Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
Syllabi for Physics Theory & Practical

From Academic year 2019 – 2020

Unit	Physics theory PHY – 301 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics theory PHY – 302 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics theory PHY – 303 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics theory PHY – 304 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics Subject Elective PHY – 305 2 Credit Total Marks 100 Internal 30 Marks External 70 Marks 3 hrs/Week	Physics Practical PHY – 306 5 Credit Total 200 Marks Internal 60 Marks External 140Marks 12 hrs/Week
I	Mathematical Physics	Molecular Spectra	Electromagnetism	Electronics	Student has to select one subject elective course from the University approved subject elective courses	There are A, B, C & D Four groups. Each group consists of 5 experiments. Total 20 experiments.
II	Mathematical Physics	Molecular Spectra	Electromagnetism	Electronics		
III	Classical Mechanics	Statistical Mechanics	Nuclear Physics	Electronics		
IV	Quantum Mechanics	Solid State Physics	Nuclear Physics	Electronics		

In order to give exposure of industry, research institute and higher learning in the field of physics, industrial visit may be arranged. It is expected that students of B.Sc. (PHYSICS) Semester – V & VI must visit industry / research institute / institute of higher learning.

College can also offer (Student can also select) subject elective course from the subject electives of Electronics Science Semester – V & VI.

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY – 301: MATHEMATICAL PHYSICS, CLASSICAL MECHANICS & QUANTUM MECHANICS
(4 Credit: 4 hrs/week)

Unit – I: Differential equations:
Some partial differential equations in physics, the method of Separation of variables, separation of Helmholtz equation in Cartesian coordinates, in spherical polar and cylindrical Coordinates, Laplace's equation in various coordinates, Choice of coordinate system and separability of a partial differential equation, Parabolic coordinates system, Prolate Spheroidal coordinates system, various examples based on the separation of variables.

Unit – II: 2nd order differential equations:
Ordinary and Singular points, Series solution around an ordinary point, Series solution around a regular singular point: the method of Frobenius, Getting a second solution, Alternative method of getting the second solution, System of linear first order differential equations, Non-linear differential equations, related examples.

Text Book: Mathematical Physics by P.K. Chattopadhyay, New Age International Publishers (2006)
Article Nos.: Chapter 2: 2.1, 2.2 (A – E), 2.3, A.3 (3, 4) Chapter 3: 3.1 to 3.7 including examples.
Reference Book: 1. Mathematical Methods for Physicists by G. Arfken, Academic Press
2. Mathematical Methods in the Physical Sciences by Mary L. Boas, Wiley India Pvt. Ltd.

Unit – III: Classical Mechanics:
Lagrangian Formulation:
Introduction, Constraints, holonomic and non-holonomic constraints, scleronomous and rheonomous constraints, generalized coordinates, D'alembert's principle, Lagrange's equations, a general expression for kinetic energy, Symmetries and the laws of conservation, Cyclic or ignorable coordinates (including illustrations), Velocity dependent potential of electromagnetic field, Rayleigh's dissipation function.

Moving Co-ordinate System: Rotating co-ordinate system, The Coriolis force, Motion on the earth, Effect of Coriolis force on freely falling particles.

Text Book: Introduction to Classical Mechanics by R. G. Takawale and P. S. Puranik, Tata McGraw-Hill Publishing Co. Ltd.
Article Nos.: Chapter 8: 8.1 to 8.9; Chapter 9: 9.2 to 9.5;
Reference Book: 1. Classical Mechanics by A. B. Bhatia, Narosa Publication.
2. Classical Mechanics by H. Goldstein, Addison Wesley.
3. Classical Mechanics by J. C. Upadhyaya, Himalaya publications

Unit – IV: Quantum Mechanics: Exactly soluble Eigenvalue problems
General Formalism of wave mechanics:

The uncertainty principle, states with minimum value for uncertainty product, Commuting observables, Removal of Degeneracy, Evolution of system with time, constants of the motion, Non- interacting & interacting systems, systems of identical particles.

Introduction, the simple harmonic oscillator, the Schrödinger equation and energy eigenvalues, the energy eigenfunctions, properties of stationary states, the abstract operator method, the angular momentum operators, the eigenvalue equation for L^2, separation of variables, admissibility conditions on solutions, eigenvalues, the eigenfunctions, Spherical harmonics, Physical interpretation, Parity.

