Shri Govind Guru University

GODHRA

Syllabus of

B. Sc. Semester – III & IV

PHYSICS

(Theory & Practical)

(Based on NEP-2020)

Effective from June, 2024

B.Sc. – Semester -III (PHYSICS)

MAJOR -1 : PHYSICS PAPER – 1 (Credit -4)

UNIT -I: SOLID STATE PHYSICS

1. Crystal Structure

Periodic Arrays of Atoms
Lattice translation vectors
Basis, Lattice , Lattice primitive cell, Wigner-Seitz unit cell
Fundamental Types Of Lattice
Two -dimensional lattice types, Oblique lattice, Bravice lattice
Three dimensional lattice types
Index system (indices) for crystal planes
Simple Crystal Structures
Sodium Chloride structure
Cesium chloride structure
Hexagonal closed packed structure (hcp)
Diamond structure

- Text Book: **Introduction to Solid State Physics** by C. Kittle.
  (8^{th} Edition)(Chapter 1)

UNIT-II: CLASSICAL MECHANICS

1. Central Force

5.1 Equivalent one-body problem
5.2 Motion in a central force field
5.3 General features of the motion
5.4 Motion in an inverse-square law force field

2. Oscillations and Collisions

6.1 Simple Harmonic Oscillator
6.2 Damped Harmonic Oscillator
7.1 Elastic and Inelastic Scattering
7.2 Laboratory and Centre of Mass Systems
7.3 Kinematics of Elastic Scattering in Lab System

- Text Book: **Classical Mechanics** by R.G.Takewale & P.S.Puranik.
  Tata McGraw Hill

UNIT-III: HEAT & THERMODYNAMICS

1. Entropy

8.1 Reversible part of the second law (clauis theorem)
8.2 Entropy
8.4 Entropy of ideal gas
8.5 T – S diagram
8.12 Application of the entropy principle

2. Mathematical Methods

10.1 Characteristics functions
10.2 Enthalpy
10.3 Helmholtz and Gibb's function
10.5 Maxwell's relations
10.6 T ds equations
10.7 Internal energy equations
10.8 Heat capacity equations.

- **Text Book : Heat & Thermodynamics** by Mark W.Zemansky & R.H.Dittman McGraw Hill ,Int.7th.edition

UNIT-IV: NUCLEAR PHYSICS

1. Detector for Nuclear Particles

1.1.3 Geiger Counter
Solid state or semiconductor detector
Compton suppressed germanium detector
Cloud and bubble chambers

2. Particle Accelerators

1.1.4 Van de Graff generator
The cyclotron
The Synchrotron
The betatron
1.1.5 Beta ray spectrometer

- Text Book: **Nuclear Physics An Introduction** by S. B. Patel. New Age International Pvt. Ltd. (2^{nd} Edition)

MAJOR-2 : PHYSICS PAPER – 2 (Credit -4)

UNIT -I : ELEMENTARY QUANTUM MECHANICS

1. The Schrodinger equation and stationary state

2.1 A free particle in one dimension
2.2 Generalization to three dimensions
2.3 The operator correspondence and the Schrödinger equation for a particle subject to forces
2.4 Normalization and probability interpretation
2.5 Non-Normalizable wave functions and box normalization
2.6 Conservation of probability
2.7 Expectation values; Ehrenfest's theorem
2.8 Admissibility conditions on the wave function
2.9 Stationary states: The time-independent Schrödinger equation
2.10 A particle in a square well potential

- Text Book: A **textbook of Quantum Mechanics** by P. M. Mathews & K. Venkatesan, Tata McGraw Hill

UNIT-II : ELECTROSTATICS

1. Properties of Dielectric Materials

2.1 Electric Polarization
2.2 Magnitude of Polarization charges
2.3 Polarization vector P
2.4 Field of a Polarized piece of dielectric
2.5 Gauss' law in dielectrics : Displacement vector
2.6 Macroscopic dielectric parameters
2.7 Force exerted by a capacitor on a dielectric slab
2.9 Polar and Non-Polar dielectrics
2.11 Lorentz Formula for internal or Local electric field
2.12 Clausius-Mosotti equation

- Text Book: **Fundamentals of Electricity and Magnetism** by R. B. Singh & A. K. Shukla. New Age International Publishers.

