तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या० : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ. B.U./Phys/2022/008 दिनाँक. 02/12/2022

The Minutes of Meeting of BOS

In reference to the BOS of department of PHYSICS ...., Institute of INSTITUTE OF BASIC SCIENCES held on 02/07/2022 regarding the revision of syllabus in tune with CBCS/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

B. Bhadoria
HOD/Coordinator
Coordinator
Department of Physics
Bundelkhand University
JHANSI - 284128 (U.P.)

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बुन्देलखण्ड विश्वविद्यालय, झाँसी
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झाँसी (उ.प्र.) 284128

संदर्भ B.U./Phys/2022/002 दिनाँक 18.07.2022

(English Version of Board of Study (Physics) Meeting)

The Board of Study (Physics) meeting is held In V.C. Committee room on 02-07-2022 at 12:30 p.m., where following members participated in offline and online mode.

1. Dr. S.K. Kushwaha	Convener
2. Dr. Ravendra Singh	Member
3. Dr. Jitendra Singh	Member
4. Dr. D.K. Sahu	Member
5. Dr. Akhilesh Kumar	External Subject Expert
6. Dr. Pawan Kumar	External Subject Expert
7. Dr. B.S. Bhadoria	Special Invitee

Proceedings

1. We have revised M.Sc. Physics syllabus and ordinance according to NEP-2020 and finalized it in the chairmanship of Dr. S.K. Kushwaha unanimously.

2. We have prepared list of external/internal examiners of M.Sc. & B.Sc. for theory and practical papers. This list has been handed over in the office of examination controller, B.U. Jhansi.

B.S. Bhadoria
(B.S. Bhadoria)

Bundelkhand University, Jhansi

Board of Studies

In accordance with NEP-2020

Name of Course			Subject			Faculty		Date of BOS	
S.No	BOS member	Designation	Feed Back of Students	Revision of Syllabus (mentioned in percentage)	Credit Course	Non Credit Course	multidisciplinary Courses	Vocational/Skilled Orientation course	Number of value added course with title(Semester wise)
1.	Dr K.S. Kushwaha	Associate Professor	–	Yes. [illegible] Around 25%	100	–	01 Elective courses Out of Dept.	Ind. Tran/ Edu. Tour/ Field Survey Dissertation	
2.	Dr D.K. Sahu	"	–	"	100	–	"	"	
3	Dr B.S. Bhadhoria	Assistant Professor	–	"	100	–	"	"	

Comments

Internal members 1 2 3

02.07.2022

Convenor Dean

External Expert 1 External Expert 2

Department of Physics,
Bundelkhand University, Jhansi(UP)
(M.Sc. Physics Programme)

INTRODUCTION

M.Sc. Physics is a two years (four semesters) Post Graduate level course intended to prepare competent youth to develop specialized knowledge and skills to engage themselves in scientific activities. This learning outcomes-based curriculum framework (LOCF) for the postgraduate programs in Physics is intended to provide a broad framework within which both the postgraduate programs in Physics help to create an academic base that responds to the need of the students to understand the basics of Physics and its ever evolving nature of applications in explaining all the observed natural phenomenon as well as predicting the future applications to the new phenomenon with a global perspective. This course is designed and formulated in order to acquire and maintain standards of achievement in terms of knowledge, understanding and skills in Physics and their applications to the natural phenomenon as well as the development of scientific attitudes and values appropriate for rational reasoning, critical thinking and developing skills for problem solving and initiating research which are competitive globally. The multicultural fabric of our nation requires that the institutions involved in implementing this curriculum framework also work hard towards providing an environment to create, develop and inculcate rational, ethical and moral attitudes and values to help the creation of knowledge society needed for scientific advancement of our nation.

After successful completion of the course the learner will also be competent and confident to capture and join various job opportunities at public and private sectors. Besides planning career in area of research and development, learners can also prepare themselves in teaching and academics.

PROGRAM LEARNING OUTCOMES (PLO)

The learning outcome based curriculum framework in Physics should also allow for the flexibility and innovation in the program design of the PG education, and its syllabi development, teaching learning process and the assessment procedures of the learning outcomes. The process of learning is defined by the following steps which should form the basis of final assessment of the achievement at the end of the program:-

1. The accumulation of facts of nature and the ability to link the facts to observe and discover the laws of nature i.e. develop an understanding and knowledge of the Physics.
2. The ability to use this knowledge to analyze new situations and learn skills and tools like mathematics, engineering and technology to find the solution, interpret the results and make predictions for the future developments.
3. The ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of the physical problems in nature and to create new skills and tools for their possible solutions.
4. Competency to respond on contemporary needs of Research and development and equip them with necessary knowledge, wisdom and skills relevant for local, national and international governance.

The conceptualization and formulation of the learning outcomes for M.Sc. Physics program is aimed to achieve all the above.

PROGRAMME SPECIFIC OUTCOMES (PSO)

The program specific outcomes of the M.Sc. Physics program are as under:

1. A systematic and coherent understanding of basic physics including the concepts, theories and relevant experimental techniques in the domains of Mechanics, Thermal Physics, Electricity and Magnetism, Modern Physics, Optics, Mathematical Physics and of the specialized fields like Nuclear and Particle Physics, Quantum Physics, Embedded Systems, etc. in their choice of Discipline Specific Elective course.
2. A wide ranging and comprehensive experience in physics laboratory methods in experiments related to mechanics, optics, thermal physics, electricity, magnetism, digital electronics, solid state physics and modern physics. Students acquire the ability for systematic observations, use of scientific research instruments, analysis of observational data, making suitable error estimates and scientific report writing.

3. Ability to relate their understanding of physics to other subjects like Mathematics, Chemistry, Computer Science or Electronics, which are part of their curriculum, and hence orient their knowledge and work towards multi-disciplinary/inter-disciplinary contexts and problems.

4. Procedural knowledge that creates different types of professionals related to different areas of study in Physics and multi/interdisciplinary domains, including research and development, teaching, technology professions, and government and public service.

5. Skills in areas related to specializations, relating the subfields and current developments in the field of Physics.

PROGRAMME SCHEME

It is based on 'The UGC guidelines on adaption of Choice Based Credit System (C.B.C.S.)', is going to introduce Credit Based Semester System (C.B.S.S.) at the M.Sc. (Physics) level from the Academic Session 2021-22. This is four semesters (each semester of about 90 days) academic program (02 years duration).The UGC has also given the option to modify the course contents according to specific needs. After a thorough review of this Curriculum of Choice Based Credit System by the members of Board of studies of Physics, it has felt necessary to reorganize the course content, number of papers and their order so as to give it a more systematic and balanced look. Despite the changes, basic common framework and spirit of the Curriculum i.e. to enhance the quality and standard of education as proposed by the UGC, remains unchanged.

