

Gujarat University
Ahmedabad

B. Sc. Semester – IV
Syllabus for Physics Theory & Practical
(Effective from June ‘2018)

Unit	Physics Theory PHY – 204	Physics Theory PHY – 205	Physics Practical PHY – 206
	4 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks	4 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks	2.5 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks
Unit – I	Solid State Physics	Sound & Optics	A, B & C three groups : Each group consists of 06 experiments. Total 18 experiments. External Examination: 70 Marks Group A : 23 Marks Group B : 23 Marks Group C : 24 Marks Practical batch size: Maximum 15 students.
Unit - II	Heat & Thermodynamics	Statistical Mechanics	
Unit - III	Electronics	Special Theory of Relativity & Quantum Mechanics	
Unit - IV	Atomic Spectroscopy	Quantum Mechanics	

In order to give exposure of industry, research institute and higher learning in the field of Physics,

Industrial / Institutional visit may be arrange. It is expected that students of SEM-III & IV with Physics as one of the subject must visit the Industry / Research Institute / Institute of higher learning during either III or IV semester.

GUJARAT UNIVERSITY
B. Sc. (PHYSICS) Semester – IV
PHYSICS : PHY – 204
(4 Credit)

UNIT – I: Solid State Physics

A. Lattice Vibrations : Harmonic crystals : the “Ball & strings” model; Normal modes of one dimensional monoatomic lattice, periodic boundary condition, concept of the first Brioullin zone, salient features of the dispersion curve; Normal modes of one dimensional diatomic lattice, salient features of the dispersion curves, optical and acoustical mode; Quantization of lattice vibrations-phonons; Measurement of phonon dispersion by inelastic neutron scattering.

B. Thermal properties : Classical lattice heat capacity Quantum theory of lattice heat capacity, Einstein model, phonon density of states; Debye continuum model; Anharmonic effects, Thermal expansion, Gruneisen parameter; Phonon collision processes, Phonon thermal conductivity.

Text book: Elements of Solid State Physics (2nd Edition) by J. P. Srivastava, PHI Learning

For A - Chapter 4: Article Nos. : 4.1, 4.2, 4.2.1, 4.2.2, 4.3, 4.3.1, 4.7, 4.8

For B - Chapter 5: Article. Nos. : 5.1, 5.2, 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.3, 5.3.1, 5.3.2, 5.3.3

Reference Books:

1. Solid State Physics (6th Edition) by S.O. Pillai, New Age International Publishers

2. Solid State Physics (4th Edition) by S.L Kakani & C. Hemrajani, S. Chand & Sons

3. Introduction to Solid State Physics (7th Edition) by C. Kittel, Wiley (India)

UNIT - II: Heat and Thermodynamics

Entropy: Reversible part of the second law (Clausius theorem), Entropy, Principle of increase of entropy, TS diagram, Application of the Entropy principle.

Pure substances: Volume expansivity: Cubic Expansion coefficient, Compressibility.

Mathematical methods in thermodynamics: Characteristics functions, Enthalpy, Helmholtz & Gibb's functions, two mathematical theorems, Maxwell's relations, Tds equations, Internal energy equations, Heat Energy equations, Heat capacity equations.

Open Systems: Joule-Thomson expansion, Liquefaction of gases by the Joule-Thomson expansion

Text book: Heat & Thermodynamics by Mark W. Zemansky and R.H. Dittman, McGraw Hill, Int. Edition (7th edition)

Article Nos. : 8.1, 8.2, 8.5, 8.11 and 8.12, 9.6, 9.7, 10.1 to 10.8, 11.1, 11.2

Reference books: Thermal Physics by A. B. Gupta, H. P. Roy (New central Publication)

UNIT - III: Transistor Circuits

Transistor Biasing: Factors contributing to thermal stability, effect of temperature increase, stability factor S , common base stability, collector to base bias, disadvantage of collector to base bias, emitter bias, voltage divider bias with emitter bias, emitter bypass capacitor, summary of stabilization circuit, additional stability factors, bias compensation

