Age International Publication.
6. Introduction to Statistical Mechanics, S.K. Sinha, 2005, Narosa Publication.

BSc/Phy/SM/4/DSC/206–Physics Lab-VIII

Credits: 2 (Practical) **Max. Marks: 50**
Teaching per week: 4 Hrs. **Duration of Exam: 3 Hrs.**

Objective: The objective of this course is to impart practical knowledge through hands on training of basic instruments.

Course outcomes: After successfully completing the course, student will be able to get:
CO1:exposure with various aspects of instruments and their usage through hands-on mode.
CO2:real work experience of various lab skills on related instruments in the profession.
CO3: basic understanding on instruments data observation, measurements, errors and analysis.
CO4: practical's training to use and learn techniques, skills and tools for professional practices.

List of Experiments:

1. To study the growth and decay of current in a L, R circuit using magnetic core inductor.
2. To determine the magnetic induction field between the pole pieces of an electromagnet with the help of a search coil and a ballistic galvanometer using a mutual inductance for calibration of ballistic galvanometer.
3. To determine the value of e/m for electron by long solenoid (Helical) method.
4. To determine e/m by magnetron method or small solenoid method.
5. To determine the electronic charge by Millikan's Method.
6. To determine the frequency of AC mains using a Sonometer and an electromagnet.
7. To find the value of B_H the Horizontal component of earth's magnetic field in the laboratory using a deflection and vibration magnetometer.
8. To find the value of M in the laboratory using deflection and vibration magnetometer.
9. To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph.
10. To study the induced emf as a junction of velocity of the magnet (simple method).
11. To study the induced emf as a junction of velocity of magnet.
12. To obtain the wave form of AC mains supply using a cathode ray oscilloscope.
13. To measure the AC voltage using a CRO and to calculate the deflection sensitivity in mm per rms volt.
14. To measure a dc voltage with the help of a CRO.
15. To demonstrate the phase difference in the case of resistance, inductance and capacitance and to measure their values using a CRO.
16. To measure the phase difference between current & voltage for CR and LR of AC circuit using a CRO.
17. Magnetic field measurement by using Helmholtz coil.

Reference Books:

1. B.Sc. Practical Physics: C.L. Arora, 2005-2006, S.Chand& Co. Ltd.
2. A text book in Electrical Technology - B L Theraja, 2006, S Chand and Co.
3. Performance and design of AC machines - M G Say, 2002, ELBS Edn.
4. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
5. Logic circuit design, Shimon P. Vingron, 2012, Springer.
6. Digital Electronics, SubrataGhoshal, 2012, Cengage Learning.

7. Electronic Devices and circuits, S. Salivahanan& N. S. Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
8. Electronic circuits: Handbook of design and applications, U. Tietze, Ch. Schenk, 2008, Springer.
9. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.
10. Experimental Physics, Gyan Prakash, 2012, Studium Press (India) Pvt. Ltd.

BSc/Phy/SM/4/DSC/207–Physics Lab-IX

Credits: 2 (Practical) **Max. Marks: 50**
Teaching per week: 4 Hrs. **Duration of Exam: 3 Hrs.**

Objective: The objective of this course is to impart practical knowledge through design and performance of experiments.

Course outcomes: After successfully completing the course, student will be able to get
CO1: hands on experience with different instruments and measurements of related physical quantities.
CO2: verify some fundamental principles, effects and concepts of physics through experimentation.
CO3: basic understanding on instruments data observation, measurements ,errors and analysis.

CO4: practical's training to use and learn techniques, skills and tools for professional practices.

List of Experiments:

1. To determine the frequency of an electric tuning fork by Melde's experiment.
2. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped film.
3. To verify inverse square law of radiation using a photoelectric cell.
4. To determine wavelength of spectral lines of Hg source using plane diffraction grating.
5. To determine dispersive power and resolving power of a plane diffraction grating.
6. To find the polarization angle of laser light using polarizer and analyzer.
7. To verify Malus law of polarization.
8. Measurement of focal length of mirrors and lenses.
9. To find Brewster's angle.
10. Study Faraday law of induction.
11. To study the characteristics of a photo-voltaic cell (solar cell).
12. Study of optical fiber as a waveguide.
13. To determine the coefficient of increase of pressure of air at constant volume.
14. To find the melting point of wax using Joly's constant volume air thermometer.

