Gujarat University
Ahmedabad

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

From Academic year 2019 – 2020

Unit	Physics theory PHY – 307 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics theory PHY – 308 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics theory PHY – 309 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics theory PHY – 310 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week	Physics Subject Elective PHY – 311 2 Credit Total Marks 100 Internal 30 Marks External 70 Marks 3 hrs/Week	Physics Practical PHY – 312 5 Credit Total 200 Marks Internal 60 Marks External 140Marks 12 hrs/Week
I	Mathematical Physics	Molecular Spectra	Plasma Physics	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	Classical Mechanics	Statistical Mechanics	Plasma Physics	Electronics		
III	Quantum Mechanics	Solid State Physics	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.

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

PHY – 307: MATHEMATICAL PHYSICS, CLASSICAL MECHANICS & QUANTUM MECHANICS
(4 Credit : 4 hrs/week)

Unit – I: Some special functions in Physics:
Bessel functions, Bessel functions of the second kind, Henkel functions, Spherical Bessel functions, Legendre polynomials, Associated Legendre polynomials and spherical harmonics, Hermite polynomials, Laguerre polynomials, The gamma function, the Dirac delta function, examples.

Text Book: Mathematical Physics by P.K. Chattopadhyay, New Age International Publishers (2006)
Article Nos.: Chapter 5: 5.1 – 5.9 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 – II: Variational principle: Lagrange's and Hamiltons equations:
Introduction, Configuration space, Some techniques of calculus of variation, the delta-notation, Applications of the variational principle, Hamilton's principle, Equivalence of Lagrange's and Newton's equations, Advantages of the Lagrangian formulation - Electromechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for non-holonomic systems, Applications of the Lagrangian method of undetermined multipliers, Hamilton's equations of motion, some applications of the Hamiltonian formulation, Phase space, Comments on the Hamiltonian formulation.

Text Book: Introduction to Classical Mechanics by R. G. Takawale and P. S. Puranik, Tata McGraw-Hill Publishing Co. Ltd.
Article Nos.: Chapter 11: 11.1 - 11.13
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 – III: Three dimensional square well potential:
Solutions in interior region, Solutions in the exterior Region and Matching, Solution of the radial Equation: energy levels, Stationary state wave functions, Discussion of bound states, Solution of confluent hypergeometric functions, non localized states, solution in parabolic coordinates, the anisotropic oscillator, the isotropic oscillator.

Text Book: A Text Book of Quantum Mechanics by P. M. Mathews and K. Venketeshan, Tata McGraw-Hill Publishing Co. Ltd.
Article Nos.: Chapter 4: 4.13 - 4.21

Unit – IV: Representations, Transformations and Symmetries:
Quantum states, state vectors and wave function, The Hilbert space of state vectors, Dirac notation, Dynamical variables and linear operators, Representations, Continuous basis - The Schrödinger representation, Degeneracy, Labeling by commuting observable, change of basis, Unitary transformations, Unitary transformation induced by change of coordinate system: translation, Unitary transformation induced by Rotation of coordinate system.

Text Book: A Text Book of Quantum Mechanics by P. M. Mathews and K. Venketeshan, Tata McGraw-Hill Publishing Co. Ltd.
Article Nos.: Chapter 7: 7.1 – 7.9
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

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

PHY – 308: Electronic Spectra, Statistical Mechanics & Solid State Physics
(4 Credit: 4 hrs/week)

Unit – I: Electronic Spectra:

Electronic Spectra, salient features, formation of electronic spectra, Vibrational (Gross) structure of electronic band system in emission, electronic band spectra in absorption, Rotational structure of electronic bands; Rotational structure of three branch bands; observed intensity distribution (vibrational) in band systems: Franck-Condon principle; explanation of intensity distribution in absorption bands from Franck-Condon principle. Explanation of intensity distribution in emission bands: Condon parabola. Line intensities in a band: Rotational intensity distribution. Quantum mechanical Exploting Franck-Condon principle.

