Shri Govind Guru University

GODHRA

Syllabus of B.Sc. Sem.-III & Sem.-IV

PHYSICS

Theory & Practicals

(Based on CBCS)

Effective from June 2017

Shri Govind Guru University
Godhra
B. Sc. Semester – III
Syllabus for Physics Theory & Practical

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 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks
Unit – I	Solid State Physics	Elementary Quantum Mechanics	A & B groups : Each group consists of 08 experiments. External Examination: 70 Marks Group A : 35 Marks Group B : 35 Marks Minimum 10 practicals must be performed (5 in each group) Practical batch size: Maximum 20 students.
Unit - II	Classical Mechanics	Electrostatics & Magnetostatics	
Unit - III	Heat & Thermodynamics	Optics	
Unit - IV	Nuclear Physics	Electronics	

Educational Tour : In order to give exposure of industry, research institute and higher learning in the field of physics, 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.

Shri Govind Guru University
Godhra
B. Sc. Semester – IV
Syllabus for Physics Theory & Practical

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 Credit Total 100 Marks Internal : 30 Marks External : 70 Marks
Unit – I	Solid State Physics	Quantum Mechanics	A & B groups : Each group consists of 08 experiments. External Examination: 70 Marks Group A : 35 Marks Group B : 35 Marks Minimum 10 practicals must be performed (5 in each group) Practical batch size: Maximum 20 students.
Unit - II	Classical Mechanics	Astrophysics & Medical Physics	
Unit - III	Statistical Mechanics & Fiber Optics	Digital Electronics	
Unit - IV	Modern Physics : Special Theory of Relativity	Electronics	

Educational Tour : In order to give exposure of industry, research institute and higher learning in the field of physics, 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.

Semester – III

PHYSICS Paper – 201 (Credits – 04) 48 Lectures

UNIT – I : Solid State Physics

1. CRYSTAL STRUCTURE .

1.0. Periodic Arrangement Of Atoms.
1.1. Lattice translation vectors.
1.2. Basis, Lattice ,Lattice primitive cell, Wigner-Seitz unit cell .
2.0. Fundamental Types Of Lattice.
2.1. Two -dimensional lattice types, Oblique lattice . Bravice lattice
2.2 Three dimensional lattice types .
3.0 Index system (indices) for crystal planes.
4.0 Simple Crystal Structures.
4.1 Sodium Chloride structure.
4.2 Cesium chloride structure .
4.3 Hexagonal close-packed structure (hcp).
4.4 Diamond structure .
4.5 Cubic Zinc -Sulfide structure

2. Wave Diffraction And Reciprocal Lattice .

2.1 Diffraction of wave by crystals, The Bragg's law.
2.2 Scattered wave Amplitude, Reciprocal lattice vectors. Diffraction condition, Laue equations.
3.0 Brillion Zone .
3.1 Reciprocal lattice to S. C. lattice .
3.2 Reciprocal lattice to B. C. C. lattice .
3.3 Reciprocal lattice to F. C. C .lattice .
4.0 Fourier Analysis Of the Basis .
4.1 Structure factor of the B. C. C. and F. C. C. structure.

Text Book : Introduction to Solid State Physics by C.Kittle. (8th Edition)

UNIT – II : Classical Mechanics

1. Mechanics of single particle & system of particles and Central Force

3.2 Mechanics of a particle.
3.5 Mechanics of system of particles.
5.1 Equivalent one-body problem
5.2 Motion in a central force field.
5.3 General features of the motion.
5.4 Motion in an inverse-square law force field.

2. Oscillations and Collisions

6.1 Simple Harmonic Oscillator.
6.2 Damped Harmonic Oscillator.
7.1 Elastic and Inelastic scattering.
7.2 laboratory and centre of mass systems.
7.3 Kinematics of elastic scattering in lab-system.

Text Book : **Classical Mechanics** by
R.G.Takewale & P.S.Puranik. Tata McGraw Hill.

