Date :- 29/06/2019

NOTIFICATION

Sub :- CBCS Syllabi of ~~B. Sc.~~/M. Sc. in Physics (Sem I & II)

Ref. :- Decision of the Academic Council at its meeting held on 28/06/2019.

The Syllabi of ~~B. Sc.~~/M. Sc. in Physics (First and Second Semesters) as per CBCS-~~UG~~/PG Regulations, 2016 and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2019-20.

Copy of the Syllabi shall be downloaded from the College Website (www.kcesmjcollege.in)

Chairman
Board of Studies

MOOLJI JAITHA COLLEGE, JALGAON — NAAC GRADE 'A' CGPA-3.15 (3rd CYCLE) — AUTONOMOUS

Principal,
M. J. College, Jalgaon

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The Director, School of Physical Sciences, M. J. College, Jalgaon.
3) The office of the COE, M. J. College, Jalgaon.
4) The office of the Registrar, M. J. College, Jalgaon.
5) Office File.

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College" Affiliated to

KBC North Maharashtra University, Jalgaon

COURSE STRUCTURE

For

M. Sc. Physics

Under Choice Based Credit System (CBCS)

[w. e. f. Academic Year: 2019-20]

Course Structure

M.Sc. - I: Physics

Term / Semester	Course Module	Subject Code	Title of Paper	Credit	Hours per Week
I	DSC	PHY-101	MATHEMATICAL METHODS FOR PHYSICS	4	4
	DSC	PHY-102	CLASSICAL MECHANICS	4	4
	DSC	PHY-103	QUANTUM MECHANICS-I	4	4
	DSC	PHY-104	GENERAL LABORATORY-I	4	8
	SEC	PHY-105	MODELLING AND SIMULATION USING MATLAB	4	4
	DSE	PHY-106	ELECTRONICS	4	4
II	DSC	PHY-201	ELECTRODYNAMICS	4	4
	DSC	PHY-202	STATISTICAL MECHANICS	4	4
	DSC	PHY-203	SOLID STATE PHYSICS	4	4
	DSC	PHY-204	GENERAL LABORATORY-II	4	8
	GE	PHY-205	RENEWABLE ENERGY AND SOURCES	4	4
	DSE	PHY-206	ELEMENTS OF MATERIAL SCIENCE	4	4

Course Structure

M.Sc. - II : Physics

Term / Semester	Course Module	Subject Code	Title of Paper	Credit	Hours per Week
III	DSC	PHY-301	ATOMIC AND MOLECULAR PHYSICS	4	4
	DSC	PHY-302	QUANTUM MECHANICS-II	4	4
	DSC	PHY-303	SPECIAL LABORATORY-III	4	8
	DSC	PHY-304	PROJECT-I	4	8
	SEC	PHY-305	COMPUTATIONAL METHODS AND PROGRAMMING USING ‘C’ LANGUAGE	4	4
	DSE	PHY-306	MATERIALS SYNTHESIS METHODS	4	4
IV	DSC	PHY-401	NUCLEAR PHYSICS	4	4
	DSC	PHY-402	LASER AND IT’S APPLICATIONS	4	4
	DSC	PHY-403	SPECIAL LABORATORY-IV	4	8
	DSC	PHY-404	PROJECT-II	4	8
	GE	PHY-405	SOLAR PHOTOVOLTAIC GRID CONNECTED SYSTEMS	4	4
	DSE	PHY-406	CHARACTERIZATION OF MATERIALS	4	4

Examination pattern (60: 40)

Nature	Marks
External Marks	60
Internal Marks	40
Total Marks	100

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College" Affiliated to

KBC North Maharashtra University, Jalgaon

KNOWLEDGE IS POWER

ESTD. 1945

SYLLABUS

Physics

M.Sc.

(Semester I & II)

Under Choice Based Credit System (CBCS)

[w. e. f. Academic Year: 2019-20]

Course Structure
M.Sc. – I Physics

Semester	Course Module	Subject code	Title of paper	No. of Credits	Hours per Semester	Marks Internal	Marks External
I	DSC	PHY-101	MATHEMATICAL METHODS FOR PHYSICS	04	60	40	60
	DSC	PHY-102	CLASSICAL MECHANICS	04	60	40	60
	DSC	PHY-103	QUANTUM MECHANICS-I	04	60	40	60
	DSC	PHY-104	GENERAL LABORATORY-I	04	60	40	60
	SEC	PHY-105	MODELLING AND SIMULATION USING MATLAB	04	60	40	60
	DSE	PHY-106	ELECTRONICS	04	60	40	60
II	DSC	PHY-201	ELECTRODYNAMICS	04	60	40	60
	DSC	PHY-202	STATISTICAL MECHANICS	04	60	40	60
	DSC	PHY-203	SOLID STATE PHYSICS	04	60	40	60
	DSC	PHY-204	GENERAL LABORATORY-II	04	60	40	60
	GE	PHY-205	RENEWABLE ENERGY AND SOURCES	04	60	40	60
	DSE	PHY-206	ELEMENTS OF MATERIAL SCIENCE	04	60	40	60