Text Book: Atomic and Molecular Spectra: Laser by Rajkumar, Kedar Nath & Ram Nath
Article Nos: Chapter 21: 1 – 11

Unit – II: Transport Phenomena:
Introduction, Mean collision time, Scattering cross-section, viscosity, electrical conductivity, thermal conductivity, thermionic emission, photoelectric effect, molecular collision, effusion, diffusion, Brownian motion, Einstein's relation for mobility

Text Book: Fundamentals of Statistical Mechanics by B. B. Laud, New Age International Publishers
Article Nos.: 12.1 – 12.12
Reference Book:

1.   Statistical Mechanics - Theory and Application by S K Sinha, Tata McGraw- Hill 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 - III: Theory of Dielectrics:

Polarization, Dielectric constant, Local Electric field, Dielectric polarizability, Sources of polarizability, theory of electric polarizability and optical absorption, ionic polarization, polarization from dipole orientation, dielectric losses, Applications to optical phonon modes in ionic crystals, the longitudinal optical mode, the transverse optical mode, the interaction of electromagnetic waves with optical modes, application to the motion of electrons in polar crystals.

Unit – IV: Diamagnetism and paramagnetism:

Langevin's theory of diamagnetism, Langevin's theory of paramagnetism, theory of atomic magnetic moment, Hund's Rule, Quantum theory of magnetic susceptibility: A quantum mechanical formulation, Dimagnetism, Paramegnetism, application to magnetic ions in solids: effect of the crystal field, van Vleck paramagnetism, Pauli paramagnetism, Nuclear paramagnetism, Cooling by adiabetic demagnetization, magnetic resonance, ESR, NMR, Spin relaxation, line width and line shape

Text Book: Elements of Solid State Physics by J. P. Srivastava, Prentice-Hall of India Private Limited, New Delhi
Article Nos.: 10.1 – 10.10
Article Nos.: 13.1 – 13.9
Reference book:
Introduction to Solid State Physics by C. Kittel, (Eight Edition) John Wiley and Sons.

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

PHY – 309: Nuclear Physics
(4 Credit: 4 hrs/week)

Unit – I:
Motion of charged particles in Magnetic & Electric field:

Microscopic & Macroscopic description, Maxwell's equation & charge conservation, Motion of a charged particle in electric & Magnetic fields, Uniform magnetic field & Oscillating electric field, Drift velocity in a gravitational field, Magnetic field varying in space & time : adiabatic variance of the magnetic moment, Inhomogeneous magnetic field : gradient drift & curvature drift, peculiarity of drift motions, Converging magnetic field : magnetic mirror, Longitudinal adiabatic invariant, Periodic magnetic field : Gyro relaxation effect, Motion of magnetic lines of force.

Unit – II:
Characteristics of plasma in magnetic field:
Description of plasma as gas mixture, Properties of plasma in a magnetic field, Force on plasma in magnetic field, Current in magnetized plasma, Diffusion in a magnetic field, Collisions in fully ionized magnetoplasma, Pinch effect, Oscillations and waves in the Plasma.

Application of Boltzmann-Vlasov equation on plasma:
Distribution function, Homogeneous, Inhomogeneous, Isotropic and Anisotropic distribution functions, Boltzmann equation, Fokker-Planck equation, Debye screening, Equilibrium distribution function and Boltzmann's H-theorem, Application of B-V equation to longitudinal waves: Dispersion relations, Initial value problem: Landau damping, Cyclotron damping, Excitation, two-stream instability: Beam plasma instability, Pinch instability, Plasma sheath, Non-linear effects

Text book: Elements of Plasma Physics by S. N. Goswami, New Central Book   Agency (P) Ltd.
Article Nos.: 2.1 – 2.12, 3.1 – 3.8, 4.1 – 4.12
Reference Book:
Introduction to Plasma Physics by F.F. Chen, Plenum Press, 2nd ed

Unit – III:
Nuclear Energy: Introduction, Neutron induced fission, Asymmetrical fission - mass yield, Emission of delayed neutrons by fission fragments, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, neutron cycle in a thermal nuclear reactor, Nuclear reactors.

Nuclear Physics in other areas of Physics: The Mossbaur effect, some experiments using Mossbaur effect, Natural Fusion - energy production in stars, Possibility of controlled fusion.

Text Book: Nuclear Physics - An Introduction by S. B. Patel, New Age International.
Article Nos.: 6.1 to 6.9, 9.5 to 9.7
Reference Books: Introduction to Nuclear Physics by H. Enge, Addison Wesley Nuclear Physics by D. C. Tayal, Himalaya
Publisher Nuclear Physics by Irving Kaplan

Unit – IV: Elementary particles:
Interactions and Particles, Leptons, Hadrons, Elementary Particle Quantum Numbers, Quarks, Field Bosons, The Standard Model and Beyond, History of Universe.
Text Book: Concept of Modern Physics by A. Beiser, McGraw Hill International Edition, 6th Ed
Articles Nos.: 13.1 – 13.8

Reference Books: Modern Physics by Kenneth Krane, John Wiley and sons.