UNIT – III : Heat & Thermodynamics

8.0 Entropy :-
8.1 Reversible part of the second law (clauis theorem).
8.2 Entropy.
8.4 Entropy of ideal gas .
8.5 T.S.diagram.
8.12 Application of the entropy principle.
9.0 Pure Substances
9.6 Volume exapancitivity :Cubic expansion coefficient .
9.7 Compressibility.
10.0 Mathematical methods
10.1 Characteristics functions.
10.2 Enthalpy.
10.3 Helmholtz and Gibb's function .
10.5 Maxwell's relations .
10.6 T ds equations.
10.7 Internal energy equations .
10.8 Heat capacity equations.
11.0 Open Systems
11.1 Joule –Thomson expansion .
11.2 Liquefaction of gases by the Joule –Thomson expansion.

Text Book : **Heat & Thermodynamics** by Mark W.Zemansky & R.H.Dittman
McGraw Hill ,Int.7th.edition.

UNIT – IV : Nuclear Physics

1. **Physical Tools For Doing Nuclear Physics .**
   1.1.3 Detector For Nuclear Particles .
   Solid state or semiconductor detector..
   Compton suppressed germanium detector ..
   Cloud and bubble chambers .
   1.1.4. Particle Accelerators .
   Vande graff generator, The cyclotron, Synchrotron, The betatron.
   1.1.5 Beta ray spectrometer .
2. **Constituents of the Nucleus and Some of their Properties.**
   4.1.1. Introduction.
   4.1.2. Rutherford scattering and estimation of the Nuclear size .
   4.1.3. Measurement of nuclear radius.
   4.1.4. Constituents of the nucleus and their properties .
   4.II.0. Alpha rays : Spectra and Decay.
   4.II.1. Range of alpha particles.
   4.II.2. Disintegration energy of spontaneous alpha decay.
   4.III.0. Beta Rays : Spectra and Decay.

4.III.1. Introduction.
4.III.2. Continuous Beta ray spectrum difficulties in understanding it.
4.III.3. Paulie's neutrino hypothesis.
4.III.4. Fermi's theory of beta decay.
4.III.5. The detection of neutrino .
4.IV.0. Introduction to Gamma- emissions.
4.IV.1. Introduction.
4.IV.2. Gama ray emission selection rules.
4.IV.3. Internal conversion.

Text Book : Nuclear Physics An Introduction by S.B.Patel. New Age International Pvt. Ltd.

PHYSICS Paper – 202 (Credits – 04) 48 Lectures

UNIT – I : Elementary Quantum Mechanics

1. The Schrodinger equation and stationary states

2.1 A free particle in one dimension
2.2 Generalization to three dimensions
2.3 The operator correspondence, and the Schrödinger equation for a particle subject to forces
2.4 Normalization and probability interpretation
2.5 Non-Normalizable wave functions and box normalization
2.6 Conservation of probability
2.7 Expectation values; Ehrenfest's theorem
2.8 Admissibility conditions on the wave function
2.9 Stationary states: The time-independent Schrödinger equation
2.10 A particle in a square well potential

Text Book : A textbook of Quantum Mechanics by P.M.Mathews & K.Venkatesan. Tata McGraw Hill.

UNIT – II : Electrostatics & Magnetostatics

1. Properties of Dielectric Materials.

2.1 Electric Polarization
2.2 Magnitude of Polarization charges
2.3 Polarization vector P
2.4 Field of a Polarized piece of dielectric
2.5 Gauss' law in dielectrics : Displacement vector
2.6 Macroscopic dielectric parameters
2.7 Force exerted by a capacitor on a dielectric slab…….
2.9 Polar and Non-Polar dielectrics
2.11 Lorentz Formula for internal or Local electric field
2.12 Clausius-Mosotti equation

2. Steady Current and Magnetostatics.

3.1 Introduction
3.2 Current and current Density
3.3 Electrical Conductivity
3.4 Equation of Continuity
3.7 Force on a current carrying conductor
3.8 Ampere's Law (Biot-savart law)
3.17 Magnetic Scalar Potential
3.18 Vector Potential

Text Book : Fundamentals of Electricity and Magnetism by
R.B.Singh & A.K.Shukla New Age International Publishers.