Course Structure
M.Sc. – II Physics

Semester	Course Module	Subject code	Title of paper	No. of Credits	Hours per Semester	Marks Internal	Marks External
III	DSC	PHY-301	ATOMIC AND MOLECULAR PHYSICS	04	60	40	60
	DSC	PHY-302	QUANTUM MECHANICS-II	04	60	40	60
	DSC	PHY-303	SPECIAL LABORATORY-III	04	60	40	60
	DSC	PHY-304	PROJECT-I	04	60	40	60
	SEC	PHY-305	COMPUTATIONAL METHODS AND PROGRAMMING USING ‘C’ LANGUAGE	04	60	40	60
	DSE	PHY-306	MATERIALS SYNTHESIS METHODS	04	60	40	60
IV	DSC	PHY-401	NUCLEAR PHYSICS	04	60	40	60
	DSC	PHY-402	LASER AND IT’S APPLICATIONS	04	60	40	60
	DSC	PHY-403	SPECIAL LABORATORY-IV	04	60	40	60
	DSC	PHY-404	PROJECT-II	04	60	40	60
	GE	PHY-405	SOLAR PHOTOVOLTAIC GRID CONNECTED SYSTEMS	04	60	40	60
	DSE	PHY-406	CHARACTERIZATION OF MATERIALS	04	60	40	60

PHY-101: MATHEMATICAL METHODS FOR PHYSICS

Lectures:: 60

Credits: 04

Course Description:

This course is aimed to provide students with a sound knowledge of mathematical methods and its application in theoretical physics as well as in wave mechanics, design of electronic circuit etc, which forms thorough basis for careers in Physics and related fields.

Course Objectives:

1. This course has been developed to introduce various topics of Mathematical Methods for Physics.
2. This course has direct relevance in other core subjects of Physics.

Course Outcomes:

After completion of the course, students would be able

1. To solve real definite integrals in theoretical Physics.
2. To use special functions and matrices for solving Quantum Mechanical Problems.
3. To use matrices for solving linear algebraic equations and to use group theory for understanding of crystallography.
4. To use Fourier series and integral transforms for analysis of wave mechanics and electrical circuit analysis.

Course Contents:

UNIT 1: VECTOR SPACES AND MATRICES (Lectures: 10)

Definition of a linear vector space, Linear independence, basis and dimension, scalar product, inner product Orthonormal basis, Schwartz Inequality, Matrices, Orthogonal, Unitary, Eigen values and Eigen vectors of matrices, Matrix diagonalization, trace and normalization of matrix, Cayley-Hamilton theorem.

UNIT 2: SPECIAL FUNCTIONS (Lectures: 08)

Definition of special functions, Generating functions for Bessel function of integral order Jn(x), Legendre polynomials Pn(x), Generating functions for Pn(x), Hermite Polynomials, Generating functions for Hermit polynomials.

UNIT 3: FOURIER SERIES (Lectures: 10)

Fourier series: periodic function, Euler Fourier formula, Dirichilete conditions, half range Fourier series, Change of interval, Parseval's identity, Application of Fourier series- Vibrating string, RLC circuit and Square Wave.

UNIT 4: INTEGRAL TRANSFORMS (Lectures: 14)

Integral transform, Laplace transform, Properties of Laplace transforms, Inverse Laplace Transform, Laplace transform of derivatives and integrals, Laplace's equation – application to electrostatic field. Fourier Transforms: Fourier sine and cosine transforms, odd and even functions, convolution theorem, Parseval's therom.

UNIT 5: ELEMENTS OF COMPLEX ANALYSIS (Lectures: 10)

Introduction, Analytic functions, Cauchy-Riemann conditions, Harmonic functions, Cauchy's integral formula, Residue theorem, Residues atdifferent poles, Contour Integrals, Taylor and Laurent series, singularities, Definite integrals.

UNIT 6: ELEMENTARY PROBABILITY THEORY (Lectures: 08)

A definition of the probability sample space, fundamental probability theorems, random variables, and probability distributions: binomial, Poisson, normal.

REFERENCE BOOKS:

1. Mathematical Methods for Physicists: Tai L. Chow, 1st Edition, 2000, Cambridge University Press

2. Mathematical Methods For Physics And Engineers: Riley, Hobson And Bence, 1st Edition, 1997, Cambridge University Presses.

3. Mathematical Methods in Physical Sciences: H. K. Das, Dr. R. Verma, 8th edition, 2018 S Chand Publications and company Ltd.

4. Matrices and Tensors in Physics: A.W. Joshi 3rd Edition, New Age International (P) Ltd.

5. Mathematical Methods for Physicists: G.BArfken, H. J.Weber, 5th Edition, Harcourt Pvt. Ltd. (Academic Press)

PHY-102: CLASSICAL MECHANICS

Lectures:: 60

Credits: 04

Course Description: This course is aimed to provide students with a sound knowledge of fundamental principles of classical mechanics and their applications in typical situations.

Course Objectives:

1. To develop familiarity with the physical concepts and the mathematical methods of classical mechanics.
2. To develop skills in formulating and solving physics problems.

Course Outcomes:

Upon completion of this course, the student should:

1. Understand the physical principles behind the derivation of Lagrange and Hamilton's equations, and the advantages of these formulations,
2. Master different problem-solving strategies within mechanical physics and assess which of these strategies is most useful for a given problem,
3. Be familiar with the fundamental principles of central force motion
4. Understand the intricacies of coupled oscillations.

