GUJARAT UNIVERSITY
Syllabus for Second Year B.Sc.: Semester – III
Effective from June 2024
DSC-C-PHY-231T (4 Credit)
Astrophysics, Nuclear Physics, Solid State Physics and Electronics

Learning Objectives

To enable learners to

- understand basic tools of observational techniques in Astrophysics
- study various types of nuclear detectors
- develop of basic concepts in solid state physics
- acquire knowledge of transistor and solid state devices

Learning Outcomes

On successful completion of the course, the learners would gain the knowledge of

- different types of telescopes, astronomical spectrographs and about the magnitudes, motion and distance of stars
- interaction between the particles and matter and get insight for the various detectors used in nuclear and particle physics
- the details of lattice structure and X-ray diffraction
- different types of transistor configurations
- construction and working of solid state device like Zener diode, tunnel diode SCR and UJT

UNIT – I: ASTROPHYSICS [15 Hours]

Astronomical Instruments

Light and properties, The Earth's atmosphere and the electromagnetic radiation, Optical telescopes, Radio telescopes, The Hubble space telescope, Astronomical spectrographs, Photographic photometry

Magnitudes, Motions and Distances of Star

Stellar magnitude sequence, Absolute magnitude and distance modulus, The bolometric magnitude, Different magnitude standards: The UBV system and six colour photometry, Radiometric magnitudes, The colour index of a star, Luminosities of stars, Stellar parallax (Trigonometric) and the units of stellar distances, Stellar positions: The stellar coordinates, Stellar motions

Reference Book:

1. An Introduction to Astrophysics by Baidyanath Basu, Tanuka Chattopadhyay and Sudhindra Nath Biswas, 2nd edition, PHI Learning private limited.
Articles: 1.1 to 1.7; 3.1 to 3.10

2. Astrophysics for Physicists by Arnab Rai Choudhuri Cambridge university press, 2010.

UNIT – II: NUCLEAR PHYSICS [15 Hours]

Physical Tools

Introduction, Interaction between particles & Matter, brief survey, Detectors for Nuclear particles (i) Proportional counter (ii) The Geiger counter (iii) Scintillation counter (iv) Solid state or semi-conductor detectors (v) Cloud & Bubble chambers (vi) Spark chamber

Particle Accelerators

Need for an accelerator of charged particles, (i) Van de Graff Generator (ii) The cyclotron (iii) Synchrotron (iv) The Betatron; Beta ray spectrometer

Reference book:

1. Nuclear physics, An introduction by S. B. Patel, New Age International (P) Ltd.
Article Nos.: 1.1.1 to 1.1.5
2. Nuclear Physics by D.C. Tayal, Himalaya Publishing House.

UNIT – III: SOLID STATE PHYSICS [15 Hours]

The Crystalline State

Crystalline, polycrystalline and glassy materials; Basis of crystal structure; Unit cell-Primitive cell structures; Symmetry operations- translation, point, hybrid operations; Classification of Crystal types-two dimensional crystal lattice and three dimensional crystal lattices; Indices of a lattice direction and a lattice plane (Miller indices); Crystal point groups and space groups, space groups, space groups; Common crystal structures, simple cubic structure, BCC, FCC, closed packed and hexagonal close-packed structure, diamond structure

Reciprocal Lattice and Crystal Diffraction

Reciprocal lattice; Bragg Law, Laue‟s interpretation of X-ray diffraction by crystals, Construction of reciprocal lattice, Relationship between a, b, c and a*, b*, c*

Reference Book:

1. Elements of Solid State Physics (2nd Edition) by J. P. Srivastava, PHI Learning Private

limited.
Art No. 1.1 to 1.7, 3.1 to 3.5

2. Solid State Physics (6th Edition) by S.O. Pillai, New Age International Publishers.
3. Solid State Physics (4th Edition) by S.L Kakani & C. Hemrajani, Sultan Chand & Sons.
4. Introduction to Solid State Physics (7th Edition) by C. Kittle, Wiley (India).