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

PHY – 310: Linear & Non-Linear Electronics circuits
(4 Credit: 4 hrs/week)

UNIT – I:
Negative Feedback in transistor amplifier: General theory of feedback, reasons for negative feedback, loop gain, types of negative feedback in transistor circuits,

Transistor Oscillators: Introduction, Effect of positive feedback, requirements for oscillations, the phase shift oscillator, Wien bridge oscillator, LC oscillators, Colpitt and Hartley oscillators with analysis.

Text Book: Electronic Devices and circuits – An introduction by Allen Mottershed
Article Nos.: 17.1 to 17.4, 18.1 to 18.7

Hand Book of Electronics by Gupta and Kumar
Article Nos.: 22.4, 22.5

UNIT – II:
Field effect transistor amplifier: Advantages and disadvantages of the FET, Basic construction of the JFET, Characteristics curve of the JFET, Principle of operation of the JFET, Effect of the VDS on channel conductivity, Channel ohmic region and pinch off region. Characteristics parameters of the FET, Common source AC amplifier

Operational Amplifier: The basic operational amplifier, the differential amplifier, offset error voltages and currents, the basic operational amplifier application,

Text Book: Electronic Devices and circuits – An introduction by Allen Mottershed
Article Nos.: 21.1 to 21.7, 21.9
Integrated Electronics by Millman Halkias
Article Nos.: 15.1, 15.2, 15.6, 16.1

UNIT – III:
Arithmetic circuits: Binary addition binary subtraction, unsigned binary number, sign magnitude numbers, 2 S compliment representation, 2' S compliment arithmetic building blocks the adder - substractor, binary multiplication and division, Digital comparator, decoder, demultiplexer, data selector, encorder.

Text Book: Digital Principles and Applications by Malvino and Leach
Article Nos.: 5.1 to 5.9

UNIT – IV:
Regulated Power Supply: Introduction, stabilization, limitations of Zener diode regulator, Transistor series voltage regulator, transistor shunt voltage regulator, a series regular with two transistors, current regulator
Text Book: Electronic Devices & Circuits by A. Mottershed
Article Nos.: 28.2 to 28.4

Electronic Instruments: Cathode ray oscilloscope: CRO, CRT, electron gun, deflecting plates, screen, methods of focusing, deflection systems, mathematical expression for electrostatic deflection sensitivity, electromagnetic deflection system, magnetic deflection in CRT, Time base (without circuits), CRO Parts, operation of a typical oscilloscope control, uses of CRO.

Text Book: Electronic & Radio Engineering by M. L. Gupta, Dhanpat Rai & Sons.
Article Nos.: 36.1 to 36.11, 36.17, 36.18, 36.20.

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

PHY – 311: SEC_A: Experimental and Measurement Techniques
(2 Credit : 3 hrs/week)

Unit – I:
Numerical analysis in physical measurement:

Measurement, The result of a measurement, Sources of uncertainty and experimental error, Systematic error, Random error, Definition of uncertainty, The analysis of repeated measurements, Mathematical description of data distribution functions.

Unit – II:
Temperature and Optical Measurement Techniques
Transducer definition, Transducer characteristics, Temperature measurements, Definition of temperature, Temperature transducers: Resistance thermometers, Thermistors, Thermocouples, Thermal radiation temperature measurements: Infra-red pyrometers, Low temperature thermometry, Optical measurements: Bolometers, Photoconductive detectors, Photoemissive detectors.

Unit – III:

Units of pressure measurement, Characteristics of vacuum, Applications of vacuum, Vacuum systems, Vacuum pumps: mechanical rotary pump, multistage diffusion pump, Vacuum gauges: Pirani gauge, penning cold cathode gauge, capacitance gauge, pumping speed for a vacuum system, leak testing.

Text Book: Measurement, Instrumentation and Experiment Design in Physics and Engineering by Michael Syer and Abhai Mansingh, PHI Learning Pvt. Ltd.