Course Contents:

UNIT 1: ENERGY AND WORK (Lectures: 12)

Conservative force, potential energy, conservative momentum and angular momentum, conservative system of particles of mass, motion of COM, conservation theorems & equation of motion under different types of forces.

UNIT 2: THE LANGRANGIAN FORMULATION OF MECHANICS (Lectures: 12)

Generalized coordinates, DoF, configurational space, constraints, D'Alembert's principle and Lagrange's equations, kinetic energy in generalized coordinates, generalized momentum and energy, Gauge invariance, cyclic or ignorable coordinates.

UNIT 3: HAMILTONIAN DYNAMICS (Lectures: 12)

Hamilton's principle and Lagrange's equations, Lagrange's equation for non-holonomic systems, few examples of Lagrange's equation of motion, method of undetermined multipliers, the Hamiltonian of the dynamical system, Hamilton's canonical equations, canonical transformations, Poisson's bracket, phase space, Lagrange from Hamiltonian, few application of Hamiltonian formulation.

UNIT 4: CENTRAL FORCE MOTION (Lectures: 12)

The two body problem and the reduced mass, general properties of central force motion, effective potential and classification of orbits, general solutions, inverse square law of the force, Kepler's law of planetary motion.

UNIT 5: COUPLED OSCILATIONS (Lectures: 12)

Coupled pendulum, normal coordinates, coupled oscillators and normal oscillators, and normal modes, equation of motion of a coupled system, normal modes of oscillation, orthogonality of Eigenvectors, normal coordinates.

REFERENCE BOOKS:

1. Classical Mechanics: T.L.Chow 1st Edition, 1995, John Willey and Sons Inc.
2. Classical Mechanics: Takwale, Puranic 1st Edition, 2007, Tata McGraw Hill Publication
3. Classical Mechanics: H.Goldstein 2nd, Edition, 1980, Narosa Publishing House
4. Classical Mechanics: Rana and Joag, 1st Edition, Tata McGraw Hill Company Ltd.
5. Classical Mechanics: A Modern Perspective- Barger and Olsson 2nd Edition, 1995, McGraw Hill Publication

PHY-103: QUANTUM MECHANICS - I

Lectures:: 60

Credits: 04

Course Description:

This course introduces the most important aspects of quantum mechanics, inadequacy of classical physics, fundamental postulates of quantum mechanics, Schrodinger equation, one dimensional problem, Dirac notation and operator formalism, time evolution of quantum system, angular momentum theory.

Course Objectives:

This course is designed for students

1. To gain knowledge about the time-dependent and time-independent Schrödinger equation for simple potentials like harmonic oscillator and hydrogen atom
2. To apply principles of quantum mechanics to calculate observations on known wave function

Course Outcomes:

After successfully completion of course, students will be able to understand:

1. differences between classical and quantum mechanics
2. knowledge of wave function and uncertainty relations
3. logic necessary to solve Schrödinger equation for simple potentials

Course Contents:

UNIT 1:THE ORIGIN OF QUANTUM THEORY (Lectures: 12)

Inadequacy of classical Physics, de Broglie hypothesis, wave-particle duality, Born's interpretation of wave function, wave function for particle momentum, wave packets, the Heisenberg's uncertainty principle.

UNIT 2:SCHRODINGER EQUATION (Lectures: 10)

Necessity of wave equation and the conditions imposed on it, time dependent Schrodinger equation, Conservation of probability, Expectation values, Ehrenfest theorem, time independent Schrodinger equation, Eigen functions and Eigen values, Stationary states, orthogonality of eigen functions, parity, continuity and boundary conditions.

UNIT 3: ONE DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS (Lectures: 12)

Free particle, infinite square well, potential step, square potential barrier, explanation of alpha decay, square well potential, Linear harmonic oscillator.

UNIT 4:FORMALISM OF QUANTUM MECHANICS (Lectures: 14)

Postulates of quantum mechanics, representation of states and dynamical variables, observables, self-adjoint operators, eigen functions and eigen values, degeneracy, orthogonality, orthonormality, completeness and closure property, physical interpretation of eigen values, eigen functions and expansion coefficients, eigen values and eigen functions of momentum operator, Dirac's bra and ket notations, linear operators, unit operator, hermitian operator, unity operator, parity operator, eigen values and eigen functions of simple harmonic oscillators by operator method.

UNIT 5:ANGULAR MOMENTUM (Lectures: 12)

Orbital angular momentum, angular momentum algebra, angular momentum as a generator of infinitesimal rotations, Eigen values and functions of L2 and Lz, ladder operators L- and L+, spin angular momentum, Pauli's spin matrices, addition of angular momenta, representation of J in ljm> basis, computation of Clebsch-Gordan coefficients in simple cases (J1=1/2, J2=1/2).

REFERENCE BOOKS:

1. Quantum Mechanics: B. H. Bransden and C. J. Joachain, 2nd Edition, 2004, Pearson Education ltd.
2. Quantum Mechanics: L. I. Schiff, 3rd edition, 1998, MGH book company.
3. Quantum Mechanics: J. D. Powell and B. Crossman. 1st edition, 1998, Narosa Publishing House.
4. Quantum Mechanics: S. Gasiorowicz, 3rd edition, 2003, Wiley International.