3. Magnetic Materials

4.14 Magnetic Media
4.15 Magnetization
4.16 Magnetic Field Vector
4.17 Magnetic Susceptibility and Permeability
4.20 Comparison of Static Electric and Magnetic Fields

Text Book : Electromagnetics by
B. B. Laud. (2nd Edition). New Age International Publishers.

UNIT – III : Optics

1. Diffraction of Light.

17.1 Introduction
17.6 Difference Between Interference and Diffraction
17.7 Fresnel and Fraunhoffer Types of Diffraction
17.11 Diffraction Pattern Due to a Narrow Slit
18.7 Plane Diffraction Grating
18.7.1 Theory of Plane Transmission Grating
18.7.7 Dispersive Power of Grating
18.7.8 Prism and Grating Spectra

2. Resolving Power of Optical Instrument.

19.1 Resolving Power
19.3 Limit of Resolution of Eye
19.5 Resolving Power of Optical Instruments
19.6 Rayleigh's Criterion of Resolution
19.7 Resolving Power of a Telescope
19.7.1 Relation Between Magnifying Power and Resolving Power of Telescope
19.11 Resolving Power of a Prism
19.12 Resolving Power of a Plane Transmission Grating

Text Book : A Textbook of Optics by
Dr. N. Subrahmanyam, Brijlal, Dr. M.N. Avadhnulu (Revised Edition), S. Chand Publication.

UNIT – IV : Electronics

2. Basic Characteristics of the Transistor.

9.1 Basic Transistor Amplifier
9.2 Two-Diode Analogy for a Transistor
9.3 Transistor Input Characteristics
9.4 Transistor Collector Characteristics
9.5 Collector Cut-off Current, I_{CEO}
9.6 Forward Current Transfer Ratio, CE
9.7 Permissible Operating Area of a Transistor, CE
9.8 The Basic Common-Base Amplifier
9.9 Forward Current Transistor Ratio, CB
9.10 Relation Between α and β
9.11 Collector Cut-off Current, I_{CBO}
9.17 Transistor Construction
9.18 Identifying the Transistor Lead

2. Solid State Electronic Devices.

6.1 Zener Diodes
6.2 Zener Diodes Specification
6.3 The Voltage Regulator Circuit
6.6 Zener Diode Breakdown Mechanism
21.2 Basic Construction of the JFET
21.7 Characteristic Parameters of the JFET
27.6 Light Emitters
27.7 Alpha Numeric Displays
28.1 The Silicon Controlled Rectifier
28.5 The Uni junction Transistor

Text Book : **Electronic Devices and Circuits** by Allen Mottershed. PHI

PHYSICS Paper – 203 Practicals (Credits – 02)

Group A

1. Y- by Koening's Method.
2. Wavelength of light using Hartmann formula.
3. Wavelength of prominent spectral lines (Mercury) by Diffraction grating.
4. Resolving Power of Telescope.
5 Diffraction by single slit.
6 Wavelength of monochromatic light by Biprism.
7 Resonance Pendulum.
8. Least Square Method.

Group B

1. Figure of Merit of a Mirror Galvanometer.
2. FET characteristics.
3. UJT characteristics.
4. Characteristics of SCR.
5 L by Anderson's bridge.
6 Zener Diode as a voltage regulator.
7 Absorption coefficient of liquid using photocell.
8. Thermocouple.