Text Book: A Text Book of Quantum Mechanics by P. M. Mathews and K. Venketeshan, Tata McGraw-Hill Publishing Co. Ltd.
Article Nos.: Article Nos.: Chapter 3: 3.11 to 3.16, Chapter 4: 4.1 to 4.4, 4.6 to 4.11
Reference Book: 1. Quantum Mechanics: Theory and Applications by A. Ghatak and S. Lokanathan, Macmillan India Limited.
2. Quantum Mechanics by F. Schwabl, Narosa Publishing House
3. Quantum Mechanics by G. Aruldhas, PHI

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY – 302: MOLECULAR SPECTRA, STATISTICAL MECHANICS & SOLID STATE PHYSICS
(4 Credit: 4 hrs/week)

Unit – I:

Types of Molecular Spectra and Molecular Energy States: Separation of electronic and nuclear motion - The Born Oppenheimer approximation, types of molecular spectra.

Pure Rotational Spectra: Salient features of Rotational spectra, Molecular requirement for rotation spectra, experimental arrangement, Molecule as a rigid rotator, explanation of rotational spectra (without the process of solving Schrodinger equation to get energy formula), the non-rigid rotator, Isotope effect on rotational spectrum, tunable laser and pulse laser - introduction

Vibrational - Rotational Spectra: salient features of vibrational - Rotational spectra, Molecule as a harmonic oscillator, Molecule as anharmonic oscillator, Vibrational frequency and force constant for anharmonic oscillator, Fine structure of Infrared bands: Molecule as vibrating rotator, Diatomic molecule as symmetric top, Thermal distribution of vibrational and rotational levels.

Unit – II:

Raman Spectra: Nature of the Raman spectra, experimental arrangement for Raman spectra, Classical theory of Raman effect, Quantum theory of Raman effect, Raman spectra and Molecular structure, Infrared spectra versus Raman spectra, Laser as intense source.

Classification of Molecular Electronic States: Molecular electronic states, Symmetry properties of electronic eigenfunctions (symmetry classification of electronic states)

Fluorescence and Phosphorescence: Luminescence, Mechanism of fluorescent emission, Mechanism of phosphorescent emission, Fluorescence spectrum compared with Raman spectrum.

Text Book: Atomic and Molecular Spectra: Laser by Rajkumar, Kedar Nath & Ram Nath

Article Nos: Chapter 17: 1, 2, Chapter 18: 1 – 6, Chapter 19: 1 – 4, 6 – 8, Chapter 20: 1 – 6, Chapter 23: 1 – 4, Chapter 24: 1,2

Unit – III:

Formulation of Quantum Statistics: Density matrix, Liovilles theorem in Quantum Statistical Mechanics, Condition for Statistical equilibrium, Ensemble in Quantum Mechanics, Problems

Bose Einstein and Fermi Dirac Distributions: Symmetry of wave functions, the Quantum Distribution functions, the Boltzmann limit of Boson and Fermions Gases, Evaluation of the Partition function, Partition function for Diatomic Molecules (a) translation partition function (b) rotational partition function (c) vibration partition function (d)electronic partition function Equation of state for an Ideal gas, The quantum mechanical Para magnetic susceptibility, problems

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

Article Nos.: 7.1 – 7.4, 8.1 – 8.7

Reference Book:

1. Statistical Mechanics - Theory and Application by S K Sinha, TMH Publishing Company Limited New Delhi:
2. Statistical Mechanics - An introduction by Evelyn Guha, Narosa publication.
3. Statistical Mechanics by R.K. Patharia, Pergamon Press
4. Statistical Mechanics by B.K. Agarwal & Melvin Eisner, Wiley Eastern

Unit – IV: Solid State Physics

Elastic constants and elastic waves: Analysis of elastic strains, Dilation, stress components, Elastic compliance and stiffness constants, Elastic energy density, elastic stiffness constants of cubic crystals, Bulk modulus and compressibility. Elastic waves in cubic crystals, waves in the [100] direction, waves in the [110] direction and waves in the [111] direction.

Free electron Fermi gas: Introduction, Energy levels in one dimension, Effect of temperature on the Fermi-Dirac distribution, Free electron gas in three dimensions and density of states, Heat capacity of the electron gas and experimental heat capacity of metals, Electrical conductivity and ohm's law, Experimental electrical resistivity of metals, Thermal conductivity of metals, ratio of thermal to electrical conductivity.

Text Book: Introduction to Solid State Physics by C. Kittel, (Eight Edition) John Wiley and Sons.