PHY-104: GENERAL LABORATORY-I

Lectures:: 60

Credits: 04

Note: At least 4 experiments from each group and minimum, 10 experiments should be performed

Group A

1. λ by Michelson Interferometer.
2. Febry -Perot Interferometer. Determination of wavelength of monochromatic source.
3. To determine ultrasonic velocity and to obtain compressibility of a given liquid.
4. Magnetic susceptibility of paramagnetic material by Quincke's method.
5. "e/m" by Millikan oil drop method.
6. Diffraction at single and double slits using laser source.
7. Surface tension by ripples method.
8. Determination of elastic constants by Cornu's method.
9. Determination of thickness of thin transparent sheet like mica using Michelson interferometer.
10. Determination of Rydberg constant using Hydrogen discharge tube.
11. To find the values of Cauchy's constants for the material of the given prism using Hg source. (Ref: Practical Physics by C.L.Arora page 163)

Group B

1. Design and build ERPS using IC 723 and study its line and load regulation.
2. Design, build and test the phase shift oscillator using IC-741.
3. Design, build and test Schmitt trigger circuit using 741.
4. To study the characteristics of LDR, Photodiode and Phototransistor.
5. Design, build and test first order & second order low pass filter using IC 741.
6. Design, build and test first order & second order high pass filter using IC 741.
7. Design, build and test precision rectifier using IC 741.
8. Design, build and test Astable / monostable multivibrator using IC 741/IC 555.
9. Design, build and test voltage to frequency converter.
10. Design, build and test the temperature to frequency converter.
11. Design, build and test transformer less class-B push pull amplifier.

PHY-105: MODELLING AND SIMULATION USING MATLAB

Lectures:: 60

Credits: 04

Course Description:

This course deal with MATLAB programming and applications in computational techniques.

Objectives:

1. To learn features of MATLAB programming tool.
2. To correlate theory and real-world applications in the field of science and technology
3. To develop and solve own problems and solve similar problems in the field of electrical systems
4. To understand and use of MATLAB simulink tool

Course Outcomes:

1. The student will understand the basic concept of MATLAB programming
2. The student will be able to learn simulation techniques using MATLAB.
3. The student will be able to use MATLAB to solve computational problems

Course Contents:

UNIT 1: MODELLING AND SIMULATION (Lectures: 12)

Need, types, steps of modelling, Equivalent circuits and mathematical models of circuit elements, simulation concept and illustrative examples.

UNIT 2: BASICS OF MATLAB (Lectures: 20)

Working in command window, input, output, file types, saving and loading, built in functions, script files, function files, matrix and array operations, command line functions, inline, functional evaluation, strings, built in function, Array-1D, 2D & mathematical operations with array, 2D & 3D plots. Script files, function files, file handling. Programming: -Conditional statement, Switch-case statement, loops, nested loops, break &continue statement, polynomial operations.

UNIT 3: MATLAB APPLICATIONS (Lectures: 14)

Root finding, Data analysis, Statistical functions, Polynomials, Curve fitting, Interpolation, Integration and differentiation, Ordinary differential equations, Circuit analysis i.e. Filters, Bode Plot, Pole Zero Plots.

UNIT 4: SIMULATIONS USING SIMULINK (Lectures: 14)

Introduction, Block diagram, Functions, Creating and working with simulink models, Simulink classes i.e. Virtual subsystems, Non virtual subsystems, Bus selector, creator, blocks, configuration parameters, data types conversion blocks, input and output blocks, MUX/DMUX blocks, integrator block operators, switch block, saturation block, application block sets, Defining and Managing signals (waveforms), waveform parameters, Running a simulation, analyzing the results, Simulink examples (i.e. Ohms law, Kirchhoff's law, Network theorems, Filter, Resonant Circuits and Rectifiers.)

REFERENCE BOOKS:

1. Getting Started with MATLAB , Rudra Pratap, 7th Ed. Oxford University Press, N.Delhi
2. MATLAB : An introduction with applications, Amos Gilat , Wiley India (2008)
3. MATLAB Programming For Engineers, Stephen J. Chapman , Thomas Learning (2008)
4. MATLAB Programming, Y Kirani Singh and B. B. Chaudhari, PHI, (2007)
5. Introduction to Simulink with Engineering Applications, Steven T Karris, 2nd edition, Orchard Publication, (2008)
6. Matlab and Simulink for Engineers, A.K.,Tyagi, Oxford University Press, New Delhi (2012)

PHY-106: ELECTRONICS

Lectures:: 60

Credits: 04

Course Description:

This Course deals with theoretical description of structure and working of analog and digital electronic devices and their applications.

Course Objectives:

1. To understand structure and characteristics of analog and digital electronic devices
2. To understand the working of these devices in different applications

Course Outcomes:

1. The student will understand structure and theory behind working of few important analog and digital electronics devices.
2. The student will be able to analyse the circuits based on these devices.
3. The student will learn how these devices are utilized in different applications.

