Gujarat University
Ahmedabad

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

Unit	Physics Theory PHY – 201 4 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks	Physics Theory PHY – 202 4 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks	Physics Practical PHY – 203 2.5 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks
Unit – I	Solid State Physics	Mathematical Physics	A, B & C three groups : Each group consists of 06 experiments. Total 18 experiments. External Examination: 70 Marks Group B : 23 Marks Group C : 24 Marks Practical batch size: Maximum 15 students.
Unit – II	Electronics	Classical Mechanics	
Unit - III	Modern Physics and Elementary Quantum Mechanics	Nuclear Physics	
Unit - IV	Wave Optics	Dielectrics & Magnetostatic	

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 S. Y. B. Sc. 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 III
PHYSICS : PHY – 201
(4 Credit)

UNIT-I: Solid State Physics

A. 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.

B. 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*, Experimental Diffraction Methods, Laue method, Rotating crystal method, powder method, Determination of lattice constants; Selection of incident beam.

Text book: Elements of Solid State Physics (2 Edition) by J. P. Srivastava, PHI Learning
For A - Chapter 1. Art No. 1.1 to 1.7
For B - Chapter 3. Art. No 3.1, 3.2, 3.3, 3.4, 3.5, 3.8.2, 3.9, 3.10

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, Sultan Chand & Sons
3. Introduction to Solid State Physics (7th Edition) by C. Kittle, Wiley (India)

UNIT-II: Electronics

Basic characteristics of the Transistor: Basic Transistor amplifier, Two diode analogy for a transistor, Transistor input characteristics, Transistor collector characteristics, collector cut off current I_{CEO}, 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 α and β, collector cut off current I_{CBO}, physical explanation of CB and CE amplifying action, reduction of CE leakage current to I_{CO}, 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

Text Book: **Electronics Devices and Circuits By Allen Mottershed, PHI**
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

Reference Book: Electronic Principles (7^{th} Edition) by Albert Malvino & David J. Bates, TMcGHill Pub.
Electronic Devices and Circuits by Sanjeev Gupta, Dhanpatrai & Sons

UNIT- III: Modern Physics and Elementary Quantum mechanics

A. 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

Text book: Quantum Mechanics by Powel and Crasemann, Addison and Wesley
Articles Nos.: 1.1, 1.2, 1.3, 1.5, 1.7 to 1.10, 1.12 to 1.16, 2.1, 2.2, 2.7

Concept of Modern Physics, Arthur Beiser, TMH Edition

B. 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.

Text book: A textbook of Quantum Mechanics, P.M. Mathews, K. Vankatesan
Article Nos. : 2.1 to 2.6

Reference books:
1. Concept of Modern Physics by Arthur Beiser, Tata McGraw Hill Edition
2. Principles of Modern Physics by A.K. Saxena, Narosa Publishing House
3. Modern Physics by Kenneth Krane, Jon Wiley & Sons

UNIT – IV: Wave Optics

A. Diffraction of Light (Fresnel class): Frensnel's half period zones, zone plate, difference between interference & diffraction,

B. Fraunhofer class: Fraunhofer diffraction at two slits, diffraction at N slits, Plane diffraction grating, Dispersive power of grating, Grating at oblique incidence.

C. 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.

Text Book: Optics & atomic physics by Singh, Agrawal (Pragati Prakashan, Meerat)
For A - Chapter 7. Article Nos. : 7.3 and 7.5
For B - Chapter 8. Article Nos. : 8.6 to 8.8, 8.15,8.16
For C - Chapter 9. Article Nos. : 9.1 to 9.4, 9.8 to 9.10

Reference Books:
1**.** Optics by Ajay Ghatak, Tata McGraw Hill Ltd.
2. A Textbook of Optics by N. Subrahmanyam & Brij Lal (S. Chand & Company Ltd.)

GUJARAT UNIVERSITY
B. Sc. (PHYSICS) Semester – III
PHYSICS : PHY – 202
(4 Credit)

UNIT - I: Mathematical Physics

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.

Text book: Mathematical Methods in Physical Sciences by Mary L. Boas (John Willey & Sons)
Article Nos. : 7.1 to 7.8. 7.11

Reference Book:
1. Mathematical Physics by H.K. Das, S. Chand Publishing Co.
2. Mathematical Physics by Satya Prakash, Pragati Prakashan

UNIT – II: Classical Mechanics

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

Text Book: 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: Nuclear Physics

A. 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.

Text book: Nuclear physics, An introduction by S. B. Patel, New Age International (P) Ltd.
For A - Chapter 1: Article Nos.: 1.1.1 to 1.1.5

Reference Book: 1. Nuclear Physics by D.C. Tayal, Himalaya Publishing House

UNIT – IV: Dielectrics & Magnetostatics

A. Electrostatics in dielectrics: Polarization, Laws of electrostatics field in presence of dielectrics, Energy of the field in the presence of a dielectric, Boundary conditions, Gaseous non polar dielectrics, Gaseous polar dielectrics, Non- polar liquids,

B. Magnetostatics: Magnetic effects, The magnetic field, force on a current, Biot Savart law, The laws of magnetostatics, the magnetic potentials, Magnetic dipole in non-uniform magnetic field, Magnetic vector potential due to a small current loop, Magnetic media, Magnetisation, Magnetic field vector, Magnetic susceptibility & permeability, Boundary conditions, Uniformly magnetized sphere in external magnetic field, A comparison of static electric & magnetic fields

Text Book: Electromagnetics by B. B. Laud, Willey Eastern Limited
For A - Chapter 2: Article Nos. : 2.7 to 2.13
For B - Chapter 4: Article Nos. : 4.1 to 4.9, 4.11 to 4.20

Reference books:

1. Introduction to Electrodynamics by D. J. Griffith (3rd edition), PHI learning
2. Electromagnetic Theory & Electrodynamics by Satya Prakash,
Kedar Nath Ram Nath, Meerut

GUJARAT UNIVERSITY
B. Sc. (PHYSICS) Semester – III

PHYSICS PRACTICAL : PHY – 203
(2.5 Credit)

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. Numerical Study of Oscillatory Motion.
6. Wavelength of light using Hartmann formula.

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.

Group C:

1. Absorption coefficient of liquid using photocell.
2. Study of electron diffraction pattern.
3. Resonance pendulum.
4. Fourier Analysis.
5. L by Maxwell's bridge.
6. Liquid Lens.

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.

Gujarat University
Ahmedabad

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

Unit	**Physics Theory PHY – 204** **4 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks**	**Physics Theory PHY – 205** **4 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks**	**Physics Practical PHY – 206** **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	

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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 inelestic 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. Kittle, 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 expansitivity: 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, Liquefication 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 Rg 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 (6^{th} 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 (2^{nd} 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. Aruldhas 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 (2^{nd} Edition) by Kenneth Krane, John Wiley & Sons
3. Atomic & molecular spectra by Rajkumar, Kedarnath Ramnath Prakashan Meerut

GUJARAT UNIVERSITY
B. Sc. (PHYSICS) Semester – IV
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. Murugeshan 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 ($\varepsilon < 0$) (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 McGrew 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 McGrew Hill
Article Nos.: 3.1 to 3.9

Reference Books:
1. Quantum Mechanics by G. Aruldhas, 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.

GUJARAT UNIVERSITY
B. Sc. (PHYSICS) Semester – IV

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 Ic & Vce with temperature in fixed bias circuit & collector to base bias circuit for CE configuration
6. To study the variation of Ic & Vce 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.