Reference Books:

1. B.Sc. Practical Physics, C.L. Arora, 2005-2006, S. Chand Publisher, New Delhi
2. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
6. Experimental Physics, Gyan Prakash, 2012, Studium Press (India) Pvt. Ltd.

BSc/Phy/SM/4/MIC/203: Electromagnetic Theory

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Objectives: The course on Electricity and Magnetism deals with the Electromagnetic induction, Maxwell's Equations, Electromagnetic wave propagation, Poynting's Vector and electromagnetic field transformation

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Course Outcomes: The student will be able to understand electromagnetic induction and it's applications, Maxwell's equations and generation of electromagnetic fields, wave propagation through vacuum and isotropic dielectric medium.
The student will be able to understand;

CO1:electromagnetic induction and it's applications.
CO2: Maxwell's equations and generation of electromagnetic fields.
CO3:wave propagation through vacuum and isotropic dielectric medium as well as wave guide.
CO4: electromagnetic potential and dipole radiation.

Note for the Paper Setter: *The question paper will consists of nine questions in all. The first question will be compulsory and will consist of seven short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Motional EMF, Faraday's Law of induction, Induced electric field, Lenz's law, Inductance,Self induction of a single coil, Mutual induction of two coils, Transformers, Energy stored in magnetic field,
Maxwell`sequations: Maxwell's fixing of Ampere's law, Displacement current, Maxwell's equations in vacuum.

UNIT-II

Maxwell's equations in matter, Boundary Conditions, Continuity equation, Poynting Theorem and Poynting vector, Maxwell Stress tensor, Conservation of Momentum and angular momentum in electromagnetic field, Energy density in electromagnetic field.

UNIT-III

The wave equation, Sinusoidal waves, Wave equations for **E** and **B** fields, Electromagnetic wave propagation through vacuum and isotropicdielectricmedium,transverse nature of EMwaves, Energy and momentum in EM waves, Propagation in linear media, Reflection and transmission at Normal and Oblique incidence, Brewster's angle, Wave guides, TEM waves

UNIT-IV

Scalar and vector potential for electromagnetic fields, Gauge Transformation, Coulomb Gauge, Lorentz Gauge,Electric and magnetic dipole radiation (no derivation needed, discussion of results only), Magnetism as relativistic phenomenon, Transformation of electric and magnetic fields between two inertial frames.

Reference Books:

1. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
2. ElectricityandMagnetism,EdwardM.Purcell,1986,McGraw-HillEducation.
3. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
4. University Physics, Ronald Lane Reese, 2003, ThomsonBrooks/Cole.

BSc/Phy/SM/4/MIC/204

Basics of Lasers

Credits: 4 **Max. Marks: 100**
Lectures: 60 **Final Term Exam.: 70**
Duration of Exam.: 3 Hrs. **Internal Assessment: 30**

Course Objectives: The objective of the course on Lasers is to familiarize the students to the basic aspects of Laser Physics

Course Outcomes: After taking the course, students should be able to explain central concepts, laws and models in Laser physics, interpret basic experiments & can use basic law sand relations to solve related problems

Note: The question paper will consist of nine questions in all. Questionno.1 will contain five short answer type questions without any internal choice covering the entire syllabus and shall be compulsory. The remaining eight questions will be set from the four units with two questions from each unit. Candidate is required to attempt five questions in all with one compulsory question and one question from each unit.

Unit-I

Review of some basic concepts and principle of laser, Introduction to LASERS: Interaction of radiation with matter – induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity. Properties – coherency, intensity, directionality, monochromaticity and focussibility.

Unit-II

Properties of LASERS Gain mechanism, threshold condition for population inversion (derivation), emission broadening – line width, derivation of FWHM natural emission line width as deduced by quantum mechanics – additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts.

Unit-III

Types of LASERS (Solid, Liquid and Gas states): principle, construction, working and application: (i) Ruby LASER – (ii) Neodymium (Nd) LASERS. (iii) He-Ne LASER Liquid dye LASERS. semiconductor diode LASERS, homo-junction and hetero-junction LASERS.

Unit-IV

Applications: Introductory fiber optic communication, Holography: Principle, types, intensity distribution, applications. laser induced fusion. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

Books References:

1. William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).
2. B B Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.
3. Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).
4. K R Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.
5. T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).