Syllabus of M.Sc. Physics (According to NEP 2020)
Bundelkhand University, Jhansi (UP)

Course Code	Name of Paper	Credit	Nature of Paper	Internal Marks	Theory Marks	Total Marks
M.Sc. Physics First Semester						
PHY-101	Mathematical Methods in Physics	4	Core	25	75	100
PHY 102	Classical Physics	4	Core	25	75	100
PHY 103	Fundamentals of Quantum Mechanics	4	Core	25	75	100
PHY 104	Electronic Devices	4	Core	25	75	100
PHY 105	Practical - 02	4	Core	25	75	100
PHY106	Minor Elective(from other department)	4	Elective	25	75	100
PHY 107	Scientific Educational Tour	4	Core	-	-	100
Total Credit		28				700
M.Sc. Physics Second Semester						
PHY 201	Advance Quantum Mechanics	4	Core	25	75	100
PHY 202	Condensed Matter Physics	4	Core	25	75	100
PHY 203	Atomic and Molecular Physics	4	Core	25	75	100
PHY 204	Electrodynamics and Plasma Physics	4	Core	25	75	100
PHY 205	Practical - 02	4	Core	25	75	100
PHY 206	Industrial Training	4	Core	-	-	100
	Total	24				600
M.Sc. Physics Third Semester						
PHY 301	Computer Programming	4	Core	25	75	100
PHY 302	Nuclear and Particle Physics	4	Core	25	75	100
PHY 303/305	Elective (Electronics-I / Condensed Matter Physics-I)	4	Elective	25	75	100
PHY 304/306	Elective-II (Electronics-II/ Condensed Matter Physics-II)	4	Elective	25	75	100
PHY 307	Practical - 02	4	Core	25	75	100
PHY 308	Scientific Survey	4	Core	-	-	100
	Total	24				600
M.Sc. Physics Fourth Semester						
PHY 401	Physics of Laser and Its Application	4	Core	25	75	100
PHY 402	Statistical Mechanics	4	Core	25	75	100
PHY 403/405	Elective-III (Electronics-III /Condensed Matter Physics-III)	4	Elective	25	75	100
PHY 404/406	Elective-IV(Electronics-IV/ Condensed Matter Physics-IV)	4	Elective	25	75	100
PHY 407	Practical - 02	4	Core	25	75	100
PHY 408	Research Project/Dissertation	4	Core	-	-	100
	Total	24				600
	Grand Total	100				2500

M. Sc. (Physics) First Semester
PHY-101
MATHEMATICAL METHODS IN PHYSICS

Course Learning Outcome:

1. Learn the significance of different function and application of these functions in Physics.
2. *To apply and analyze the various vector and matrix operations for solving physical problems.*
3. *To demonstrate and utilize the concepts of Fourier series, Fourier transforms and Laplace Transforms.*
4. *To apply partial differential equations and special functions for solving mathematical problems.*
5. *To solve problems in various branches of Physics with the help of suitable numerical techniques.*

Unit-1 Differential Equations and Special Functions
Beta and Gamma functions, Second ordered linear differential equations, with variable coefficients, Solution by series expansion, Legendre, Bessel, Hermite and Laguerre equations, Physical applications, Generating functions, Recursion relations.

Unit-2 Laplace Transformation
Integral transform, Laplace Transform, First and Second shifting theorems, Inverse LT by partial fractions, LT of derivatives and integral of a function.

Unit-3 Fourier Series and Transform
Fourier series, FS for arbitrary period, half wave expansions, partials sums, Fourier integrals and transform, FT of delta functions, Solution of time dependent problems by FT.

Unit-4 Error Analysis and Roots of Equations
Precision and accuracy, significant figures, floating point arithmetic, round-off and truncation error, False-position method, Newton-Raphson method, multiple roots, Fixed-point iteration method, convergence of solutions.

Unit-5 Numerical Integration and Ordinary Differential Equations
Trapezodial rule, Simpson’s rules and Gauss method, Euler’s methods, Huen’s method, Runga Kutta method, Predictor and corrector method.

Text and Reference Books
1. G. Arfken, Mathematical methods for Physicist,Seventh edition, Elsevier; 2012
2. H.K. Dass and Rema Verma, Mathematical Physics, First edition, S Chand, 2021
3. S.S. Sastry, Introductory methods and Numerical analysis, Fifth edition, PHI, 2012
4.V. Rajaraman, Computer Oriented Numerical Methods, 3rd Edition, PHI, 1993.
5.Canale Chapra**,** Numerical Methods for Engineers ,7th Edition, McGraw Hill, 2016.
6. Saumyen Guha and Rajesh Srivastava, Numerical Methods, Oxford University Press, 2012.

M. Sc. (Physics) First Semester
PHY-102
CLASSICAL MECHANICS

Course Learning Outcome:

1. Understand analytical methods of mechanics based on generalised coordinates of momenta and solve the practical problems using these concepts.
2. Understand and demonstrate the concepts of Physics through classical mechanics.
3. Understand the drawbacks of Newtonian Mechanics and the establishment of Lagrangian Mechanics.
4. Develop mathematical formulation of physical problems using Lagrangian and Hamiltonian techniques.
5. Apply the concepts of Poisson's Bracket algebra and its implementation in Quantum mechanical formulations.

Unit-1 Preliminaries of classical mechanics

Newtonian mechanics one and many particle systems, Conservation laws, work energy theorem, open system (with variable system) Constraints, their classification, D'Alembert's principle, generalized coordinates.

Unit-2 Lagrange Formulation

Lagrange's equations, gyroscopic forces, dissipative systems, Jacobi integral, gauge invariance, generalized coordinates and momentum, integrals of motion, symmetries of space and time with conservation laws, invariance under Galilean transformation.

Unit-3 Central Forces

Rotating frames, inertial forces, terrestrial and astronomical applications, coriolis forces, Central force, definition and characteristics, two body problems, closure and stability of circular orbits, general analysis of orbits, Kepler laws and equations, Rutherford scattering.

Unit-4 Hamiltonian Formulation

Principle of least action, derivation of equation of motion, variation and end points, Hamilton's principles and characteristics functions, Hamilton-Jacobi equation.

Unit-5 Canonical Transformation

Canonical transformation, generating functions, properties, group properties, examples, infinitesimal generators, Poisson brackets, Poisson theorems, angular momentum, PBs small oscillation, normal modes and coordinate.