Article Nos.: Chapters 3 & 6

Reference book:

Elements of Solid State Physics by J. P. Srivastava, Prentice-Hall of India Private Limited, New Delhi

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY- 303: Electromagnetism and Nuclear Physics
(4 Credit: 4 hrs/week)

Unit – I:

Electromagnetic induction: Hysteresis, Maxwell's equations, Decay of free charge, Potentials of electromagnetic fields, More about the Lorentz gauge condition, Field energy and Field momentum.

Electromagnetic waves: Plane waves in non-conducting media, Polarizations, Energy flux in a plane wave, Radiation pressure and Momentum, Plane waves in conducting medium, Skin effect.

Unit – II:

Electromagnetic Radiation: Retarded Potential, Radiation from an oscillating dipole, Linear Antenna, Lienard-Wiechert Potentials, Potentials for a charge in uniform motion – Lorentz formula, Fields of an accelerated charge, Radiation from an acceleration charged particle at low velocity, Radiation when the velocity and acceleration of the particles are collinear, Radiation from a charged particle moving in a circular orbit, Elective quadrupole radiation.

Text Book: Electromagnetics by B. B. Laud, 2nd Edition, Wiley Eastern Ltd.
Article Nos.: 5.7 - 5.12, 6.1 - 6.6
Article Nos.: 9.1 – 9.10

Unit – III: Alpha and Beta Rays:

Alpha Rays: Range of alpha particles, Disintegration energy of the spontaneous alpha decay, Alpha decay paradox - barrier penetration.

Beta Rays: Introduction, Continuous Beta ray spectrum - difficulties encountered to understand it, Pauli's Neutrino Hypothesis, Fermi's theory of Beta decay, the detection of neutrino, Parity non-conservation in Beta decay.

Unit – IV: Gamma Rays and The liquid drop model of the nucleus:
Gamma Rays: Introduction, Gamma-ray emission – selection rules, Internal conversion, Nuclear isomerism.

The liquid drop model of the nucleus: Introduction, Binding energies of nuclei: plot of B/A against A., Weizsacher's semi empirical mass formula Mass parabolas: prediction of stability against Beta decay for members of an isobaric family, Stability limits against spontaneous fission, Barrier penetration - decay probabilities for spontaneous fission, Nucleon emission.

Text Book: Nuclear Physics - An Introduction by S.B. Patel, New Age International. Article Nos.: 4 – II - 1 to 4 – II - 3, 4 – III - 1 to 4 – III - 6, 4 – IV - 1 to 4 – IV - 4, 5.1 to 5.7

Reference books:

1. Introduction to Nuclear Physics by H.Enge, Addison Wesley
2. Nuclear Physics by D. C. Tayal, Himalaya Publisher
3. Nuclear Physics by Irvin Kaplan
4. Modern Physics by Kenneth Krane, John Wiley and sons.

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY – 304: Linear & Non-Linear Electronics circuits
(4 Credit: 4 hrs/week)

UNIT – I: General amplifier characteristics:

Introduction, concept of amplification, amplifier notations, current gain, voltage gain, power gain, amplifier input resistance, amplifier output resistance, maximum power transfer, conversion efficiency, classes of amplifier operation, harmonic distortion, three point method of calculating harmonic distortion, five point method of calculating harmonic distortion, oscilloscope display of an amplifier dynamic transfer curve, measurement of harmonic distortion, other types of amplifier distortion, decibels, other equations for decibel computation, zero dB reference level, use of voltmeter as dB indicator, voltmeter range correction factor, impedance correction factor, frequency response curves, amplifier bandwidth, phase relationship in amplifier square wave testing.

Text Book: Electronic Devices and circuits – An Introduction by Allen Mottershead, Printice-Hall of India Private Limited
Article Nos. 7.1 - 7.16, 8.1 - 8.8, 8.10, 8.11

UNIT – II: Frequency response of a transistor amplifier:

Low frequency response of a transistor amplifier:
Effect of an emitter by pass capacitor on low frequency response, effect of coupling capacitor on low frequency response, cascading of CE stages, mid frequency gains, low frequency response of cascaded stages amplifier, low frequency response to a square wave, transformer coupled transistor amplifier, low frequency response of TC amplifier, step response of a TC amplifier.

High frequency response of a transistor amplifier:
High frequency model for a CE amplifier, approximate CE high frequency model with a resistive load, CE short circuit current gain, high frequency current gain with a resistive load, high frequency response of cascaded CE stages, amplifier high frequency response to a square wave high frequency response of a transformer coupled amplifier.