Article No: 1.1 to 1.8,. 2.2., 2.3, 3.1 to 3.6, 6.1 to 6.7)

Reference Books:
5.   Experimental Methods for Engineers by J.P. Holman, 7th Edition, Tata McGraw Hill
6.   Advanced Experimental Techniques in Modern Physics by K. Muraleedhara Varier, Anthony Jodrph, P.P Pradyumanan, Pragati Prakashan

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

PHY – 311: SEC_B: Instrumentation
(2 Credit: 3 hrs/week)

Unit – I: Transducers:

What is a transducer? Classification of transducers, classification based on electrical principle involved, resistive position transducer, resistance pressure transducer, Inductive pressure transducer, capacitive pressure transducer, self inductive transducer, linear variable differential transformer (LVDT), piezoelectric transducer, strain gauge, temperature transducers, resistance temperature detectors, thermistors, thermocouples, ultrasonic temperature transducers, photoelectric transducers.

Unit – II: Electronic Instruments:

Introduction, analog and digital instruments, functions of instruments, electronic versus electric instruments, essentials of an electronic instrument, measurement standards, the basic meter movement, characteristics of moving coil meter measurement, variations of basic meter movement, converting basic meter to dc ammeter, multirange multimeter, measurement of current, converting basic meter to dc voltmeter, multirange dc voltmeter, loading effect of a voltmeter, ohmmeter multimeter, rectifier type of ac meter, electronic voltmeter, direct current VTVM, comparison of VOM and VTVM, direct current FETVM, digital voltmeter.

Text book: Basic electronics Solid State by B. L. Tharaja (1st multicolour illustrative edition)

Unit – III: Signal Generators:

Introduction, fixed frequency AF oscillator, variable oscillator, basic standard signal generator (sine wave), standard signal generator, modern laboratory signal generator, AF sine and square wave generator, function generator, square and pulse generator, random noise generator, sweep generator.

Text book: Electronic instrumentation by H. S. Kalsi

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

PHY – 311: SEC_C: Visual Basics
(2 Credit: 3 hrs/week)

Unit – I:
Introduction to the VB Environment
Visual Basic 6.0, Overview & Terminology, Event driven programming, VB Programming

Creating the User Interface
Building the User Interface Creating an Application Building Menus

Unit – II:
VB Programming Language

Event Handling Using Properties Methods Naming Conventions Variables Variable Scope Constants Arrays User Defined Types Comments Continuation Statements Assignment Statements Operators Loops & Decision structures

Unit – III:
Error handling and debugging

Error Handling, Avoid Variable Name Errors, Setting Your Own Error Codes, Simulating A Visual Basic Error, Catering for Unexpected Errors, Delayed Error Handling, Turning Off Error Handling, Function Specific Error, Procedures, Debugging your code, Using the Debug, Window Passively, Using the Debug Window Actively,

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

1.   Prepare a Simple Calculator in VB.
2.   Write a VB script to input any number N and Calculate its Factorial.
3.   Write a VB script to print first 25 terms of Fibonacci Sequence.
4.   Write a VB script to print prime number from 1 to 100.
5.   Write a VB script to print Automorphic number from 1 to 100.

Reference Books:
1.   Visual Basics. Net (Version 2012)
2.   Mastering in Visual Basic 6.0 BPB publications Evangelos Petroutsos
3.   SAMS Teach Yourself Visual Basic 6.0 in 21 Days Techmedia By Greg Perry
4.   The Complete Reference Visual Basic 6.0, Tata Mcgraw-Hill Publishing Pvt.Ltd. by Noel Jerke

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

Physics Practical: PHY – 312
(5 credits: 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

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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.

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

Physics Practical: PHY – 312
(5 Credit: 12 hrs/week)

No	GROUP- A
01	Acceleration due to gravity by Kater's pendulum (variable knife edge)
02	e/k by power transistor.
03	Rubber tubing.
04	Susceptibility of ferromagnetic substance by Quink's method (Magnetic fluid).
05	To find the value of permeability of free space

No	GROUP- B
01	Michelson interferometer - To determine "d"
02	To calibrate the spectrometer using Edser-Butler plate.
03	Absorption spectrum of Iodine molecule
04	To determine the charge on electron by Millikan's experiment.
05	Determination of dead time of G.M. tube. Comparison of relative intensities of different sources using G.M. Tube.

No	GROUP- C
01	Heaviside mutual inductance bridge.
02	Self-inductance of a coil by Rayleigh's method.
03	Use of Excel for data analysis and graph plotting.
04	Study of voltage regulated circuit using IC7805
05	Half adder, Full adder and subtracter using IC 7483.

No	GROUP- D
01	Frequency response of a common source FET amplifier.
02	Colpitts oscillator.
03	Negative feedback amplifier using transistor.
04	Nibble Multiplexer and 8:1 Multiplexer
05	OPAMP Applications: Adder and Subtracter.