Semester – IV

PHYSICS Paper – 204 (Credits – 04) 48 Lectures

UNIT – I : Solid State Physics

1. Crystal Binding And Elastic Constants.

3.1	Crystal of inert gases.
3.1.1	Wander walls London interaction.
3.1.2	Repulsive interaction.
3.1.3	Equilibrium lattice constant.
3.1.4	Cohesive energy.
3.2	Ionic crystals.
3.2.1	Madelung energy, evaluation of madelung constant.
3.3	Covalent Crystals.
3.4	Metals.
3.5	Hydrogen bonds.
3.6	Atomic Radii.
3.6.1	Ionic Crystal radii.
3.7	Analysis of elastic strains.
3.7.1	Dilation.
3.7.2	Stress components.
3.8	Elastic Compliance And Stiffness Constants.
3.8.1	Elastic energy density.
3.8.2	Elastic stiffness constant of cubic crystals.

2. SUPERCONDUCTIVITY .

10.1	Experimental Survey.
10.1.1	Occurrence of superconductivity.
10.1.2	Destruction of superconductivity by magnetic field .
10.1.3	Meissner effect.
10.1.4	Heat capacity , energy gap.
10.1.5	Microwaves and infrared properties.
10.1.6	Isotope effect.
10.2	Theoretical Survey.
10.2.2	London equation.
10.2.4	BCS theory of superconductivity.
10.2.5	Flux quantization in a superconducting ring.
10.2.6	Type -2 superconductor.

Text Book : Introduction to Solid State Physics by C.Kittle. (8th Edition)

UNIT – II : Classical Mechanics

1. Lagrangian Formulations

8.1 Constraints.
8.2 Generalised coordinates.
8.3 D'Alembert's principle.
8.4 Lagrange's equations.
8.7 Cyclic or ignorable coordinates.

2. Moving coordinate system

9.1 Coordinate systems with relative translation motion.
9.2 Rotating coordinate systems.
9.3 The Coriolis force.
9.4 Motion on the earth.

Text Book : **Classical Mechanics** by R.G.Takewale & P.S.Puranik. Tata McGraw Hill.

UNIT – III : Statistical Mechanics & Fiber Optics

1. Macroscopic and Microscopic states

3.1 Macroscopic states
3.2 Microscopic states
3.3 Phase space
3.4 The u-space (note: please write here mu
3.5 The G-space
3.6 Postulate of equal priori probabilities
3.7 Ergodic hypothesis
3.7.1 Mean value over an ensemble
3.7.2 Mean value over phase space
3.8 Density distribution in phase space
3.9 Liouville's theorem
3.10 Principle of conservation of density in phase and principle of conservation of extension in phase
3.11 Condition for statistical equilibrium

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

2. Fibre Optics.

24.1 Introduction
24.2 Optical Fibre
24.2.1 Necessity of Cladding
24.2.2 Optical Fibre System
24.2.3 Optical Fibre Cable
24.4 Propagation of Light Through an Optical Fibre
24.4.1 Critical angle of Propagation
24.4.2 Acceptance Angle
24.5 Fractional Refractive Index Change

24.11 The Three Types of Fibres
24.11.1 Single Mode Step Index Fibre
24.11.2 Multi Mode Step Index Fibre
24.11.3 Graded Index Fibre
24.12 Materials
24.12.1 All Glass Fibres
24.12.2 All Plastic Fibres
24.12.3 PCS Fibres
24.18 Characteristics Of Fibres
24.20 Applications

Text Book: **A Textbook of Optics** by
Dr. N. Subrahmanyam, Brijlal, Dr. M.N. Avadhnulu .
(Revised Edition), S.Chand Publication.

UNIT – IV : Modern Physics : Special Theory of Relativity

1.1 Postulates of special relativity. (With Michelson Morley Experiment)
1.2 Time Dilation.
1.3 Doppler Effect.
1.4 Length Contraction.
1.7 Relativity of Mass.
1.8 Mass and Energy.
1.10 Lorentz Transformations.
1.11 Velocity Addition.

Text Book : **Concepts of Modern Physics** by
Arthur Beiser. (4th Edition) McGraw Hill Pub. Co.

