

**Shri Govind Guru  
University  
GODHRA**

**Syllabus of B.Sc. Sem.-V & Sem.-VI**

**PHYSICS**

**Theory & Practicals  
( Based on CBCS )**

Effective from June 2018

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

<b>Unit</b>	<b>Physics theory PHY – 301 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week</b>	<b>Physics theory PHY – 302 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week</b>	<b>Physics theory PHY – 303 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week</b>	<b>Physics theory PHY – 304 4 credit Total 100 Marks Internal 30 Marks External 70 Marks 4 hrs/Week</b>	<b>Physics Subject Elective PHY – 305 2 Credit Total Marks 100 Internal 30 Marks External 70 Marks 2 hrs/Week</b>	<b>Physics Practical PHY – 306 5 Credit Total 200 Marks Internal 60 Marks External 140Marks 12 hrs/Week</b>
<b>I</b>	<b>Mathematical Physics</b>	<b>Molecular Physics</b>	<b>Electro- magnetism</b>	<b>Electronics</b>	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.
<b>II</b>	<b>Mathematical Physics</b>	<b>Astrophysics</b>	<b>Electro- magnetism</b>	<b>Electronics</b>		
<b>III</b>	<b>Classical Mechanics</b>	<b>Statistical Mechanics</b>	<b>Nuclear Physics</b>	<b>Digital Electronics</b>		
<b>IV</b>	<b>Quantum Mechanics</b>	<b>Solid State Physics</b>	<b>Nuclear Physics</b>	<b>Digital Electronics</b>		

**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 B. Sc. SEM-V & VI with Physics as principal subject must visit the industry / research institute / institute of higher learning during either V or VI semester.

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

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

**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 B. Sc. SEM-V & VI with Physics as principal subject must visit the industry / research institute / institute of higher learning during either V or VI semester.

# Semester – V

**PHYSICS: Paper – 301 ( Credits – 04 ) 48 Lectures**

## UNIT – I : MATHEMATICAL PHYSICS

### 1. Numerical Techniques:

**Curve Fitting:** Introduction, Least squares method, Fitting a straight line, Fitting a Parabola, Fitting a Curve of the form  $y=ax^b$ , Fitting an exponential curve. **Integration:** Integration by Trapezoidal Rule, Simpson's (1/3) rule, Eigen value and its problems.

#### Text Book & Reference Books:

1. Mathematical Methods in the Physical Sciences by Mary L. Boas, 2<sup>nd</sup> Edition, John Wiley & Sons.
2. Mathematical Physics by B. D. Gupta, 2<sup>nd</sup> Revised Edition, Vikas Publishing House Pvt. Ltd.

### 2. 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.

**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)

## UNIT – II : MATHEMATICAL PHYSICS

### 1. 2<sup>nd</sup> 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 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

### 1. Motion of a rigid body

Introduction, Euler's theorem, Angular momentum and kinetic energy, The inertia tensor, Euler's equations of motion, Torque free motion, Euler's Angles, Motion of a symmetric top, Nutational motion.

### 2. Variational principle

Introduction, Configuration space, Some techniques of calculus of variation, the delta-notation, Applications of the variational principle.

**Text Book: Introduction to Classical Mechanics** by R. G. Takawale and P. S. Puranik, Tata McGraw-Hill Publishing Co. Ltd. Article Nos.: Chapter 10: 10.1 to 10.7 ; Chapter 11: 11.1 to 11.3.

**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

### 1. Exactly soluble Eigen value problems

Introduction, the simple harmonic oscillator, the Schrödinger equation and energy eigen values, the energy eigen functions, properties of stationary states, the abstract operator method, Coherent states, the angular momentum operators, the eigen value equation for  $L^2$ , separation of variables, admissibility conditions on solutions, eigen values, the eigen functions, Spherical harmonics, Physical interpretation, Parity. Angular momentum in stationary states of systems with spherical symmetry

**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: 4.1 to 4.12

**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. Aruldas, PHI

**UNIT-I : ATOMIC PHYSICS**

Resume of atomic models, Spectrum of Hydrogen atom and spectral series, Observation of Hydrogen spectrum, Failure of electromagnetic theory, Bohr's theory and spectrum of Hydrogen atom, Franck-Hertz Experiment, Stern-Gerlach Experiment, Fine structure of Hydrogen lines, Positronium, Different series in Alkali spectra, Alkali-like spectra, atoms of Alkaline elements, Spectra of Alkaline earths, Related Numericals.