Text and Reference Books:

1. N C Rana and P S Joag: Classical Mechanics, TMH, 1991
2. H Goldstein: Classical Mechanics, Narosa Pub. House, 2001.
3. K C Gupta: Classical Mechanics Of Particles And Rigid Bodies, New Age,3rd edition, 2018.
4. I Percival and D Richards: Introduction to Dynamics, Cambridge Univ Press, 1982.
5. J C Upadhyaya, Classical Mechanics, Himalaya Publishing House, 2018.

M. Sc. (Physics) First Semester
PHY-103
FUNDAMENTALS OF QUANTUM MECHANICS

Course Learning Outcome:

1. Understand various experiments establishing quantum physics and their interpretation.
2. Wave-particle duality, uncertainty relation and their implications.
3. Schrodinger equation and its simple applications in one dimensional potential problem of scattering.
4. Learn to grasp the basic foundation of various experiments establishing the quantum physics by doing the experiments in laboratory and interpreting them.
5. How to solve a given problem such as hydrogen, particle in a box etc. atom etc using wave function, operators and solve them.

Unit-1Fundamentals

Correspondence principle, complementarily, uncertainty principle and applications, Schrödinger wave equation, normalization, probability current density, expectation values, Ehrenfest theorem, energy eigen function and eigen values, separation of time dependent wave equation, stationary states, boundary and continuity conditions, dynamical variables as operators, hermitian operators and their properties, Orthonormality, free particle solution.

Unit-2Application to One Dimensional Problems

One dimensional step potential (finite and infinite) particle in one dimensional square potential well (finite and infinite) parity, linear harmonic oscillator, zero point energy, rectangular potential barrier.

Unit-3Three Dimensional System

Particle in three dimensional box, Dirac delta functions, orbital angular momentum, commutation relations, central force problems, solution of Schrödinger equation for spherical symmetric potentials, Hydrogen atom-reduced mass, wave function, energy levels, degeneracy, Energy Eigen function and Eigen values of three dimensional harmonic oscillator, and rigid rotator.

Unit-4Matrix Theory

Matrix, formulation of quantum theory, linear vector space, vector and operators and their matrix representation, bra and ket notations, projection operator, unitary transformation, matrix theory of linear harmonic oscillator, raising and lowering operators eigen values and eigen functions of L^2 and L_x, spin, Pauli spin matrices, and their algebra, matrices for J^2 and J_x, addition of two angular momenta, (elementary discussion).

Unit-5Approximation Methods

Time independent perturbation theory for non degenerate case, formulation upto second order, perturbation of linear harmonic oscillator- (i) estimation of correction up to second order for perturbation term depending on x and x^2 (ii) first order correction to energy by x^3 and x^4 type terms, Ground state of Helium atom, Stark effect of a plane rigid rotator.

Text and Reference Books:

1. L I Schiff: Quantum Mechanics, McGraw Hill Education; 4th edition, 2017.
2. Stephen Gasiorowicz, Quantum Mechanics:, John Wiley & Sons, 2003.
3.J L Powell and B Crasemann, Quantum Mechanics, Addison Wiley, 2015.
4. P M Mathews and K Venkatesan: Quantum Mechanics, McGraw Hill, 1979.
5. J J Sakurai and J Napolitano: Modern Quantum Mechanics,Cambridge University Press,3rd edition, 2020.
6. G Aruldhas: Quantum Mechanics, Prentice Hall India Learning Private Limited; 2nd edition, 2008.
7.N. Zettili: Quantum Mechanics: Concepts and Applications, Wiley, 2nd edition, 2009.
8. H C Verma: Quantum Mechanics, TBS, 2nd edition, 2012.

M. Sc. (Physics) First Semester
PHY-104
ELECTRONIC DEVICES

Course Learning Outcome:

1. Learn basic concepts of transistors and their applications to develop electronic devices.

2. Study about junction transistor and their applications.

3. Comprehend the knowledge about different types of microwave devices including Impatt diodes and parametric devices.

4. Learn about memory, charge coupled and photonic devices.

5. Learn about various type of oscillators, voltage regulators, and their applications.

Unit-1 Transistors

Bipolar junction transistor BJT, Junction field effect transistor JFET, Metal oxide semiconductor field effect transistor MOSFET: Structure, working, derivation of the equation for I-V characteristics under different conditions, high frequency limits.

Unit-2 microwave Devices

Tunnel Diode, Transfer electron devices, Gunn Diode, Avalanche transit time devices, Impact diode and parametric devices.

Unit-3 Photonic Devices

Radiative and non-radiative transitions, Photoconductive devices LDR, diode photo detector, Solar cell, light emitting diode LED, high frequency limit, effect of surface and indirect recombination light confirmation factor, optical gain and threshold current for lasing.

Unit-4 Memory Devices

Static and Dynamic random access memories, SRAM and DRAM, CMOS and NMOS, non volatile NMOS, magnetic, optical and ferro-electric memories, charge coupled devices CCD.

Unit-5 Other Electronic Devices

Electro-optic, Magneto-Optic and Acousto-Optic effects, material properties related to get these effects, Piezo-electric, Electro-strictive and Magneto-strictive effects, sensors and Actuators devices.

Text and Reference Book

1. S M Sze: Semiconductor Devices- Physics and Technology, Willey, 1985.
2. M S Tyagi: Introduction to Semiconductor Devices, John Willey & Sons, 1991.
3. M Sayer and A Mansingh: Measurement, Instrumentation and Experimental Design in Physics and Engineering, Prentice Hall India Learning Private Limited,n1999.
4. Ajoy Ghatak and K Tyagrajan: Optical Electronics, Cambridge, 2017.
5.Albert Paul Malvino, Electronic Principles, 6th Edition, McGraw-Hill, 1998.

M. Sc. (Physics) Second Semester
PHY-201
ADVANCE QUANTUM MECHANICS

Course Learning Outcome:

1. Develop the variation method and applied it to Ground state of helium.

2. Learn the development of time-dependent perturbation theory and WKB method and its applications.

3. Develop the methods of the Semi classical theory of radiation, Transition probability for absorption and induced emission.

4. Learn the Fundamentals of Angular momentum matrices, Pauli's spin matrices. Formulate addition of angular momentum and find out the possible values of J-Clebsh-Gordan coefficients for $j_1=j_2=1/2$ and $j_1=1$, $j_2=1/2$.

5. Understand basic concepts of special theory of relativity and its applications to dynamical systems of particles. Learn determination of Klein-Gordon equation, Dirac equation, probability and current densities.