Hybrid equivalent circuit for a transistor: conversion of a transistor to a standard form, general Black box theory, Hybrid 'h' parameters, obtaining the hybrid h parameters, typical h parameter value, Amplifier equation, voltage and current gains taking into account R_g of source, dependence of amplifier characteristics on R_L and R_g , comparison of CB, CC and CE

Text book: Electronics Devices and Circuits By Allen Mottershed, PHI
Article no. 12.1 to 12.12, 14.1 to 14.10

Number system: Binary number system, Binary to decimal conversion, decimal to binary conversion, Hexadecimal numbers, ASCII codes, The Excess 3 code, Gray code

Text Book: Digital principle and Application By Malvino, Leach and Saha (6th edition)
Article no. 5.1 to 5.3, 5.5 to 5.8

Reference Books: Electronic Principles (7th Edition) by A. Malvino & D.J. Bates, TMcGhill Pub.
Electronic Devices and Circuit Theory (8th Edition) by Robert Boylestad and L. Nashelsky, PHI
Fundamentals of Digital Circuits by A. Anandkumar, PHI (2nd Edition)

UNIT – IV: Atomic Spectroscopy

Hydrogen atom spectrum, Orbital magnetic moment of hydrogen, Larmor precession, Stern-Garlach experiment, Electron spin, The vector atom model, Spin-orbit interaction and fine structure, Pauli's exclusion principle and electronic configuration, Total angular momentum in many electron atoms, L-S coupling, j-j coupling, Hund rules, Energy levels and transitions of Helium, Alkali spectra, Shielding of core electrons, Spectral terms of equivalent electrons, Normal Zeeman effect, experimental arrangement and theory, Anomalous Zeeman effect, Paschen-Bach effect, Stark effect, Characteristics X-ray spectrum, Moseley's law, Width of spectral lines.

Text Book: Modern Physics by G. Aruldas and P. Rajagopal, PHI Learning Pvt. Ltd.

Article Nos. : 7.1 to 7.19

Reference books:

1. Principles of Modern Physics by A. K. Saxena, Narosa Publishing House
2. Modern Physics (2nd Edition) by Kenneth Krane, John Wiley & Sons
3. Atomic & molecular spectra by Rajkumar, Kedarnath Ramnath Prakashan Meerut

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PHYSICS : PHY - 205

UNIT – I: Sound and Optics

Sound: Architectural Acoustics, Sabine's formula, Reverberation time-theoretical treatment, Reverberation time of a live room, Reverberation time of a dead room, optimum reverberation time.

Text book: A textbook on oscillations, waves & acoustics by M. Ghosh, D. Bhattacharya, S. Chand Publishers

Article Nos. : 24.1 to 24.5

A. Polarization of light & double refraction : Plane polarized light, pictorial representation of light vibrations, method to produce plane polarized light (only names), double refraction or birefringence, geometry of calcite crystal, Optical axis principal section & principal plane, Nicol prism, Parallel & Crossed Nicol prism, Huygen's theory of double refraction in uniaxial crystals, refractive indices for o-rays & e-rays, Polaroids.

B. Production & Analysis of Polarized light : Introduction, superposition of two plane polarized waves having perpendicular vibrations, The elliptically & circularly polarized light, quarter wave plate, half wave plate, production of plane elliptically & circularly polarized light, detection of plane elliptically & circularly polarized light, systematic analysis of polarized light

Text Book: Optics & atomic physics by Singh, Agrawal (Pragati Prakashan, Meerat)

For A: Article Nos. : 10.2 to 10.4, 10.9 to 10.12, 10.14 to 10.16, 10.18, 10.21

For B: Article Nos. : 11.1 to 11.17

Reference book:

1. Optics by Ajoy Ghatak, Tata McGraw Hill Ltd.

2. A Textbook of Optics by N. Subrahmanyam & Brij Lal (S. Chand & Company Ltd.)

UNIT - II: Statistical Mechanics

Macroscopic and microscopic states: Macroscopic states, Microscopic states, Phase spaces, μ -space, Γ -space, Postulate of equal a priori probabilities, Ergodic hypothesis, Density distribution in phase space, Liouville's theorem, Principle of conservation of density in phase and principle of conservation of extension in phase, Condition for statistical equilibrium,

Statistical ensemble: Microcanonical ensemble, Canonical ensemble, Mean value and fluctuations, Grand canonical ensemble, Fluctuations in the number of particles of a system in a grand canonical ensemble.