UNIT – IV: ELECTRONICS [15 Hours]

Basic Characteristics of the Transistor

Basic Transistor amplifier, Two diode analogy for a transistor, Transistor input characteristics, Transistor collector characteristics, collector cut off current ICEO, Forward current transfer ratio CE , Permissible operating area of a transistor CE, The basic common base amplifier, CB, Forward current transfer ratio CB, relation between and β, collector cut off current ICBO, physical explanation of CB and CE amplifying action, reduction of CE leakage current to ICO, common collector amplifier, identifying the transistor leads

The Common Emitter Amplifier

Graphical analysis of CE class A amplifier, input and output resistance, effect of adding a class A amplifier, conversion efficiency of class A amplifier with a direct coupled resistive load, phase relationship in CE amplifier, input waveform consideration, comparison of basic transistor amplifier

Solid State Electronics Devices

Zener diode, Zener diode specification, the voltage regulator circuit, design of a voltage regulator circuit, effect of supply voltage variation, Zener break down mechanism, the Tunnel diode, application of Tunnel diode, Introduction of Silicon controlled rectifier and Uni junction transistor

Reference Book:

1. Electronics Devices and Circuits By Allen Mottershed, PHI Learning private limited.
Article no, 9.1 to 9.15, 9.18, 11.1 to 11.6, 11.9, 6.1 to 6.6, 6.11, 6.12, 28.1, 28.5
2. Electronic Principles (7th Edition) by Albert Malvino & David J. Bates, TMcGHill Pub.
3. Electronic Devices and Circuits by Sanjeev Gupta, Dhanpatrai & Sons.

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Effective from June 2024
DSC-C-PHY-232T (4 Credit)

Mathematical Physics, Classical Mechanics, Modern Physics and Wave Optics

Learning objectives

To enable learners to understand

- Fourier series and its applications in various fields of Physics and Electronics
- detailed theory of planetary motions and collisions
- basic concepts of quantum mechanics
- diffraction phenomenon in wave optics and its applications

Learning outcomes

On successful completion of the course, the learners would gain detailed understanding of

- the knowledge of Fourier series to analyse different types of waveforms
- the general features of motion, Kepler's laws of planetary motion, elastic and inelastic scattering
- black body radiation, Frank-Hertz experiment, Compton effect and comprehend the knowledge of historical origin of quantum mechanics
- Fresnel and Fraunhofer diffraction, diffraction grating and importance of resolving power of optical instruments

UNIT – I: MATHEMATICAL PHYSICS **[15 Hours]**

Fourier Series

Introduction, Simple Harmonic motion & wave motion – Periodic functions, Applications of fourier series, Average value of a function, Fourier co-efficients, Dirchlet conditions, complex form of fourier series, other intervals, Even & odd functions, Parsevel‟s theorem, Applications/Numericals on Fourier series

Reference Book:

1. Mathematical Methods in Physical Sciences by Mary L. Boas (John Willey & Sons). Article Nos.: 7.1 to 7.8. 7.11
2. Mathematical Physics by H.K. Das, S. Chand Publishing Co.
3. Mathematical Physics by Satya Prakash, Pragati Prakashan.

UNIT – II: CLASSICAL MECHANICS [15 Hours]

Motion in a Central Force Field

General features of the motion, Motion in an inverse square law force field, Equation of the orbit, Kepler‟s laws of planetary motion

Collision of Particles

Elastic & inelastic scattering, Elastic Scattering: Laboratory & Centre of mass system, Kinematics of elastic scattering in the laboratory system, inelastic scattering, cross-section, The Rutherford formula

Reference Book:

1. Classical mechanics by R.G. Takewale & P.S. Puranik, Tata McGraw Hill.
Article Nos.: 5.2 to 5.6, 7.1 to 7.6

UNIT – III: MODERN PHYSICS AND ELEMENTARY QUANTUM MECHANICS

[15 Hours]

Historical Origins of Quantum Theory

Difficulties with Classical: models, optical spectra Black body radiation, Frank- Hertz experiment, Stationary states of atoms. The correspondence principle, Bohr atom, Spectroscopic series, Quantization of the orbits. The Elliptic Orbits, Particle in a box, rigid rotator, Harmonic oscillator, Compton effect, particle diffraction, Wave packets and Einstein De Broglie relation