Unit-1 Approximation Methods-II

Variational method, WKB approximation,Time-dependent perturbation theory, Harmonic perturbation, Fermi's golden rule, Adiabatic and Sudden approximation.

Unit-2 Scattering

Collision in 3-D and scattering, Laboratory and CM reference frames, scattering amplitude, differential scattering cross section and total scattering cross section, scattering by spherically symmetric potentials, partial waves and Phase shifts, scattering by perfectly rigid sphere and by square well potential and absorption.

Unit-3 Identical Particles

Identical particles, symmetric and antisymmetric wave functions, Collision of identical particles, Spin angular momentum, Spin function for a many electron system.

Unit-4 Radiation Theory

Semiclassical theory of radiation, Quantum Theory of radiation, Transition probability for absorption and induced emission, electric dipole, forbidden transmissions, selection rules.

Unit-5Relativistic Theory

Relativistic theory, The Klein-garden equation, The Dirac equation, covariance of Dirac equation, energy levels of hydrogen atoms, hole theory and positrons.

Text and Reference Books:

1. L I Schiff: Quantum Mechanics, McGraw Hill Education; 4th edition, 2017.
2. Stephen Gasiorowicz: Quantum Mechanics:, John Wiley & Sons, 2003.
3. J L Powell and B Crasemann: Quantum Mechanics, Addison Wiley, 2015.
4. P M Mathews and K Venkatesan: Quantum Mechanics, McGraw Hill, 1979.
5. J J Sakurai and J Napolitano: Modern Quantum Mechanics,Cambridge University Press; 3rd edition, 2020.
6.N. Zettili: Quantum Mechanics: Concepts and Applications, Wiley, 2nd edition, 2009.

M. Sc. (Physics) Second Semester
PHY-202
CONDENSED MATTER PHYSICS

Course Learning Outcome:

1. Learn basics of crystal structure and physics of lattice dynamics.
2. Gain the knowledge of different types of materials like magnetic materials, dielectric materials, metals, and their properties.

3. Increase knowledge about different modes of lattice vibrations and its effect on thermal and electrical conductivity.

4. Formation of band structure in a solid and the origin of band gap in semiconductors.

5. Comprehend the basic theory of superconductors. Type I and II superconductors and their properties. Understand the physical concept of BCS theory.

Unit-1 Crystal Physics

Crystalline solids, unit cell and direct lattice, Miller indices of planes and axes, two and three dimensional Bravais lattices, closed packed structures, Braggs law, experimental diffraction techniques, construction of reciprocal lattice, reciprocal lattice vector, Brillouin zone and atomic factor.

Unit-2 Point Defect and Imperfection

Point defect, line defect and planer stacking fault, the role of dislocation in plastic deformation and crystal growth, the observation of imperfection in crystal, X-ray and electron microscopic techniques.

Unit-3 Electronic Energy Bands

Electrons in periodic lattice, Bloch theorem, Band theory, classification of solids, effective mass, tight binding, cellular and pseudo potential method.

Unit-4 Superconductivity

Superconductivity: Critical temperature, persistent current, Meissner effect, type I and type II superconductors, heat capacity, energy gap, isotopic effect, London's equation, coherent length.

Unit-5 Magnetic Properties of Solids

Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, spin waves and magnons, Curie-Weiss law for susceptibility, ferri and antiferro magnetic order, Domains and Bloch-wall energy.

Text and Reference Books

1.A R Verma and O N Srivastava: Crystallography applied to Solid State Physics, New Age International, second edition, 1991.
2. N W Ashcroft and N D Mermin: Solid State physics, Cengage, 1st edition 2003.
3. C Kittel: Introduction to Solid State Physics, Wiley; Eighth edition, 2012.
4. R K Puri, V K Babbar: Solid State Physics, S Chand, 2010.
5. A J Dekker: Solid State physics, Laxmi Publications, 2008.

M. Sc. (Physics) Second Semester
PHY-203
ATOMIC AND MOLECULAR PHYSICS

Course Learning Outcome:

1. Learn about atomic structure and its spectra. Gain knowledge about the splitting of level in presence of electric and magnetic field.
2. Understanding about electronic, vibrational, and rotational spectra of diatomic molecules.
3. Study the basic concepts of Nuclear Magnetic Resonance Spectroscopy and its instrumentation.
4. Develop knowledge about Nuclear Magnetic Resonance, Quantum Description of Nuclear Magnetic Resonance, Instrumentation, Chemical Shift, Spin-Spin Coupling.
5. Working principle of various spectroscopic techniques i.e., IR, UV, Raman spectroscopy etc.

Unit-1 Atomic Physics

Quantum states of one-electron atoms, atomic orbital, hydrogen spectrum, Pauli's principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra- equivalent, non-equivalent electrons.

Unit-2 Atomic Spectra

Normal and anomalous Zeeman effect, Paschen Back effect, stark effect, two electron system, interaction energy in LS and JJ coupling, hyperfine structure (qualitative).

Unit-3 Diatomic Molecular Spectra

Rotational spectra of diatomic molecules as a rigid rotator, Energy levels and spectra of non-rigid rotator, Intensity of spectral lines.

Unit-4 Energy of Molecules

Vibrational energy of diatomic molecules, diatomic molecules as a simple harmonic oscillator, Energy level and spectrum, Mores potential energy curve, Molecules as vibrating rotator, vibrational spectrum of diatomic molecules, PQR branches.

Unit-5 Spectrometers

IR spectrometer (qualitative), UV spectrometer, NQR spectrometer, Stark modulated microwave Spectrometer (qualitative).

Text and Reference Book

1. H E White: Introduction to atomic spectra,McGraw-Hill, 1934.
2. C W Banwell: Fundamental of molecular spectroscopy, McGraw-Hill, 4^{th} Ed., 2017.
3. Walker and Straughen: Spectroscopy Vol I II III, Chapman & Hall, 1976.
4. G M Barrow: Introduction to molecular spectroscopy, McGraw-Hill, 1962.
5. G. Herzberg Molecular Spectra and Molecular Structure: Spectra of Diatomic Molecules, Krieger Publishing Company; 2nd edition, 1950.