**Text and Reference Books:**

1. Molecular structure and Spectroscopy by G. Aruldas, Prentice-Hall of India Pvt. Ltd.
2. Elements of Spectroscopy by S. L. Gupta, V. Kumar, R. C. Sharma, Pragati Prakashan

**UNIT-II : ASTROPHYSICS****1. Stars and Stellar evolution**

Astronomical distance, The birth of a star , The Hertzsprung–Russell diagram, Evolution of massive stars post-main sequence

**Text Book : Physics Astrophysics AQA A-Level Year 2** By Chris Bishop. Harper Collins Publishers. Article Nos.: 2.2, 3.1, 3.2, 3.3 ( From Chap 2 & 3 )

**2. Atmosphere of Stars**

Introduction, Some important definitions, The Equation of Transfer, The solution of the equation of transfer, Processes of absorption in stellar atmospheres, continuous absorption by the Negative hydrogen Ion in cooler stars, Analysis of spectral line broadening, The curve of Growth, Stellar Temperatures, The chemical composition of Stars

**Text Book: An introduction to Astrophysics** by Baidyanath Basu, Tanuka Chattopadhyay and Sudhindra Nath Biswas, PHI learning pvt. Ltd. Chapter 6: Article Nos: 6.1 to 6.10

**Reference Book:**

1. The Fundamentals of Stellar Astrophysics by George W. Collins, II, W H Freeman & Co.

**UNIT-III : STATISTICAL MECHANICS****1. Formulation of Quantum Statistics:**

Density matrix, Liouville's theorem in Quantum Statistical Mechanics, Condition for Statistical equilibrium, Ensemble in Quantum Mechanics, Problems

- 2. 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 Paramagnetic 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****1. 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 6

**Reference book:**

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

# PHYSICS: Paper – 303 ( Credits – 04 ) 48 Lectures

## UNIT-I : ELECTROMAGNETISM

### 1. Magnetic Materials

Magnetic Media, Magnetization, Magnetic Field Vector, Magnetic Susceptibility and Permeability, Comparison of Static Electric and Magnetic Fields

### 2. Electromagnetic induction

Electromotive force, Faraday's law of electromagnetic induction, Induction law for moving circuits, Integral and differential form of Faraday's law, Self inductance and Mutual inductance, Energy in magnetic fields.

**Text Book : Electromagnetics** by B. B. Laud. (3<sup>rd</sup> Edition). New Age International Publishers. Article Nos.: 4.14, 4.15, 4.16, 4.17, 4.20 & 5.1 to 5.6

## UNIT-II : ELECTROMAGNETISM

### 1. 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.

### 2. 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.

**Text Book : Electromagnetics** by B. B. Laud. (3<sup>rd</sup> Edition). New Age International Publishers. Article Nos.: 5.7 - 5.12, 6.1 - 6.6

## UNIT-III : NUCLEAR PHYSICS

### 1. Constituents of Nucleus

Introduction, Rutherford Scattering and estimation of the nuclear size, Measurement of nuclear radius, Constituents of the nucleus and their properties, Nuclear spin, moments and statistics.