Course Contents:

UNIT 1: SEMICONDUCTOR DEVICES (Lectures: 12)

Diodes, transistors, Field Effect Devices, homo and hetero-junction devices: device structure, device characteristics, frequency dependence and applications. Opto-electronic devices: solar cells, photo-detectors, LEDs

UNIT 2: BI-JUNCTION TRANSISTOR AMPLIFIERS (Lectures: 14)

Transistor DC biasing circuits: DC load line, Q-point, base bias, voltage divider bias, Emitter bias, collector feedback bias, Emitter feedback bias: circuit analysis Amplifier AC equivalent circuits: ac analysis of transistors, small signal analysis, H parameters;

UNIT 3: OSCILLATORS (Lectures: 12)

Feedback: Positive and negative feedback and their effects, Oscillators: Introduction, Barkhausen criteria, Wien bridge, phase shift, Colpitt and Hartley. Amplifier properties: gain, input and output impedance, Class A, B and C amplifiers, power amplifiers

UNIT 4: OPAMP CIRCUITS (Lectures: 10)

Linear Op Amp Circuits, Non Linear Op Amp Circuits, applications: integrator, differentiator, comparator, Schmidt trigger, active filters

UNIT 5: DIGITAL ELECTRONICS (Lectures: 12)

Digital Electronics-Logic gates, Arithmetic circuits, Flip Flops, NAND & NOR gates as building blocks, X-OR Gate, simple combinational circuits, K-Map, Flip-flop, shift register, counters, Basic principles of A/D & D/A converters ; Simple applications of A/D & D/A converters.

REFERENCE BOOKS:

1. Semiconductor Physics and Devices- Donald A. Neaman 3rd Edition, 2007, Tata McGraw Hill Company.
2. Electronic Principles- A. Malvino, D.J. Bates 7th Edition, 2008, Tata Mc Graw-Hill Publication Pvt Ltd.
3. Introductory Electronic Devices and Circuits- Painter 2nd Edition, 1991, New Jerky; Regents/Prentice Hall
4. Electronic Devices And Circuits-Michael Hassul, Don Zimmerman Prentice Hall
5. Operational Amplifiers – G.B.Clayton (5th edition) Newnes
6. Operational Amplifiers Applications – G.B.Clayton 7. Digital Principles and Applications : Malvino and Leach

PHY-201: ELECTRODYNAMICS

Lectures:: 60

Credits: 04

Course Description: This Course deals with understanding the basics and few advanced theories of electricity and magnetism.

Course Objectives:

1. To understand the basics of electrostatics, magneto statics, electrodynamics and thepotential formulation of basic laws.
2. To understand how to apply basic theories in electromagnetic waves and radiation.

Course Outcomes:

1. The student will understand the basic theories governing the electricity and magnetism.
2. The student will be able to know how to apply the basic theories in electromagnetic waves and radiation.
3. With the help of problems solving student will be able to learn to apply the basic theories to real problems.

Course Contents:

UNIT-1: ELECTROSTATICS AND MAGNETOSTATICS (Lectures: 10)

The electric field, continuous charge distribution, divergence and curl of electrostatic fields, Gauss's law and applications, electric potentials, Poison's equations and Laplace equation, the potential of localized charge distribution, electrostatic boundary condition, work and energy in electrostatics. Biot-Savart's laws, divergence and curls of B, Amperes law and its applications, magnetic vectors potential: the vector potential, magnetostatic boundary conditions, multipole expansion of the vector potential

UNIT-2: SPECIAL TECHNIQUES (Lectures: 10)

Laplace equation in one, two and three dimensions, boundary conditions and uniqueness theorems, The method of images, the classic image problem, other image problems, spherical co-ordinates, multipole expansion, approximate potentials at large distances, the monopole and dipole terms, origin of coordinates in multipole expansions

UNIT-3: ELECTRODYNAMICS (Lectures: 10)

Electromotive force, electromagnetic induction: Faraday's law, The induced electric field, Inductance, energy in magnetic fields, Maxwell's equation's: Electrodynamics before Maxwell, How Maxwell fixed Amperes law?, Maxwell’s equations, magnetic charge, Maxwell’s equations in matter, boundary conditions, conservation laws, the continuity equation and Pointing’s theorem

UNIT-4: ELECTROMAGNETIC WAVES (Lectures: 12)

Boundary conditions, reflection and transmission, polarization, electromagnetic waves in vacuum, wave equations for E and B, monochromatic plane waves, energy and momentum in electromagnetic waves, electromagnetic waves in matter, propagation in linear media, R and T at normal incidence, absorption and dispersion, electromagnetic waves in conductors, reflection at conducting surface, guided waves, wave guides, TE waves in rectangular waveguides, the co-axial transmission line 18

UNIT-5: POTENTIAL FIELDS (Lectures: 10)

The potential formulation, scalar and vector potentials, gauge transformations, Coulomb and Lorentz’s gauge, Continuous distributions: retarded potentials, Jefimenko’s equations, Point charges: Lienard-Wiechert potential, field of moving point charge

UNIT-6: RADIATION (Lectures: 08)

Dipole radiation, electric dipole radiation and magnetic dipole radiations: E and B radiated, Energy flux and power radiated, Radiation from an arbitrary source, power radiated by a point charge