M. Sc. (Physics) Second Semester
PHY-204
ELECTRODYNAMICS AND PLASMA PHYSICS

Course Learning Outcome:

1. Comprehend the role of Maxwell's equation in unifying electricity and magnetism.
2. Learn the implications of Gauge invariance in EM theory in solving the wave equations and develop the skills to solve the wave equation in various media.
3. Gain the knowledge aboutretarded potential and different types of radiations.
4. Learn the basic physics associated with the polarization of electromagnetic waves.
5. Learn the fundamentals of plasma and application of wave propagation in magneto plasma; electromagnetic waves propagating parallel and perpendicular to the magnetic field.
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Unit-1 Review of Electrodynamics

Review of four vectors and Lorentz transformation in four dimensional space, electromagnetic field tensor in four dimensions and Maxwell's equation, wave equation for vector and scalar potentials.

Unit-2 Retarded Potentials

Retarded potential and Lienard-Wiechart potential, electric and magnetic fields due to a uniformly moving charge and an accelerated charge, Linear and circular acceleration and angular distribution of power radiated Bremsstrahlung, synchrotron radiation and Cerenkov radiation, reaction force of radiation.

Unit-3 Motion of Charged Particles

Motion of charged particles in electromagnetic field: Uniform E and B fields, non- uniform magnetic fields, diffusion across magnetic field, time varying E and B fields, adiabatic invariants: first, second and third adiabatic invariants.

Unit-4 Basics of Plasma

Elementary concepts: Derivation of moment equations from Boltzmann equation, plasma oscillations, Debye shielding, plasma parameters, magnetoplasma, plasma confinement, hydro dynamical description of plasma, fundamental equations, hydromagnetic waves, magnetosonic and Alfven waves.

Unit-5 Wave Propagation

Wave phenomena in magnetoplasma: Polarization, phase velocity, group velocity, cutoff, resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field, Appleton-Hartree formula.

Text and Reference Books:

1. Wolfgang K. H. Panofsky and Melba Phillips,Classical electricity and magnetism, Dover Publications; Second edition, 2005.
2. J.A. Bittencourt, Fundamentals of Plasma Physics, 3rd Edition, Springer,2004.
3. Francis F. Chen, Introduction to Plasma Physics and Controlled Fusion, Second Edition, Springer ,2008.
4. David J. Griffiths, Introduction to Electrodynamics, 4th Edition, Pearson,2019.
5. Paul Lorrain and Dale Corson,Electromagnetic fields and Waves, Second Edition,CBS,2001.

M. Sc. (Physics) Third Semester
PHY-301
COMPUTER PROGRAMMING

Course Learning Outcome:

1. Learn basic concepts of computer viz., CPU, Memory, etc.

2. Study about fundamentals of C programming and its applications.

3. Learn about various memory devices.

4. Input/output data handling and analysis.

4. Learn about various types of functions and file handling.

Unit- 1 Introduction to Computer

Simple model of a computer system: CPU, Memory, Input/output Devices. Hardware and software, Booting Process and DOS Command. Steps involved in computer programming, problem analysis, algorithms & flow charts. Computer programming (in C): Various data types (simple and structured) and their representation, constants and variable, arithmetic's and logical expressions, data assignment, input and output statement. High level and low level programming languages.

Unit- 2 Basics of C

History of C, Salient features of C, Structure of C Program, Compiling C Program, Link and Run C Program, Character set, Tokens, Keywords, Identifiers, Constants, Variables, Instructions, Data types, Standard Input/Output, Operators and Expressions.

Unit- 3 Conditional Programming

C Programming: Control statement-sequencing, conditional and unconditional branching and looping. Single and multi-dimensional arrays, String, Stack and Recursion

Unit- 4 Function and File Handling

Searching (Linear, binary), sorting (bubble, selection and insertion) and merging, Address arithmetic, Function passing, Dynamic memory allocation, Structure and union, file handling, command line arguments.

Text and Reference Books:

1. Yashavant Kanetkar, Let us C,15th Edition, BPB publications,2016.
2. Pradeep K. Sinha, Computer fundamentals: Concept, systems and application, 8th Edition, BPB, 2004.
3. Rema Thareja, Computer fundamentals and programming in C, 2nd Edition, Oxford university press, 2016.
4. Brian W. Kernighan / Dennis Ritchie, The C Programming Language, Second Edition, Pearson , 2015
5. Peter Norton, Introduction To Computers (Special Indian Edition),TMH, 2005.

M. Sc. (Physics) Third Semester
PHY-302
NUCLEAR AND PARTICLE PHYSICS

Course Learning Outcome:

1. Understand miscellaneous aspects of nuclear structure, masses and binding energies of nuclei.

2. Understand the concept of Liquid drop model, Semi empirical mass formula, Magnetic dipole moments, and Electric quadrupole moments.

3. Learn about classification of elementary particles and fundamental forces.

4. Learn basic mechanism of Detectors: GM counters, scintillation detectors, semiconductor radiation detector, magnetic Beta-ray spectrometer Scintillation, and Gamma-ray spectrometer.

5. Understand the theory of nuclear forces. Understand the fundamental radioactivity and mechanisms-alpha, beta and gamma decay.

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Unit-1 General Properties of Nucleus

The construction of the nucleus and its general properties, proton electron hypothesis, proton neutron hypothesis, nuclear mass, mirror nuclei and isotopic spin, packing fraction and binding energy, nuclear radius and its determination, nuclear force.

Unit-2 Nuclear Decay

α decay-range, α particle spectra, Gamow's theory, beta decay- Fermi decay of beta decay, shape of the beta spectrum, total decay rate, angular momentum and parity selection rules, parity violation, detection and properties of neutrino, application of radiation theory to multipole transitions in nuclei, angular momentum and parity selection rules, internal conversion, nuclear isomerism.

Unit-3 Nuclear Models

Experimental evidences for shell model, spin orbit coupling, magic numbers, angular momenta and parities of nuclear ground states, qualitative discussion and estimates of transition rates, magnetic moments and Schmidt lines, collective model of Bohr and Mottelson.

Unit-4 Nuclear Reactions

Direct and compound reaction mechanism, scattering by a central potential, cross section in terms of partial wave amplitudes, effective range analysis.

Unit-5 Elementary Particle Physics

Types of interaction between elementary particles, Hadrons and leptons- symmetry and conservation laws, elementary ideas of CP and CPT invariance, classification of hadrons quark model SU(2) SU(3) multiplets, Gell-Mann-Okubo mass formula for octet decuplet hadrons.

Text and Reference Book

1. S N Ghosal: Atomic and Nuclear physics, Vol 2, S. Chand, Edition: 2nd ,1998.
2. D J Griffiths: Introduction to elementary particles, Harper and Row, New York, 1987.
3. H A Enge, Introduction to nuclear physics, Addison Wesley, 1975.
4. S de Benedetti, Nuclear interaction, John Wiley & Sons, New York, 1955.
5. M K Pal, Theory of nuclear structure affiliated East- West, Madras, 1982.
6. D. C. Tayal,Nuclear Physics, 5^{th} Edition, Himalaya Publishing House, 2011.