UNIT-III : OPTICS

1. Diffraction of Light

17.1 Introduction

17.6 Difference between Interference and Diffraction

17.7 Fresnel and Fraunhofer Types of diffraction

17.11 Diffraction pattern due to narrow slit

18.7 Plane Diffraction Grating

18.7.1 Theory of plane transmission grating

18.7.7 Dispersive power of grating

18.7.8 Prism and grating spectra

2. Resolving Power of Optical Instrument

19.1 Resolving power

19.3 Limit of resolution of eye

19.5 Resolving power of optical instruments

19.6 Rayleigh's criterion of resolution

19.7 Resolving power of a telescope

19.7.1 Relation between magnifying power and resolving power of telescope

19.11 Resolving power of a prism

19.12 Resolving power of a plane transmission grating

- Text Book **: A Textbook of Optics** by Dr. N. Subrahmanyam, Brijlal, Dr. M. N. Avadhnulu (Revised Edition), S. Chand Publication

UNIT-IV : ELECTRONICS

1. Basic Characteristics of the Transistor

9.1 Basic transistor amplifier

9.2 Two diode analogy for a transistor

9.3 Transistor input Characteristics

9.4 Transistor collector characteristics

9.5 Collector cut-off current, I_{CEO}

9.6 Forward current transfer ratio, CE

9.7 Permissible operating area of a transistor, CE

9.8 The basic common-base amplifier

9.9 Forward current transistor ratio, CB

9.10 Relation between α and β

9.11 Collector cut off current, I_{CBO}

9.17 Transistor construction

9.18 Identifying the transistor lead.

2. Hybrid Equivalent Circuits for a Transistor

14.2 General Black Box Theory

14.3 Hybrid parameters

14.4 Obtaining the Hybrid parameters

- Text Book: **Electronic Devices and Circuits** by Allen Mottershed. PHI Publication

MAJOR-3 : PHYSICS PRACTICAL (Credit-4)

Group A

1. Identification of elements in line spectra
2. Resolving power of Telescope
3. Wavelength of light using Hartmann formula
4. To study double refraction in calcite prism
5. λ of prominent spectral lines (Mercury) by Diffraction Grating
6. Diffraction by single slit

Group B

1. Characteristics of a Transistor
2. Study of electron diffraction pattern
3. Analysis of elliptically polarized light using photocell
4. h-parameters of CE transistor
5. Thermocouple
6. e/m by Thomson's method

B. Sc. - Semester – III (PHYSICS)

MULTIDISCIPLINARY COURSE (MDC) (Theory)

BASICS OF OPTICS AND ELECTRONICS (Credit-2)

UNIT-I: OPTICS

1 Resolving Power of Optical Instrument

19.1 Resolving power
19.3 Limit of resolution of eye
19.5 Resolving power of optical instruments
19.6 Rayleigh's criterion of resolution
19.7 Resolving power of a telescope
19.7.1 Relation between magnifying power and resolving power of telescope
19.11 Resolving power of a prism
19.12 Resolving power of a plane transmission grating

- Text Book: **A Textbook of Optics** by Dr. N. Subrahmanyam, Brijlal, Dr. M.N. Avadhanulu (Revised Edition), S. Chand Publication.

UNIT-II : ELECTRONICS

1. **Solid State Electronic Devices**

6.1 Zener Diodes
6.2 Zener Diodes Specification
6.3 The Voltage Regulator Circuit
6.6 Zener diode Breakdown Mechanism
21.2 Basic Construction of the JFET
21.3 Characteristics curves of the JFET
21.7 Characteristic Parameters of the JFET
28.1 The Silicon Controlled Rectifier
28.5 The Uni Junction Transistor

- Text Book: **Electronic Devices and Circuits** by Allen Mottershed. PHI

B. Sc. - Semester – III (PHYSICS)

MULTIDISCPLINERY C O U R S E (M D C PHYSICS) PRACTICAL

BASICS OF OPTICS AND ELECTRONICS (Credit-2)

1. Resolution power of prism
2. Resolution power of grating
3. Wavelength of light by Adser's A pattern
4. Wavelength of prominent spectral lines by diffraction grating (Mercury Spectrum)
5. Characteristics of SCR
6. Zener Diode Characteristics
7. UJT Characteristics
8. FET Characteristics

B. Sc. - Semester – III

SKILL ENHANCEMENT COURSE (SEC)

ASTROPHYSICS AND MEDICAL PHYSICS (Credit-2)

UNIT- I: ASTROPHYSICS

1 Telescopes

1.1 Early telescopes and the use of lenses
1.2 Astronomical telescope consisting of two converging lenses
1.4 Reflecting telescopes
1.6 Resolving power of telescopes
1.7 Collecting power of telescopes
1.8 Radio telescopes
1.9 Infrared, ultraviolet and x-ray telescopes
1.11 Charged-coupled devices in astronomy

- Text Book: **Physics Astrophysics AQA A-Level Year 2** By Chris Bishop, Harper Collins Publishers