REFERENCE BOOKS:

1. Introduction to Electrodynamics- D.J. Griffith 3rd Edition, 2000, Prentice Hall of India.
2. Electromagnetic Field Theory Fundamentals- Guru andHiziroglu 2ndEdition, 1998, Cambridge University Press.
3. Introduction to Electromagnetic Fields-Paul and Nasar. 2nd Edition, 1987, McGrawHill Company Pvt. Ltd.
4. Classical Electrodynamics- J.D.Jackson 3rd Edition,2007,Wiley India Pvt Ltd.
5. Electricity and Magnetism- Edward Purcell(For Basic Readings) 2nd Edition, Tata McGraw Hill Publication Pvt. Ltd
6. Fundamentals of Applied Electromagnetics- FawwazUlaby 1st Edition, 2002, Prentice Hall of India Pvt. Ltd.

PHY-202: STATISTICAL MECHANICS

Lectures:: 60

Credits: 04

Course Description:

This course is aimed to provide students with a sound knowledge of fundamental principles of statistical mechanics and their applications in typical situations.

Course Objectives:

The objective of the course is to enable students to get familiar and experience with various aspects and novelty of statistical mechanics from the point of basic studies and for the development of new technological devices.

Course Outcomes:

The knowledge gained may be helpful for the students for their career from research point of view. The course contents will be useful for the interdisciplinary approach for basic studies as well as applied studies.

Course Contents:

UNIT 1: LAWS OF THERMODYNAMICS (Lectures: 12)

Necessity of Statistical Mechanics The laws of thermodynamics and their consequences, phase space, Statistical description of system of particles: state of a system, microstates, ensembles, basic postulates

UNIT 2: STATISTICAL DESCRIPTION OF SYSTEM OF PARTICLES & STATISTICAL THERMODYNAMICS (Lectures: 12)

Behaviour of density of states, density of states for ideal gas in classical limit, thermal and mechanical interactions, quasi-static process Statistical thermodynamics: Irreversibility and attainment of equilibrium, Reversible and irreversible processes, thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of DoS on external parameters, Statistical calculation of thermodynamic variables

UNIT 3: CLASSICAL STATISTICAL MECHANICS (Lectures: 12)

Microcanonical ensemble and their equivalence, canonical and grand canonical ensembles, partition function, thermodynamic variables in terms of partition and grand partition functions, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem, MB gas velocity and speed distribution, Chemical potential, Free energy and connection withthermodynamic variables

UNIT 4: FORMULATION OF QUANTUM STATISTICS (Lectures: 12)

Formulation of quantum statistics, ensembles in quantum statistical mechanics, The theory of simple gases: Maxwell Boltzmann, Bose-Einstein, Fermi-Dirac gases, Statistics of occupation numbers, Evaluation of partition functions, Ideal gases in the classical limit

UNIT 5: IDEAL BOSE AND FERMI SYSTEMS (Lectures: 12)

Ideal Bose system: Thermodynamic behaviour of an ideal Bose gas, Bose-Einstein condensation Thermodynamics of Black-bodyradiation, Stefan-Boltzmann law, Wien's displacement law, Specific heat of solids (Einstein and Debye models) Ideal Fermi systems: Thermodynamic behavior of an ideal Fermi gas, degenerate Fermi gas, Fermi Energy and mean energy, Fermi Temperature, Fermi velocity of a particle of a degenerate gas

REFERENCE BOOKS:

1. Fundamentals of Statistical and Thermal Physics-F.Reif 1st Edition, 1965, McGraw Hill Publication Pvt. Ltd
2. Statistical Mechanics- K. Huang 1st Edition, 1991, Wiley Eastern Ltd.
3. Statistical Mechanics-R.K. Patharia 2nd Edition, Elsevier
4. Fundamentals of Statistical Mechanics-B.B.LaudEdition, 2007,New Age International Publishers.
5. Statistical Physics – F.Reif Berkeley Physics Course(Vol.5), Tata McGraw Hill Pvt. Ltd.

PHY-203: SOLID STATE PHYSICS

Lectures:: 60

Credits: 04

Course Description:

This Course proposes to introduce the students to the fundamental concepts of solid state physics.

Course Objectives:

1. to understand the different theories of specific heat, conductivity and band theory of solids.
2. to understand the classical and quantum theory concepts of magnetization, polarization superconductivity etc. of materials.

Course Outcomes:

1. Students will understand the basic theories governing the different properties of solids.
2. Students will be able to understand various theories of different classes of solids showing varying properties like magnetism, polarization and superconductivity.
3. With the help of problems solving skills, students will be able to learn to apply the basic theories to real problems.

Course Contents:

UNIT 1: SPECIFIC HEAT AND LATTICE VIBRATIONS (Lectures: 08)

Classical theory of specific heat and it's drawbacks, Einstein theory of specific heat, vibrational modes of a continuous medium, Debye approximation, The Born cut-off procedure, Vibrational modes of a finite one-dimentional lattice of identical and diatomic lattice.

UNIT 2: FREE ELECTRON THEORY OF METALS (Lectures: 08)

The free electron theory of metals, electronic specific heat, Response and relaxation phenomena, Drude model of electrical and thermal conductivity, the Fermi surface, electrical conductivity; effects of the Fermi surface, Fermi surfaces: its characteristics.