M. Sc. (Physics) Third Semester

PHY-303 (S)

ELECTRONICS-I

Course Learning Outcome:

1. Learn basic concepts of amplifier, Op-amplifier, etc.

2. gain knowledge of square wave, triangular wave generators.

3. Comprehend the knowledge about different types of detectors.

4. Learn about dynamic and static memories.

5. Learn about various types of oscillators, voltage regulators, and its classification.

Module-1 Operational Amplifier

Differential amplifier, circuit configuration, dual input, balanced output, differential amplifier, inverting and non-inverting inputs, CMRR. Block diagram of a typical Op-amplifier analysis, inverting and non-inverting amplifier, Op-amplifier with negative feedback, voltage series feedback, integrator and differentiator. Oscillators principles, Oscillator types- frequency stability response, the phase shift oscillator, Wein bridge oscillator, IC tunable oscillator, multivibrators, monostable and astable comparators, square wave and triangular wave generators.

Module-2 Analog and Digital System & Optoelectronics

Analog computation, active filters, comparators, logarithmic and antilogarithmic amplifiers, sample and hold amplifiers, waveform generators, square and triangular wave generators, pulse generators. ROM and applications, RAM and applications, digital to analog converters, analog to digital converters, successive approximation and dual slope converters, applications of DACs and ADCs.

Photodetectors: Photo detectors with external photo effect, Photo detectors with internal photo effect, photo conductor and photo resistor, junction photo detector, circuits with LED, diode tester, polarity and voltage tester, LED, numeric and alphanumeric display units, semiconductor switches and potential isolation, the phototransistor as a switch in the optocouplers, steady state performance, dynamic performance.

Text and Reference Books

1. Robert Boylested and Louis Nashdsky: Electronic devices and circuit theory, Pearson, 2015.
2. Ramakanth A Gayakwad: OP amps & linear integrated circuits second addition, PHI, 1991
3. Jacob Millman: Microelectronics, McGraw Hill, New Delhi, 1990
4. Texas Instruments: Optoelectronics- theory and practice, McGraw Hill, 1978.

M. Sc. (Physics) Third Semester

PHY-304 (S)

ELECTRONICS-II

Course Learning Outcome:

1. Learn basic concepts of communication system.

2. Gain knowledge of frequency stabilization.

3. Comprehend the knowledge about sampling of signals

4. Learn about different types of noise.

5. Understand about various types of signals.

Module-1 Electronics Communication

Amplitude modulation- generation of AM wave, demodulation of AM waves DSBSC modulation, generation of DSBSC waves, coherent detection of DSBSC waves, SSB modulation, generation and detection of SSB waves, vestigial sideband modulation, frequency division multiplexing (FDM), Principle of superhetrodyne receiver, square law detector, linear diode detector, frequency modulation & spectrum, reactance tube modulator, FM using verector diode, Armstrong method of FM, frequency stabilization.

Module-2 Digital Communication

Pulse modulation system: Sampling theorem-pass and band-pass signals, PAM, channel BW for a PAM signal, natural sampling, flat top sampling, single recovery through holding, quantization of signal, differential PCM, delta modulation, adaptive delta modulation, CVSD.

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 noise, mixing involving noise, linear filtering, noise bandwidth.

Text and Reference Books

1. Symen Haykins, Communication System, Wiley, 4th Ed., 2000.

2. A P Malvino and Donald P. Leach, Digital principles and applications, Tata McGraw Hill, 1993 .

3. B P Lathi, Communication System, BSP, 2001.

4. S. L. Gupta V. Kumar**,** Hand Book of Electronics**,** Pragati Prakashan, 2012.

M. Sc. (Physics) Third Semester
PHY-305 (S)
CONDENSED MATTER PHYSICS-I

Course Learning Outcome:

1. Understand about diffraction conditions, diffraction method, and principle of powder diffraction method.
2. Basic idea about different symmetry in crystal structure i.e. point group symmetry and space group symmetry.
3. Learn about formation molecular bonding and formation of bands in materials.
4. Understanding about Fermi surface and variations in Fermi shape with different situations.
5. Learn about different characterization techniques i.e. X-ray diffraction, Mossbauer spectroscopy, etc.

Unit-1 Crystal Physics and X-Ray Crystallography

External symmetry elements of crystals, concept of point groups, influence of symmetry on physical properties, electrical conductivity, space groups, derivation of equivalent point positions (with examples from triclinic and monoclinic systems), experimental determination of space group, principle of power diffraction method, interpretation of powder photographs, application of powder method.

Unit-2 Lattice Dynamics

Inter atomic forces and lattice dynamics of simple metals, ionic and covalent crystals, optical phonons and dielectric constants, inelastic neutrons scattering, Mossbauer effect, Debye-Waller factor, Anharmonicity, thermal expansion and thermal conductivity, Fermi surface, de Hass van Alphen effect, cyclotron resonance, magneto-resistance, Quantum Hall effect.

Text and Reference Books

1. B. D. Cullity, S R stock: Elements of X-Ray Diffraction, Pearson Education India, 3rd edition, 2014.
2. A R Verma and O N Srivastava, Crystallography applied to Solid State Physics, New Age International, Second edition, 1991.
3.L Azaroff, Introduction to solids, McGraw Hill Education, 2017.
4. O Madelung: Introduction to Solid - State Theory, Springer (India) Pvt. Ltd., 2004.
5. J Callaway: Quantum theory of solids state, Academic Press Inc; 2nd edition, 1999.
6. A Huag: Theoretical solid-state physics , Elsevier, 1st edition,1972.
7. C Kittel: Introduction to Solid State Physics, Wiley; Eighth edition, 2012.
8.N W Ashcroft and N D Mermin: Solid State physics, Cengage, 1st edition 2003.
9. A J Dekker: Solid State physics, Laxmi Publications, 2008.

M. Sc. (Physics) Third Semester
PHY-306 (S)
CONDENSED MATTER PHYSICS-II

Course Learning Outcome:

1. Understand about electron phonon interaction.

2. Learn about superconductivity and its applications. Gain knowledge behind high temperature superconductivity.

3. Gain knowledge about how to localized states are generated by point defect.

4. Basic idea of localization and delocalization and its correlation with metal and insulator.

5. Learn to explain Anderson model for random systems, electron localization, mobility edge, amorphous semiconductors and hopping conduction.