UNIT -II: MEDICAL PHYSICS

1. Introduction to Medical Imaging

1.1 Radiography (X-ray imaging)
1.2 Contrast materials
1.3 Computed tomography
1.4 Ultrasound
1.5 Scintigraphy (nuclear medicine)
1.6 Magnetic resonance image
1.7 Hazards associated with medical imaging

- Text Book: **Imaging for Students** by David A. Lisle **(**Fourth Edition)

B.Sc. – Semester –IV (PHYSICS)

MAJOR-1 : PHYSICS PAPER – 1 (Credit -4)

UNIT –I : SOLID STATE PHYSICS

1. Crystal Binding

Crystal of inert gases
Wander walls London interaction
Repulsive interaction
Equilibrium lattice constant
Cohesive energy
Ionic crystals
Madelung energy, evaluation of Madelung constant
Covalent crystals
Metals
Hydrogen bonds

- Text Book: **Introduction to Solid State Physics** by C. Kittle, (8^{th} Edition) (Chap. 3)

UNIT -II : CLASSICAL MECHANICS

1. Lagrangian Formulations

8.1 Constrains
8.2 Generalized co-ordinates
8.3 D' Alembert's principle
8.4 Lagrange's equations
8.7 Cyclic or ignorable co-ordinates

2. Moving Coordinate System

9.1 Co-ordinate systems with relative translation motion
9.2 Rotating co-ordinate systems
9.3 The Coriolis force
9.4 Motion on the earth

- Text Book: **Classical Mechanics** by R. G. Takewale & P. S. Puranik, Tata Mc Graw Hill

UNIT-III : MAGNETOSTATICS

1. Steady Current and Magnetostatics

4.1 Electric Current
4.2 Ohm's Law - Electrical conductivity
4.4 Magnetic Effects
4.5 The Magnetic Field
4.6 Force on a current
4.7 Biot-Savart law
4.8 The Laws of Magnetostatics
4.9 The Magnetic potential
4.14 Magnetic Media
4.15 Magnetization
4.16 Magnetic Field Vector
4.17 Magnetic Susceptibility and Permiability

- Text Book: **Electromagnetics** by B. B. Laud. New Age International Publishers.(2nd Edition)

UNIT- IV : MODERN PHYSICS

1. Special Theory of Relativity

1.1 Postulates of special relativity.(with Michelson Morley experiment)
1.2 Time dilation
1.3 Doppler effect
1.4 Length contraction
1.7 Relativity of mass
1.8 Mass and energy
1.10 Lorentz transformation
1.11 Velocity addition

- Text Book: **Concepts of Modern Physics** by Arthur Beiser.(4th Edition) McGraw Hill Pub. Co.

MAJOR-2 : PHYSICS PAPER – 2 (Credit -4)

UNIT-I : QUANTUM MECHANICS

1. General formalism of Wave Mechanics

3.1 The Schrödinger equation and the probability interpretation for an N-particle system

The fundamental postulates of wave mechanics

a. Representation of states

b. Representation of dynamical variable; expectation values, observables

3.3 The adjoint of an operator, and self-adjointness

3.4 The eigen value problem; Degeneracy

3.5 Eigen value and eigen function of self-adjoint operators

3.6 The dirac delta function

3.7 Observables : Completeness and normalization of eigen functions

3.9 Physical interpretation of eigenvlaues, eigenfunctions and expansion Coefficients

3.11 The uncertainty principle

3.12 States with minimum value for uncertainty products

- Text Book: **A textbook of Quantum Mechanics** by P. M. Mathews & K. Venkatesan. Tata McGraw Hill.

UNIT – II : SEMICONDUCTOR PHYSICS

1. Introduction to Semiconductors

9.1 Classification of semiconductors

9.2 Examples of band structure

9.2.1 Silicon and Germanium

9.2.2 Gallium Arsenide

9.2.3 Determination of band gap

9.3 Intrinsic Carrier densities

9.4 General features of extrinsic semiconductors

9.4.1 The n-type semiconductors

9.4.2 The p-type semiconductors

9.5 Population of donor and acceptor levels in the state of thermal equilibrium

9.6 Extrinsic carrier densities

9.7 Temperature dependence of electrical conductivity

9.8 Hall effect and magnetoresistance

9.9 The p-n junction

9.10 Examples of p-n junction-based devices

9.10.1 The Tunnel Diode

9.10.2 The injection laser

- Text Book: **Elements of Solid State Physics** by J. P. Srivastava. 4th Edition PHI Publication

UNIT –III : DIGITAL ELECTRONICS

1. Circuit Analysis

2.1 Boolean Laws and Theorems
2.2 Sum of Product Method
2.3 Truth Table to Karnaugh Map
2.4 Pairs, Quads and Octats
2.5 Karnaugh Simplifications
2.6 Don't Care Conditions
2.7 Product of Sums Method
2.8 Product of sums Simplifications