UNIT 3: THE BAND THEORY OF SOLIDS (Lectures: 08)

The formation of bands in solids, The Bloch theorem, The Kronig-Penny model, The motion of electrons in one dimension according to the band theory, the distinction between metals, insulators and intrinsic semiconductors, the concept of a hole. Brillouin zones,

UNIT 4: DIELECTRIC AND OPTICAL PROPERTIES OF INSULATORS (Lectures: 12)

Static fields: Macroscopic description of the static dielectric constant, The static electronic and ionic polarizabilities of molecules, Oriental polarization, The internal field according to Lorentz and the Clausius-Mosotti formula. Alternating fields: The complex dielectric constant and dielectric losses, dielectric losses and relaxation time, The Classical theory of electronic polarization and optical absorption. Ferroelectricity: General properties of ferroelectric materials, classification, ferroelectric domains.

UNIT 5: MAGNETISM (Lectures: 12)

Magnetic materials and their properties, Quantum theory of paramagnetism, Diamagnetism, Ferromagnetism: The Weiss molecular field and its interpretation, Temperature dependence of spontaneous magnetization.Antiferromagnetism: Molecular field theory, two sub lattice model.

UNIT 6: SUPERCONDUCTIVITY (Lectures: 12)

Introduction, Meissner effect, the critical field, Thermodynamics of superconducting transition: The heat capacity and stability of superconducting state, Electrodynamics of superconductors: The London equation, coherence length and penetration depth, BCS theory of superconductivity, the condensate, The Josephson Tunneling: DC and AC effect, Introduction to high Temperature superconductivity.

REFERENCE BOOKS:

1. J. Dekker, Solid State Physics, Macmillan India Limited, 1991.
2. Charles Kittel, Introduction to Solid State Physics, John Wiley and Sons.
3. H. P. Myers, Viva Books Private Limited, Second Edition.
4. N. W. Ashcroft and N. D. Mermin, Solid State Physics, CBS publishing Asia Ltd.
5. M. Ali Omar, Elementary Solid State Physics, Pearson Education.

PHY-204: GENERAL LABORATORY-II

Lectures: 60

Credits: 04

Note: At least 4 experiments from each group and minimum, 10 experiments should be performed

Group A: Experiments based on electronics

1. Study of differential amplifiers
2. Design of CE amplifier
3. PAM, PWM and PPM: modulation and demodulation
4. Study of multivibrators
5. Study of JFET as amplifier and switch
6. Study of digital to analog converter
7. Study of PID controller
8. Study of modulation and demodulation
9. Study of H-parameter of transistor

Group B: General physics experiments

1. Temperature dependent resistivity of semiconductor using Four probe method
2. Determination of bandgap and reverse saturation current of semiconductor
3. Study of dispersion relation for the monoatomic lattice and diatomic lattice
4. Study of GM tube
5. Determination of absorption coefficient of beta rays in Al
6. Study the Hall effect phenomenon and determine the Hall coefficient and type of charge carrier
7. Conductivity of ionic conductors
8. Study of different type of transducers
9. Determination of Stefan's constant by using a diode
10. Study of Fourier analysis

PHY-205: RENEWABLE ENERGY AND SOURCES

Lectures:: 60

Credits: 04

Course Description:

This Course introduces the students to the different forms of renewable energy.

Course Objectives:

1. To understand the different forms of renewable energy sources.
2. To understand applications of these sources and their impact on the environment.

Course Outcomes:

1. Students will understand the basic theories of different renewable energy sources.
2. Students will be able to understand technical aspects in these sources.

Course Contents:

UNIT 1:INTRODUCTION TO ENERGY STUDIES (Lectures: 12)

Importance of energy, various relevant definitions, Energy and development of society, various external and internal, kinetic and potential energy forms, types of fuels, the Sun, solar radiation, extra-terrestrial distribution of solar radiation, atmospheric attenuation, apparent motion of sun, sunrise, sunset, day length, instruments for measuring solar radiation.

UNIT 2:FUEL CELLS AND HYDROGEN ENERGY (Lectures: 12)

Concept and characterization of fuel cells, electrochemistry basics, alkaline fuel cells, phosphoric acid fuel cells, components, characteristics, merits, demerits and application of fuel cells. Production of Hydrogen (electrochemical, thermo-chemical, fossil fuels, solar energy methods), characteristics, storage, transportation, utilization of hydrogen, safety and Energy management issues.

UNIT 3:WIND ENERGY (Lectures: 12)

Energy in wind, Principle of wind energy conversion into useful energy, power in wind, wind velocity and height from ground, types and components of Wind Energy Conversion Systems (WECS), application, merits and demerits of WECS, dependence of wind power on various factors, criteria of site selection for installation of WECS.

UNIT 4:HYDEL ENERGY **(Lectures: 12)**

Hydel Energy, concept and operation hydroelectric energy, scenario of hydroelectric energy in India,classification of hydropower schemes, various types of hydroelectric turbines, properties, advantages, applications.