Unit-1Electron-Phonon Interaction

Interaction of electron with acoustic and optical phonons, polarons, superconductivity: critical temperature, persistent current, Meissner effect, manifestations of energy gap, cooper pairing due to phonons, BCS theory of superconductivity, Ginzsburg-Landau theory and application to Josephson effect: D C Josephson effect, A.C. Josephson effect, macroscopic quantum interference, vortices and type II superconductors, high temperature superconductivity (elementary).

Unit-2Disordered Systems

Point-defects shallow impurity states in semiconductors, localized lattice states in solids, vacancies, interstitials and colour centers in ionic crystals. Disordered in condensed matter, substitutional positional and topographical disorder, short and long range order, atomic correlation function and structural descriptions of glasses and liquids. Anderson model for random systems and electron localization, mobility edge, qualitative application of the idea to amorphous semiconductors and hopping conduction.

Text and Reference Books

1. O Madelung: Introduction to Solid - State Theory, Springer (India) Pvt. Ltd., 2004.
2. J Callaway: Quantum theory of solids state, Academic Press Inc; 2nd edition, 1999.
3. A Huag: Theoretical solid-state physics , Elsevier, 1st,1972.
4. C Kittel: Introduction to Solid State Physics, Wiley; Eighth edition, 2012.
5. N W Ashcroft and N D Mermin: Solid State physics, Cengage, 1st edition, 2003.
6. A J Dekker: Solid State physics, Laxmi Publications, 2008.

M. Sc. (Physics) Fourth Semester
PHY-401 Core Paper
STATISTICAL MECHANICS

Course Learning Outcome:

1. Develop the concept of phase space to define and formulate the dynamical systems.
2. Identify the dynamical systems in Biology, Chemistry, Economics and computing and
3. Learn to simulate onset of chaos (Fluctuations) in simple dynamical systems in various conditions.
4. Learn to solve the basic equations to explain the basic properties of fluids like thermal Conductivity, viscosity, mass diffusivity etc.
5. Demonstrate some simple examples of fluid flow as described in the syllabus.

Unit-1 Basics of Statistical Mechanics

Foundation of statistical mechanics, specification of states of a system, contact between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox, phase space, trajectories and density of states, Liouville's theorem.

Unit-2 Ensemble Theory

Micro-canonical, canonical and grand canonical ensembles, partition functions, calculation of statistical quantities.

Unit-3 Statistics

Density matrix, statistics of ensembles, statistics of indistinguishable particles, Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.

Unit-4 Ising Model

Cluster expansion for a classical gas, Virial equation of state, Ising model, mean field theories of Ising model in one, two and three dimensions, exact solution in one dimension.

Unit-5 Fluctuations

Fluctuations in ensemble, correlation of space-time dependent fluctuations, fluctuations and transport phenomenon, Brownian motion, Langevin theory, fluctuation dissipation theorem, Fokker-Plank equation.

Text and Reference Books

1. F Reif, Fundamentals of Statistical and Thermal Physics, Waveland Press, 2010.
2. Kerson Huang, Statistical Mechanics, 2nd Edition, Wiley, 2008.
3. R K Pathria, Statistical mechanics , 4th Edition, Elsevier, 2011.
4. R Kubo, Statistical mechanics,Elsevier Science,1971.
5. L. D. Landau and E. M. Lifshitz: Statistical Physics, First edition, CBSPD, 2008.

M. Sc. (Physics) Fourth Semester
PHY-402 (B) Elective Paper
PHYSICS OF LASER AND ITS APPLICATION

Course Learning Outcome:

1.Basic lasing mechanism, characteristics and working of different types of LASERs.

2. Basics of nonlinear optics and various nonlinear optical processes.

3. Concept of optical fiber and its characteristics.

4. Construction and working of optical fiber.

5.Understand about various laser spectroscopy techniques.

Module-1 Physics of Laser

Laser Characterization & Laser System: Gaussian beam and its properties, Stable Two Minor optical resonators, Longitudinal and Transverse modes of Laser Cavity, Mode Selection, Gain in regenerative laser cavity, Threshold for 3 and 4 level laser systems, Q switching and Mode locking, Pulse Shortening, picosecond & femtosecond operation, Spectral Narrowing and Stabilization. Ruby Laser, Nd-YAG Laser, Semi Conductor Lasers, Diode Pumped Solid State Lasers, Nitrogen Laser, Carbon dioxide Laser, Excimer Laser, Dye Laser, High Power Laser system.

Module-2 Applications of Laser

Laser Spectroscopy, Techniques and Other Applications: Laser fluorescence, Raman Scattering and their use in Pollution studies, Non linear interaction of light with matter, Laser induced multiphoton processes and their applications, Ultra high resolution spectroscopy with lasers and its applications, propagation of light in a medium with variable refractive index, Optical fibers, Light wave communication, Qualitative treatment of Medical and Engineering applications of lasers.

Text and Reference Books

1. Orazio Svelto,Principle of Lasers, 5th Edition, Springer; 2010.
2. William T. Silfvast, Laser Fundamentals, Second Edition, Cambridge University Press,2020.
3. Wolfgang Demtröder, Laser Spectroscopy,Springer; 3rd Edition, 2002.
4. B.B. Laud, Laser and Nonlinear Optics, 3rd Edition, New Age,2011.
5.K.R. Nambiar, Lasers principles, types and applications,New Age, 2006

M. Sc. (Physics) Fourth Semester
PHY-403 (S)
ELECTRONICS-III

Course Learning Outcome:

1. Learn basic concepts of velocity modulation.

2. Gain knowledge to construct and amplify microwave signals.

3. Comprehend the knowledge about different types of microwave devices including Impatt diodes and parametric devices.

4. Learn about working of satellite system.

5. Learn about Radar system.

Module-1 Microwave Devices

Klystrons, magnetrons and traveling wave tubes, velocity modulation, basic principles two cavity klystrons and reflex klystrons, principles of operation of magnetrons, Helix traveling wave tubes, wave modes, transferred electron devices, Gunn effect, principle of operations, read diode, IMPATT and TRAPATT diode.

Advantage and disadvantage of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnel zone problem, ground reflection, fading sources, detectors, components, antennas used in MWC system.

Module-2 Radar Systems & Satellite Communications

Radar block diagram of an operation, radar frequencies, pulse considerations, radar range equation, derivation of radar range equation, minimum detectable signal, receiver noise, signal to noise ratio, integration of radar pulses, radar cross section, pulse repetition frequency, antenna parameters, system losses and propagation losses, radar transmitters, receivers, antenna displays.