2. Arithmetic Circuits

5.1 Binary Addition
5.2 Binary Subtraction
5.3 Unsigned Binary Numbers
5.4 Sign-Magnitude Numbers
5.5 2's Complement Representation
5.6 2's Complement Arithmetic

- Text Book: **Digital Principles and Applications** by Albert Paul Malvino,Donald P.Leach. (4th Edition, Mc GRAW-HILL)

UNIT- IV: ELECTRONICS

1. Solid State Electronic Devices

6.1 Zener Diodes
6.2 Zener Diodes Specification
6.3 The Voltage Regulator Circuit
6.6 Zener diode Breakdown Mechanism
21.2 Basic Construction of the JFET
21.3 Characteristics curves of the JFET
21.7 Characteristic Parameters of the JFET
28.1 The Silicon Controlled Rectifier
28.5 The Uni Junction Transistor

- Text Book: **Electronic Devices and Circuits** by Allen Mottershed. PHI

MAJOR-3 : PHYSICS PRACTICAL (Credit-4)

Group A

1. Study of a Zener Diode as a voltage regulator
2. Silicon Controlled Rectifiier
3. Uni Junction Transistor
4. Field Effect Transistor
5. Simplification of Boolean Equation By Karnaugh Map
6. Use of EXCEL for Data Analysis and Graph Plotting

Group B

1. Measurement of voltage and frequency by CRO
2. Resonance Pendulum
3. Hall Effect experiment.
4. Determination of Young's modulus by Koenig's method
5. Susceptibility of Ferromagnetic Substance by Quink's Method
6. Numerical Integration by Computer

B. Sc. - Semester – IV (PHYSICS)

MINOR COURSE (Theory)

FUNDAMENTALS OF SOLID STATE PHYSICS AND THERMODYNAMICS

(Credit -2)

UNIT -I: SOLID STATE PHYSICS

1 Crystal Structure

Periodic Arrays of Atoms
Lattice translation vectors
Basis, Lattice , Lattice primitive cell, Wigner-Seitz unit cell
Fundamental Types Of Lattice
Two -dimensional lattice types, Oblique lattice , Bravais lattice
Three dimensional lattice types
Index system (indices) for crystal planes
Simple Crystal Structures
Sodium Chloride structure
Cesium chloride structure
Hexagonal closed packed structure (hcp)
Diamond structure

- Text Book: **Introduction to Solid State Physics** by C. Kittle. (8th Edition) (Chapter 1)

UNIT-II: THERMODYNAMICS

1. Entropy and Pure Substances

8.1 Reversible part of the second law (Clausius theorem)
8.2 Entropy
8.4 Entropy of ideal gas
8.5 T – S diagram
8.12 Application of the entropy principle
9.0 Pure substances
9.6 Volume exapansivity
9.7 Compressibility

- **Text Book : Heat & Thermodynamics** by Mark W. Zemansky & R. H. Dittman McGraw Hill, Int.7th.edition

B. Sc. - Semester – IV (PHYSICS)

MINOR PHYSICS PRACTICAL
FUNDAMENTALS OF SOLID STATE PHYSICS AND THERMODYNAMICS
(Credit-2)

1. Thermocouple
2. Identification of elements in Line Spectra.
3. Study of electron diffraction pattern
4. Absorption coefficient of liquid using photocell
5. To verify the Stefan Boltzmann's fourth power law by using dc power source
6. Phonon dispersion relation of monoatomic lattice

B. Sc. - Semester – IV (PHYSICS)

SKILL ENHANCEMENT COURSE

REMOTE SENSING AND ITS APPLICATIONS (Credit-2)

UNIT -I : INTRODUCTION TO REMOTE SENSING

1 Introduction
1.1 Sun and atmosphere
1.2 Concept of signatures
1.2.1 Multispectral concept
1.3 Remote sensing system
1.3.1 Remote sensors
1.3.2 Platforms
1.3.3 Data product generation
1.3.4 Data analysis
1.3.5 End utilization
1.4 Why observe earth from space?
1.5 Remote sensing –A historic perspective
1.6 Indian Remote sensing program
1.7 The earth observation evolution-the paradigm shift
1.8 Legal and ethical aspects

UNIT- II : APPLICATIONS OF REMOTE SENSING

11 Introduction
11.1 Agriculture
11.2 Forestry applications
11.3 Land cover/land use mapping
11.4 Water Recourses
11.5 Snow and Glaciers
11.6 Wet Land Management
11.7 Coastal Zone Management
11.8 Marine Fisheries
11.9 Remote Sensing of Earth System Science Studies

- Text Book**: Fundamentals of remote sensing** by George Joseph, University Press (India) Pvt. Ltd., Hyderabad.