PHYSICS Paper – 205 (Credits – 04) 48 Lectures

UNIT – I : Quantum Mechanics

1. General formalism of wave mechanics

3.1 The Schrödinger equation and the probability interpretation for an N – particle System
3.2 The fundamental postulates of wave mechanics
a. Representation of states
b. Representation of dynamical variable; expectation values, observables
3.3 The adjoint of an operator, and self-adjointness
3.4 The eigenvalue problem; Degeneracy
3.5 Eigenvalue and eigenfunctions of self-adjoint operators
3.6 The Dirac delta function
3.7 Observables: Completeness and normalization of eigenfunctions
3.8 Closure
3.9 Physical interpretation of eigenvlaues, eigenfunctions and expansion coefficients

3.10 Momentum eigenfunctions : wave functions in momentum space

a) Self-adjointness and reality of eigenvalues
b) Normalization and closure
c) The wave function and operators in momentum space

3.11 The uncertainty principle
3.12 States with minimum value for uncertainty product

Text Book : A textbook of Quantum Mechanics by P.M.Mathews & K.Venkatesan. Tata McGraw Hill.

UNIT – II : Astrophysics & Medical Physics

1. Telescopes

1.1 Early telescopes and the use of lenses
1.2 Astronomical telescope consisting of two converging lenses
1.4 Reflecting telescopes
1.6 Resolving power of telescopes
1.7 Collecting power of telescopes
1.8 Radio telescopes
1.9 Infrared, ultraviolet and X-ray telescopes
1.11 Charge-coupled devices in astronomy

2. Stars and Stellar evolution

2.2 Astronomical distance
3.1 The birth of a star
3.2 The Hertzsprung–Russell diagram
3.3 Evolution of massive stars post-main sequence

Text Book : Physics Astrophysics AQA A-Level Year 2 By Chris Bishop. Harper Collins Publishers.

3 Introduction to Medical Imaging

1.1 Radiography (X-ray imaging)
1.2 Contrast materials
1.3 CT
1.4 US
1.5 Scintigraphy (nuclear medicine)
1.6 MRI
1.7 Hazards associated with medical imaging

Text Book : Imaging for Students by David A. Lisle **(**Fourth Edition)

UNIT – III : Digital Electronics

1. Logic circuits

1.1 Binary Number System
1.5 Boolean Algebra
1.6 NOR Gates
1.7 NAND Gates
2.1 Boolean Laws and Theorem
3.7 Exclusive-OR Gates

2. Number Systems and Codes

4.2 Binary to Decimal Conversion
4.3 Decimal to Binary Conversion
4.4 Octal Numbers
4.5 Hexadecimal Numbers
4.6 The ASCII code
4.7 The Excess-3 code
4.8 The Gray code

Text Book : Digital Principles and Applications by
Albert Paul Malvino, Donald P. Leach. (4th Edition, McGRAW-HILL)

UNIT – IV : Electronics

1. The Common Emitter Amplifier.

11.1 Graphical Analysis of Class-A Amplifier
11.2 Input and Output Resistance
11.3 Effect of Adding an AC load
11.4 Conversion Efficiency of a Class-A Amplifier with a Direct-Coupled Resistive Load
11.5 Phase Relationships in a CE Amplifier
11.6 Input Waveform Consideration
11.9 Comparison of Basic Transistor Amplifiers

2. Thermal Stability I: Transistor Biasing.

12.1 Factors Contributing to Thermal Instability
12.2 Effect of Temperature Increase
12.3 Stability Factor S
12.4 Common Base Stability
12.5 Collector to Base Bias
12.6 Disadvantages of Collector to Base Bias
12.7 Emitter Bias
12.8 Voltage divider Bias

3. Hybrid Equivalent Circuits for a Transistor.

14.2 General “Black Box” Theory
14.3 Hybrid h-Parameters
14.4 Obtaining the Hybrid H-Parameters

Text Book : Electronic Devices and Circuits by
Allen Mottershed. PHI

PHYSICS Paper – 206 Practicals (Credits – 02)

Group A

1. Study of electron diffraction pattern
2. Double refraction in Calcite Prism.
3. Wavelength of light by Adser's A pattern.
4. Resolving Power of grating.
5 Identification of elements in Line Spectra.
6 Analysis of elliptical polarized light using photocell.
7 (i) Gray code to Binary & Decimal conversion
(ii) To write words from given ASCII code Table.
8. Decimal to Octal & Hexadecimal conversion and vice-varsa.