Text Book: Electronic Devices and circuits – An Introduction by Allen Mottershead, Printice-Hall of India Private Limited
Article Nos.: 15.1 – 15.8, 16.1 – 16.7

UNIT – III: Circuit analysis, design and Flip-Flop:
Circuit analysis and design:
Boolean laws and theorems, sum of products method, truth table to Karnaugh map, pairs, quads and octets, Karnaugh simplification, don't care conditions, product of sums method, product of sums simplification, Exclusive OR gate.

FLIP- FLOP:
RS flip flop, clocked RS flip flop, D flip flop, Edged triggered D flip flop, JK flip flop, JK master slave flip flop
Book recommended: Digital Principles and Applications by Malvino and Leach Article Nos.: 2.1 - 2.8, 3.7

UNIT – IV: Network Transformations:
Reduction of complicated network, conversion between T and π sections, bridge T network, the lattice network, superposition theorem, the reciprocity theorem, thevenin's theorem, Norton theorem, maximum power transfer theorem, compensation theorem.

Resonance: Definition of Q, the figure of merit, series resonance, Bandwidth of the series resonant circuit, parallel resonance or antiresonance, current in antiresonant circuits, Bandwidth of antiresonant circuits.

Text Book: Network Lines and Field by J D Ryder. (1.4 to 1.13, 2.1 to 2.4, 2.6, 2.8)
Reference Books: 1. Network Analysis by M. S. Van Valkenburg,
2. Network Analysis by G K Mithal

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY – 305: SEC_A: Nanoscience and nanotechnology
(2 Credit: 3 hrs/week)

Unit – I: Introduction to Nanomaterials:

Introduction to nano-sized materials and structures, Definitions of nanomaterials, Brief history of Nanomaterials and challenges in Nanotechnology, Properties of Nanomaterials: Effect of reduction of dimensions, quantum size effects, Mechanical, Thermal, Optical and Magnetic properties of nanomaterials

Unit – II: Methods of Synthesis of Nanomaterials:

Bottom-up and Top-down approaches - Mechanical method: High Energy Ball Milling, Methods based on evaporation (Physical Vapour Deposition), Chemical Vapour Deposition, Chemical Methods: Colloidal Method and Sol-gel Method

Special Nanomaterials:

Carbon Nanotubes (CNT), Types –Single walled, multiwalled CNT, Structures and properties of CNTs, Synthesis of carbon nanotubes

Unit – III: Analytical (Characterization) Technique:

Microscopes: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-ray diffraction

Applications: Electronics, Biotechnology and Medical, Automobiles, Space, Defense, Sports, Cosmetics, Cloth Industry.

Text Book:
Nanotechnology: Principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi.

Reference:

1. Introduction to Nanotechnology, C.P. Poole Jr. and F.J. Ownes, Wiley Publication.

2. Nanoscience and Technology eds. R. W. Kelsall, I.W. Hemley & M. Geoghehan, John Wiley and sons

3. Introduction to Nanoscience and nanotechnology by K.K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd. 2012

4. Origin and Development of Nanotechnology, P. K. Sharma, Vista International Publishing House

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY – 305: SEC_B: Atmospheric Science
(2 Credit: 3 hrs/week)

Unit – I: Introduction and Chemistry of Earth's atmosphere:

Evolution of earth's atmosphere, Nitrogen, hydrogen halogen, sulfur, carbon-containing compounds in the atmosphere, ozone and neutral chemistry, chemical and photochemical processes, Chemical and dynamical life time of atmospheric constituent. Eddy diffusion and Turbulence.

Unit – II: Ozone in the Atmosphere:

Evolution of the ozone layer, sources and sinks of tropospheric and stratospheric ozone, chlorofluorocarbons, ozone and UV-radiations, supersonic transport.

Unit – III: Atmospheric aerosols:

Concentration and size, sources, and transformation, Chemical composition, transport and sinks, residence times of aerosols, geographical distribution and atmospheric effects, Air Pollution: Sources of anthropogenic pollution, Emission Inventory, Atmospheric effects- smog, visibility. Measurements of Particulate matters, SOx, NOx and CO

Reference Books:

1. Introduction to Atmospheric Chemistry by P.V. Hobbs

2. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change by John H. Seinfeld, Spyros N. Pandis

3. Chemistry of the Upper and Lower Atmosphere by Barbara J. Finlayson-Pitts, Jr., James N. Pitts.

4. Chemistry of Atmospheres by Richard P. Wayne.

5. Basic Physical Chemistry for Atmospheric Sciences by P.V. Hobbs

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

PHY – 305: SEC_C: Object Oriented Programming: C++
(2 Credit: 3 hrs/week)