BSC/PHY/SM/3/SEC/201
MATLAB (Practical)

Marks (Total):75 **Credits:03**
Duration of Exam: 3 Hrs.

Course Outcomes: This course will enable the students to:-
CO1: Get familiar with the importance and working of MATLAB as computation platform hrough the knowledge of characters, variables, operators, functions and expressions as used for elementary operations in matrix algebra along with the editing, load/save data and compilation/execution/quitting of source programs.
CO2: Learn the process of writing a source program in MATLAB as high-level language making use of the statements for input/output, conditional/non-sequential processing involving functions, arrays and structures.

Practical Course Syllabus:

1. Know syntax of expressions, statements, datatypes, structures, commands and to write source code for a programing MATLAB.
2. Edit, compile /interpret and execute the source program for desired results.

Computing lab work will be based on programming in MATLAB for computing various mathematical problems. There will be 12-15problems/ programmes during the course.

Recommended Books:

1. *Learning MATLAB*, COPYRIGHT1984-2005byTheMathWorks,Inc.
2. Amos Gilat, *MATLABAnIntroductionWithApplications5ed, Wiley,2008*.
3. C.F.VanLoanandK.-Y.D.Fan., *Insigh through Computing: AMatlabIntroductiontoComputationalScienceandEngineering, SIAMPublication,2009*.
4. T.A.DavisandK.Sigmon,*MATLABPrimer*7thEdition,CHAPMAN&HALL/CRC,2005.
5. B.R.Hunt, R.L.Lipsman,J.M.Rosenberg,K. R.Coombes,J.E.Osborn,andG.J.Stuck,*AGuidetoMATLAB*,SecondEdition,Cambridge University Press, 2006

CDLU/VAC/101

Communication Skills

Credits: 2 (Theory) | **Max. Marks: 50**

Lectures: 30 | Final Term Exam: 35

Duration of Exam: 2 Hrs. | **Internal Assessment: 15**

COURSE OBJECTIVES

• Identify common communication problems that may be holding learners back

• Perceive what the non-verbal messages are communicating to others

• Understand the role of communication in the teaching-learning process

LEARNING OUTCOMES

• Get a clear understanding of good communication skills.

• Know what they can do to improve their communication skills.

Unit-1

Listening: Techniques of Effective Listening, Listening and Comprehension, Probing Questions Barriers to Listening.
Speaking: Pronunciation, Enunciation, Vocabulary, Fluency, Common Errors.
Reading: Techniques of Effective Reading, Gathering Ideas and Information from a Given Text, evaluating these Ideas and Information, Interpreting the Text.
Writing and Different Modes of Writing: The Writing Process, Effective Writing Strategies, Different Modes of Writing.
Digital Literacy and Social Media: Basic Computer Skills, Introduction to Microsoft (MS) Office Suite, Open Educational Resources, Basic Virtual Platforms, Trending Technologies, Machine Learning, Artificial Intelligence (AI), Internet of Things (IoT), Social Media, Introduction to Social Media Websites, Advantages of Social Media, Ethics and Etiquettes of Social Media, How to Use Google Search Better?, Effective Ways of Using Social Media, Digital Marketing, Introduction to Digital Marketing, Traditional Marketing versus Digital Marketing, Digital Marketing Tools, Social Media for Digital Marketing, Digital Marketing Analytics.

Unit-2

Digital Ethics and Cyber Security: Digital Ethics, Digital Literacy Skills, Digital Etiquette, Digital Life Skills, Cyber Security, Understanding and introducing the environment of security, Types of attacks and attackers, the art of protecting secrets.

Nonverbal Communication: Meaning of nonverbal communication, Advantages of using nonverbal communication, Introduction to modes of nonverbal communication, Open and Closed body language, Eye contact and Facial expression, Hand gestures, Do's and Don'ts in NVC, Learning from experts, Activities-based learning.

Suggested Readings: Follow Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0 at UGC website:
https://www.cdlu.ac.in/assets/admin/miscellaneous/Implementation%20of%20Curriculum%20and%20Guidelines%20on%20Life%20Skills%20(Jeevan%20Kaushal)%202.0.pdf

Note for the Paper Setter: *The question paper will consist of* ***five*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***1*** *marks each covering the whole syllabus. In addition,* ***four*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***two*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***two more questions*** *selecting at least one question from each unit.*