The Schrodinger Equation and Stationary States

A free particle in one dimension, Generalization to three dimensions, Operator correspondence and the Schrodinger equation for a particle subjected to force, Physical Interpretation of wave function, Normalization, Non normalizable wave functions and box normalization, conservation of probability

Reference book:

1. Quantum Mechanics by Powel and Crasemann, Addison and Wesley
Articles no: 1.1, 1.2, 1.3, 1.5, 1.7 to 1.10, 1.12 to 1.16, 2.1, 2.2, 2.7
2. A textbook of Quantum Mechanics, P.M. Mathews, K. Vankatesan
Article no: 2.1 to 2.6
3. Concept of Modern Physics by Arthur Beiser, Tata McGraw Hill Edition
4. Principles of Modern Physics by A.K. Saxena, Narosa Publishing House
5. Modern Physics by Kenneth Krane, Jon Wiley & Sons

UNIT – IV: WAVE OPTICS **[15 Hours]**

Diffraction of Light

Fresnel class

Frensnel's half period zones, zone plate, difference between interference & diffraction.

Fraunhofer Class

Fraunhofer diffraction at two slits, diffraction at N slits, Plane diffraction grating, Dispersive power of grating, Grating at oblique incidence

Resolving Power of Optical Instrument

Resolving power, Rayleigh's criterion of resolution, resolving power of telescope, relation between magnifying power & the resolving power of telescope, resolving power of a plane diffraction grating, difference between resolving power & dispersive power of grating, comparison of prism & grating spectra

Reference Book:

1. Optics & atomic physics by Singh, Agrawal (Pragati Prakashan, Meerat)
Article Nos.: 7.3, 7.5, 8.6 to 8.8, 8.15, 8.16, 9.1 to 9.4, 9.8 to 9.10
2. Optics by Ajay Ghatak, Tata McGraw Hill Ltd.
3. A Textbook of Optics by N. Subrahmanyam *&* Brij Lal (S. Chand & Company Ltd.)

GUJARAT UNIVERSITY
Syllabus for Second Year B.Sc.: Semester – III
Effective from June 2024
DSC-C-PHY-233P (4 Credit)
General Physics, Optics and Electronics
[120 Hours]

Course objectives

To enable the learners to

- understand the physical phenomena and fundamentals of general physics
- perform experiments in the field of general physics and electronics
- interpret the practical results to corroborate the theory

Course outcome

After successful completion of course learners will

- develop the ability to analyse the basic experiment
- conduct experimental investigation on mechanical, electrical and optical physics.
- be familiar with basic electronic circuits and solid state devices
- corelate the theory and experimental results
- practice recording of experimental work and data graphing

Group A:

1. Y-by Koening's method.
2. Wavelength of prominent spectral lines by diffraction grating.
3. Flatness of plate by Newton's ring.
4. Resolving power of telescope.
5. Wavelength of light using Hartmann formula.
6. Study of electron diffraction pattern.
7. Resonance pendulum.
8. To understand the excel for data analysis and graph plotting.
9. Study of X ray diffraction.
10. Optical lever.
11. Cauchy constant.
12. Thickness of wire using optical bench.

Group B:

1. Figure of Merit of a mirror galvanometer.
2. C1/C2 by Desauty's method.
3. Zener diode as a voltage regulator.

4. h-parameters of CE transistor.
5. UJT.
6. Load line and determination of Q point for BJT.
7. L by Maxwell's bridge.
8. To find band gap of semiconductor material
9. To find the Planck's constant using LED
10. Characteristics of solar cell
11. Fourier Analysis
12. e/K by power transistor

Reference book:

1. Advanced practical physics for students by Worsnop and Flint
2. B. Sc. Practical Physics by C. L. Arora; S. Chand Publication
3. Practical Physics by G. L. Squires.
4. Practical Physics by Gupta and Kumar; Pragati Prakashan