Unit – I: Introduction to Object Oriented Programming:

C++ fundamentals, Classes and Objects, Constructors and destructors, Inline functions, Friend functions and classes, Static class members: Static data members and member functions

Unit – II: Arrays, Pointers, References, Overloading Function and Operator

Array of objects, References, Pointers to objects, Function overloading, copy constructors and Default arguments, Creating a member Operator Function, Overloading new and delete

Unit – III: Exception handling and I/O system

Exception handling Fundamentals, Handling derived class exceptions, Streams and stream classes, Formatted I/O, Opening and closing files, Reading and writing text files

In addition to above content, student has to learn following exercise

1. Write a program to find average of two numbers.
2. Write a program to convert and display temperature in Fahrenheit to Celsius and vice versa.
3. Write a program to evaluate the following equation/series: Sin x= x-x^3/3!+x^5/5!-x^7/7!+…..
4. Write a program to input data and display with Class and Objects.
5. Write a program to add time data in hours and minutes format.
6. Write a program for arithmetic operator overloading.
7. Write a program for function overloading.
8. Write a program to display string:

Recommended Reference Books:

1. The complete reference C++: Herbert Schildt, TMH.
2. Object Oriented Programming in C++: Robert Lafore - Galgotia Publication.
3. C++: Effective Object Oriented Software Construction - Kayshav Dattari.
4. Object Oriented Programming using C++ - Addition Wesley.
5. Object Oriented Programming in C++ - Bala Guruswamy.

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

Physics Practical: PHY – 306

(5 credit: 12 hrs/week)

Total: 200 Marks
Internal: 60 Marks
External: 140 Marks

There are A, B, C & D four groups.
Each group consists of 5 experiments.
Total 20 experiments.

External examination 140 Marks

Group A: One Practical: 35 Marks: 3 Hrs

Group B: One Practical: 35 Marks: 3 Hrs

Group C: One Practical: 35 Marks: 3 Hrs

Group D: One Practical: 35 Marks: 3 Hrs

Practical batch size: Maximum 16 students

In order to give exposure of industry, research institute and higher learning in the field of physics, industrial visit may be arranged. It is expected that students of B.Sc. (PHYSICS) Semester – V & VI must visit industry/research institute / institute of higher learning.

Gujarat University
Ahmedabad

B. Sc. (PHYSICS) Semester – V
From Academic year 2019 - 2020

Physics Practical: PHY – 306

(5 credit : 12 hrs/week)

Total: 200 Marks
Internal: 60 Marks
External: 140 Marks

No	GROUP- A
01	Acceleration due to gravity by Kater's pendulum (fixed knife edges).
02	To determine melting point of a substance by platinum resistance thermometer using Callender-Griffiths bridge.
03	Characteristics of G.M. Tube.
04	Viscosity by Log decrement
05	Hall effect

No	GROUP- B
01	Refractive index by total internal reflection using Gauss eye piece.
02	Fabry-Perot etalon. Determination of the thickness of air film and wavelength of light using spectrometer.
03	Michelson interferometer. To determine the wavelength of monochromatic light.
04	To measure a threshold current of a LASER diode at room temperature.
05	An optical method of determining dielectric constant, dipole moment and polarizability of a polar liquid using Hollow prism

No	GROUP- C
01	Mutual Inductance by Ballistic Galvanometer
02	Determination of capacity of Schering Bridge
03	Determination of Curie temperature of ferroelectric ceramic
04	I -V Characteristics of Solar Cell and to determine fill-factor, voltage-factor and efficiency
05	Determination of unknown frequency using Wein Bridge

No	GROUP- D
01	Hartley Oscillator. Measurement of frequency by C.R.O. (Transistorized).
02	Series and parallel resonance. To find the band width and Q value of a coil.
03	Frequency response of CE amplifier
04	RS Flip flop using gates (IC 7400, 7402) and D Flip flop using IC 7474.
05	A.C. Circuit analysis by C.R.O. Measurement of frequency and phase difference

Reference Books:

1. Practical Physics by S.L.Gupta & V kumar
2. Advanced Practical Physics I & II by S.P.Singh, Pragati prakashan vol. 1 & 2.
3. B.Sc. Practical Physics by C.L.Arora, S Chand.
4. An advanced course in Practical Physics by D. Chattopadhyay & P. C. Rakshit, New central Book Agency (P), Kolkata.