Satellite communication: orbital satellites, geostationary satellites, orbital patterns, look angles, orbital spacing, satellite systems, link modules.

Text and Reference Books:

1. Wayne Tomasi: Advanced electronics communications systems, PhI. 1987.
2. Taub and Schilling: Principles of communication systems, second edition, TMH, 1990
3. Simon Haykin, Communication systems, third edition, John Wiley and Sons, 1994.
4. S. L. Gupta V. Kumar**,** Hand Book of Electronics**,** Pragati Prakashan, 2012.

M. Sc. (Physics) Fourth Semester
PHY-404 (S)
ELECTRONICS-IV
Principles of Digital Electronics

Course Learning Outcome:

1. Design of Integrated Circuits Technology, Basic Monolithic Integrated circuits, Epitaxial growth, masking and Etching, Diffusion of impurities.

2. Construction and working of OP-AMPs and design waveform generator circuits. Working of differentiator and integrator.

3. Construction of TTL circuits: 7400 devices, TTL characteristics, TTL overview, Encoders and Decoders.

4. Concept of Karnaugh maps and Karnaugh simplification.

5. Study of adder and subtractor circuits. Construction and working of FLIP FLOPS.

Unit- 1 Number system and Logic Gates

Various Number system (binary, octal, decimal, hexadecimal) and concept of Boolean algebra.
Representation of characters: BCD, ASCII, EBCDIC Codes. Weighted codes, self complementary codes, error detecting codes and error correcting codes (Parit, Gray, Hamming codes).
Logic gates: Logic gates and Boolean Algebra Representation and Simplification of functions Karnaugh Maps. Combinational circuits design.

Unit- 2 Logic Circuits

Combinational circuits- adder, subtractor, decoder, demultiplexer, encoder, multiplexer, comparator, Sequential Logic Circuit & Design– flip flop, shift register, asynchronous and synchronous counters.

Unit- 3Logic Families and Semiconductor Memories

Digital Logic Families and their characteristics: RTL, DTL, TTL, Schottky TTL, ECL, MOS and CMOS, Fan in, Fan out.
Semiconductor Memories: RAM, ROM, PROM, EPROM, BJTRAM Cell, MOS RAM Cell, Organization of RAM, Charged coupled device (CCD), storage of charge and transfer of charge in CCD.

Text and Reference Books:

1. C.P. Malvino and D. P. Leach, Digital Principles and Applications, McGraw Hill, 1985.
2. M. Morris Mano, Digital Logic and Computer Design,4th Edition,Pearson, 2016.
3. Herbert Taub and Donald Schilling, Digital Integrated Circuit, McGraw Hill. 2017
4. John.P. Hayes, Computer Architecture and Organization, McGraw Hill, 2017.
5. Thoms. L. Floyd,Digital Fundamentals, 11th Edition, Pearson, 2015.

M. Sc. (Physics) Fourth Semester
PHY-405 (S)
CONDENSED MATTER PHYSICS-III

Course Learning Outcome:

1.Basic understanding about direct and indirect transition in semiconductor.
2. Different types of interaction in materials.
3.Gain knowledge of formation of plasma in metallic materials.
4.Basic understanding of dielectric function and its correlation with propagation of light in material.
5. Learn about surface states and surface reconstruction.

Unit-1Optical Properties of Solids

Interaction of electron and phonons with photons, direct and indirect transition, absorption in insulators, polaritions, one phonons absorption, optical properties of metals, skin effect and anomalous skin effect.
Interacting electron gas: concept of many electron system, Thomas Fermi theory, Hartee and Hartee-Fock approximations, correlation energy, Linhard theory and Thomas Fermi theory of screening, plasma oscillations in free electron gas.

Unit-2Electrons in Solid and Surface States

Dielectric function of an electron gas in random phase approximation, limiting cases and Friedel oscillation, strongly interacting Fermi system, elementary introduction to Landau's quasi-particle theory of a Fermi liquid, strongly correlated electron gas, elementary idea regarding surface states, metallic surfaces and surface reconstruction.

Text and Reference Books

1. Rajendra Prasad: Electronic Structure of Materials, CRC Press, 1st edition, 2013.
2. O Madelung: Introduction to Solid - State Theory, Springer (India) Pvt. Ltd., 2004.
3. J Callaway: Quantum theory of solids state, Academic Press Inc; 2nd edition, 1999.
4. A Huag: Theoretical solid-state physics, Elsevier, 1st,1972.
5. C Kittel: Introduction to Solid State Physics, Wiley; Eighth edition, 2012.
6. N W Ashcroft and N D Mermin: Solid State physics, Cengage, 1st edition 2003.
7. A J Dekker: Solid State physics, Laxmi Publications, 2008.

M. Sc. (Physics) Fourth Semester
PHY-406 (S)
CONDENSED MATTER PHYSICS-IV

Course Learning Outcome:

1. Understand about screw and edge dislocation.
2. Different types of dislocation in different materials and their effect on states in a material.
3. Learn about optical behaviors of thin film.
4. Understand about conductivity and Boltzmann transport equation in thin film.
5. Gain knowledge how to Measure film thickness by light source.

Unit-1Imperfection in Crystals

Mechanism in plastic deformation in solids, Stress and strain fields of screw and edge dislocation, elastic energy of dislocations, forces between dislocation, stress needed to operate Frank-Read source, dislocation in fcc, hcp and bcc lattices, partial dislocations and stacking faults in closed-packed structures.

Unit-2Films and Surfaces

Study of surface topography by multiple beam interferometry, condition for accurate determination of step height and film thickness (Fizeau fringes), electrical conductivity of thin films, difference of behavior of thin films from bulk, Boltzmann transport equation for a thin film (for diffused scattering), expression for electrical conductivity for thin film.

Text and Reference Books

1.A Goswami: Thin film phenomena, New Age International, 5th Edition, 2005.
2.K L Chopra: Thin Film Phenomena, Krieger Pub Co, 1969.
2. O Madelung: Introduction to Solid - State Theory, Springer (India) Pvt. Ltd., 2004.
3. J Callaway: Quantum theory of solids state, Academic Press Inc; 2nd edition, 1999.
4. A Huag: Theoretical solid-state physics, Elsevier, 1st,1972.
5. C Kittel: Introduction to Solid State Physics, Wiley; Eighth edition, 2012.
6. N W Ashcroft and N D Mermin: Solid State physics, Cengage, 1st edition 2003.
7. A J Dekker: Solid State physics, Laxmi Publications, 2008.