UNIT 5:BIO ENERGY **(Lectures: 12)**

Biomass and its conversion to useful energy, photosynthesis, Biogas generation, designs of Biogas plants, use of biogas as a fuel, site selection criteria for biogas plant, thermal gasification of biomass, types and operation of gasifiers.

REFERENCE BOOKS:

1. Pattern of Energy use in developing countries by Ashok V. Desai,Wiley Eastern Limited.
2. Solar Energy by S P Sukhatme.
3. Fuel Cells by B. Viswanathan, M. AuliceScibioh, Universities press.
4. Non-Conventional Sources of Energy by G. D. Rai, Khanna Publishers.
5. Wind Energy Systems by G. L. Johnson, Kansas State University.

PHY-206: ELEMENTS OF MATERIALS SCIENCE

Lectures:: 60

Credits: 04

Course Description:

The course discusses detail of various properties of material as well as different types of materials.

Course Objective: The important objective of this course is to explore the fundamental properties of various materials including metal, ceramics and insulators.

Course Outcome:

After the successful completion of the course:

1. The students will understand various fundamental properties of materials.
2. The students will be benefitted in terms of knowledge of thermodynamics behind alloy formation.
3. The students will also know basics of advanced materials.

Course Contents:

UNIT 1: CLASSIFICATION OF MATERIALS (Lectures: 03)

Classification of Engineering Materials, Selection of materials, Level of structure, Modern material needs, structure-property relationship in materials.

UNIT2: PROPERTIES OF MATERIALS (Lectures: 13)

Mechanical properties: Mechanical fundamentals, isotropy and anisotropy, stressand strain, hooks law and modulus of materials, Poisson's ratio, stress-strain relation, Importantproperties: strength, Elasticity, fatigue, ductility, toughness, stiffness, malleability, plasticity,hardness,brittleness, factors affecting mechanical properties. Electrical properties: Resistivity, conductivity, Ionic conductivity, Superconductivity, Insulators, Semiconductors, factors affectingconductivity. Thermal properties: Melting point, Thermal Shock, Heat capacity, Specific heat, Thermal expansion and thermal conductivity. Optical properties: Electromagnetic radiation, refraction, reflection, absorption, transmission, color. Magnetic properties:

magnetization, magnetic moments, dipoles, magnetic domain, diamagnetism, paramagnetism, ferromagnetism,ferrimagnetism, susceptibility and curie temperature, hysteresis loss, Ferrites.

UNIT 3: PHASE DIAGRAM (Lectures: 12)

Single and multi-phase solids, solid solutions, factors governing the solid solubility (Hume Rotheryrules for primary solid solution), inter-metallic compounds, valency compounds, electron compounds, interstitial compounds, Phase diagrams:Phase rule, Unary and binary phase diagram, construction of phase diagram, Lever rule, interpretation of phase diagram, Isomorphous system, eutecticsystem, eutectoid system, peritectic system, micro structuraldiagramdevelopments: Study of Pb-Sn, Fe-C, Cu-Ni phase diagram.

UNIT4: METALLURGICAL THERMODYNAMICS AND PHASE TRANSFORMATION (Lectures: 08)

Thermodynamic origin of phase diagram, Crystal, grain and grain boundary, Solidification and crystallization, nucleation,nucleation rate, crystal growth, rate of crystal growth, surface energy, critical radius inheterogeneous and homogenous nucleation, allotropic transformation.

UNIT5: POLYMERIC MATERIALS (Lectures: 08)

Basic concepts of polymer, size of polymer, mechanisms ofpolymerization, molecularweight, molecular shape, structure, configuration, crystallanity, mechanical, optical and thermal properties of polymers, electricalproperties - conducting polymers.

UNIT 6: CERAMICS (Lectures: 04)

Classification of ceramics, structure of ceramics, silicates structure, polymorphism of ceramics, mechanical,thermal and electrical properties of ceramic phases, clay and clay materials.

UNIT7: ADVANCED MATERIALS (Lectures: 12)

a) Nanomaterials: Concept of nanomaterials, electron confinement in infinitelydeep square well, confinement in two and one dimensional well, idea ofquantum well structure, quantum dots, mechanical, electrical, thermal,magnetic and optical properties of nanomaterials.

b) Composite materials: Concept of composite, Types of composite, agglomerated materials, reinforce material, Surface coating: Laminates, metallic coatings.

c) Materials for Solar energy: Photovoltaic materials:Inorganic materials (Si, GaAs), Organic materials, perovskite, photothermal: selective coatings.

REFERENCE BOOKS:

1. Material Sciences and Process, S. K. Hajara-Chaudhari, Indian BookDistributing Co.
2. Material Science and Engineering, W.D. Callister, Jr. W, Wiley InternationalEditions, 2003.)
3. Material Science and Engineering , V. Raghavan, Prentice Hall of India Pvt. Ltd., New Delhi.
4. Physical Metallurgy Part I and II, Edited by R. W. Cahn and H_Haasan, NorthHolland, 1983.
5. Phase transformation in metals and allys, david A. Porter and K.E. Easterling,(Van NostarndRcinhold Co., Newyork).
6. Nano: The essentials – Understanding Nanoscience and Nanotechnology, T.Pradip, Tata Mac Graw Hills
7. Nanotechnology, Booker and Boysen, Wiley.