Group B

1. h-parameters of CE transistor.
2. C_1/C_2 by Desauty's method.
3. Collector to Base Bias circuit for CE configuration.
4. Potential divider Bias circuit for CE configuration.
5 e/m by Thomson's method.
6 Verification of De Morgan's Theorems.
7 Measure voltage & frequency using CRO.
8. Characteristics of a Transistor in CE configuration.

University Examination Pattern

Theory :

70 Marks : 4 questions from each unit of 14 marks.
As (A) or (A) and (B) or (B).
In (A) or (B) problems may be asked with short theory instead of one long theory question.
5^{th} Question will have 14 short questions, 3 from each unit and 2 from any unit.

Practical :

70 Marks : 2 sessions of 3 hours each of 35 marks
One from A group and one from B group.

Reference Books for all Topics :

1. **Fundamentals of Digital Circuits** by Anandkumar. PHI (2nd Edition)
2. **Electronic Principles** by Albert Malvino and David J Bates (7th Edition), Tata McGraw Hill Ltd.
3. **Electronic Devices and Circuits** by Sanjeev Gupta, Dhanpatrai and Sons.
4. **Principles of Electronics** by V.K.Mehta, Rohit Mehta. S.Chand.
5. **Electronic Devices and Circuit Theory** by Robert Boylested and L. Nashelsky (8th Edition).
6. **Optics** by Ajay Ghatak (3rd Edition), Tata McGraw Hill Ltd.
7. **Optics and Atomic Physics** by Singh, Agrawal. (Pragati Prakashan, Meerat).
8. **Introduction to Electrodynamics** by David J. Griffiths. PHI.
9. **Mechanics and Electrodynamics** by Brijlal, Subrahmanyam, Seshan (S.Chand)
10. **Classical Mechanics** by G.Aruldhas. PHI.
11. **Classical Mechanics** by R.Douglas Gregory. Cambridge.
12. **Applied Physics for Engineers** by Neeraj Mehta. PHI.
13. **Quantum mechanics: fundamentals** by Kurt Gottfried, Tung-Mow Yan, Springer.
14. **Quantum Mechanics** by Leonard I.Schiff. 3rd Edition, Tata McGraw Hill
15. **Applied Solid State Physics** by Rajanikant. Wieley,India.
16. **Thermodynamics Principles and Applications** by N C Dey. New Central Book Agency
17. **Physics Galaxy – Vol I to IV** by Ashish Arora. G.K.Publishers Pvt. Ltd.
18. **Multiple Choice Questions in Physics** by S.Mohan. MJP Publishers.
19. **Practical Physics** by D.Chattopadhyay, P.C.Rashit. Central.
20. **Sòlid State Physics** by S.O. Pillai , New age international Publishers.
21. **Solid State Physics** by S.L.Kakani & C.Hemrajani by Sultan Chand & Sons.
22. **BIOPHYSICS Principles and Techniques** by M.A. Subramanian.
23. **Medical Imaging** by Krzysztof Iniewski. Wiley.
24. **Diagnostic Radiology Physics** A Handbook for Teachers and Students. IAEA
25. **Astrophysics for Physicists** Arnab Rai Choudhary. Cambridge.
26. **The Design and Construction of Large Optical Telescopes** by Pierre Y. Bely.
27. **A Concise Introduction to Astrophysics** by M. Kachelrieß
28. **Principles of PHYSICS** by Halliday, Resnik, Walker 9th Edition Willy-India Edition