Some applications of Statistical mechanics: Thermodynamics, Statistical interpretation of basic thermodynamic variables, Ideal gas, Gibbs paradox, the equipartition theorem

Text books: Fundamentals of Statistical Mechanics by B.B. Laud, New Age International Publishers

Article Nos.: 4.1 to 4.11, 5.1, 5.2, 5.4, 5.5, 5.7, 6.3, 6.4, 6.8 to 6.10

Reference books:

1. Statistical Mechanics An Introduction by Evelyn Guha, Narosa Publications

2. Introduction to Statistical Mechanics by S. K. Sinha, Narosa Publication
3. Fundamentals of Statistical and Thermal Physics by F. Reif, McGraw Hill Book Co.

UNIT – III: Relativity

Relativity: Postulates of Special Relativity, Time Dilation, Doppler Effect, Length Contraction, Twin Paradox, Electricity and Magnetism, Relativity of mass, Mass and Energy, Massless Particles, Lorentz Transformation, Velocity addition, Michelson-Morley Experiment.

Text Book: Concepts of Modern Physics by Arthur Beiser, 4th edition, McGraw Hill Pub. Co.

Chapter 1: Articles Nos.: 1.1 to 1.11, Appendix – I

Reference books:

1. Modern Physics by R. Murugesan and K. Sivaprasath, (S. Chand & Company Ltd.)

UNIT – IV: Quantum Mechanics

Expectation values: Ehrenfest's Theorem, Admissibility conditions on the wave functions, stationary states : The time dependent Schrodinger equation, A particle in a square well potential, bound states in a square well ($\epsilon < 0$) (a,b,c,d), The square well : Nonlocalized states ($E > 0$), square potential Barrier

Text Book: A Textbook of Quantum mechanics by PM Mathews & K. Venkatesan, Tata McGraw Hill

Chapter 2: Article Nos.: 2.7 to 2.14

General Formalism of wave mechanics: The Schrodinger equation & the probability interpretation for an N- particle system, the fundamental postulates of wave mechanics. The adjoint of an operator & self adjointness. The Eigen value problem, Degeneracy, Eigen values & Eigen functions of self- adjoint operators, The Dirac delta function, observables: Completeness & normalization of Eigen functions, closure, physical interpretation of Eigen values, Eigen functions & Expansion coefficients.

Text Book: A Textbook of Quantum mechanics by PM Mathews & K. Venkatesan, Tata McGraw Hill

Article Nos.: 3.1 to 3.9

Reference Books:

1. Quantum Mechanics by G. Aruldas, PHI Limited
2. Quantum Mechanics by H. C. Verma, Surya Publications
3. Quantum Mechanics- A text book for Undergraduates by Mahesh C. Jain, PHI Ltd.

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PHYSICS PRACTICAL: PHY – 206
(2.5 Credit)

Group A:

1. Searl's goniometer.
2. To study double refraction in calcite prism.
3. Resolving power of grating.
4. Diffraction by single slit.
5. Wavelength of light by Biprism.
6. Phonon dispersion relation of monoatomic lattice.

Group B:

1. FET Characteristics.
2. C by ballistic galvanometer.
3. Gray to binary code conversion.
4. High Resistance by leakage method.
5. To study the variation of I_c & V_{ce} with temperature in fixed bias circuit & collector to base bias circuit for CE configuration
6. To study the variation of I_c & V_{ce} with temperature in fixed bias circuit & potential divider circuit for CE configuration

Group C:

1. Identification of elements in line spectra.
2. Thevenin's maximum power theorem.
3. Analysis of elliptical polarized light using photocell.
4. Wavelength of light by Adser's A pattern.
5. L by Anderson's bridge.
6. Least Square Method.

A, B & C three groups: (Total 100 Marks: Internal 30 marks, External 70 Marks)

Each group consists of 06 experiments.

Total 18 experiments.

External Examination: 70 Marks

Group A: 23 Marks

Group B: 23 Marks

Group C: 24 Marks

Practical batch size: Maximum 15 students.