### 2. Alpha Rays

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

**Text Book: Nuclear Physics - An Introduction** by S.B. Patel, New Age International. Article Nos.: Chapter-4- Part-I and II

## UNIT-IV : NUCLEAR PHYSICS

### 1. 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.

### 2. Gamma Rays

Introduction, Gamma ray emission- selection rules, Internal conversion, Nuclear Isomerism

**Text Book: Nuclear Physics - An Introduction** by S.B. Patel, New Age International. Article Nos.: Chapter-4- Part-III and IV

#### 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.



# PHYSICS: Paper – 304 ( Credits – 04 ) 48 Lectures

## UNIT – I: ELECTRONICS

### 1. General amplifier characteristics (Distortion)

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

### 2. General amplifier characteristics (Decibels)

Introduction, 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: ELECTRONICS

### 1. Low frequency response of a transistor amplifier:

Introduction, 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.

### 2. High frequency response of a transistor amplifier:

Introduction, 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: DIGITAL ELECTRONICS**

### **1. Circuit analysis, 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.

#### **Text Book and Reference Book :**

1. Digital Principles and Applications by Malvino and Leach Article Nos.: 2.1 - 2.8.

## **UNIT – IV: DIGITAL ELECTRONICS**

### **1. Arithmetic circuits:**

Binary addition binary subtraction, unsigned binary number, sign magnitude numbers, 2's complement representation, 2's complement arithmetic building blocks.

### **2. 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

#### **Text Book: Digital Principles and Applications by Malvino and Leach**

Article Nos.: 5.1 to 5.7, 8.1 -8.4, 8.6, 8.7

# PHYSICS: Paper – 306 : Practical

(Credits – 05 ) (5 credit : 12 hrs/week)

Total : 200 Marks (Internal : 60 Marks, External : 140 Marks)

## GROUP-A

1. Acceleration due to gravity by Kater's pendulum (fixed knife edges).
2. Hall Effect
3. Characteristics of GM Tube
4. Viscosity by Log decrement
5. Gonio meter

## GROUP-B

1. Michelson interferometer. To determine the wavelength of monochromatic light.
2. To calibrate the spectrometer using Edser-Butler plate.
3. Refractive index by total internal reflection using Gauss eye piece.
4. An optical method of determining dielectric constant, dipole moment and polarizability of a polar liquid using Hollow prism
5. Fabry-Perot etalon. Determination of the thickness of air film and wavelength of light using spectrometer.

## GROUP-C

1. Mutual Inductance by Ballistic Galvanometer
2. Determination of Curie temperature of ferroelectric ceramic
3. Use of Excel for data analysis and graph plotting.
4. Heaviside mutual inductance bridge.
5. Numerical integration by computer

## GROUP-D

1. Hartley Oscillator. Measurement of frequency by C.R.O. (Transistorized).
2. Half adder, Full adder and subtractor using IC 7483.
3. Series resonance. To find the band width and Q value of a coil.
4. Frequency response of CE amplifier
5. Study of voltage regulated circuit using IC7805

### 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.

# PHYSICS: Paper – 307 ( Credits – 04 ) 48 Lectures

## Unit-I : Mathematical Physics

1. **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 to 5.9.

### Reference Book:

1. Mathematical Methods for Physics and Engineering by K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press.
2. Mathematical Methods in the Physical Sciences by Mary L. Boas, Wiley India Pvt. Ltd.

## Unit-II : Classical Mechanics

### 1. Lagrange's and Hamiltons equations

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.

### 2. Canonical Transformations

Gauge transformation, Canonical transformation, Condition for transformation to be canonical, Illustrations of canonical transformations.

**Text Book: Introduction to Classical Mechanics** by R. G. Takawale and P. S. Puranik,

Tata McGraw-Hill Publishing Co. Ltd. Article Nos.: Chapter 11.4 to 11.13;

Chapter 12: 12 .1 to 12.4

### Reference Book:

1. Classical Mechanics by A. B. Bhatia, Narosa Publication.
2. Classical Mechanics by H. Goldstein, Addison Wesley.

## Unit-III : Quantum Mechanics

1. **Three dimensional square well potential:** Solutions in interior region, Solutions in the exterior Region and Matching, Theory of Hydrogen atom: Solution of the radial Equation, energy levels, Stationary state wave functions, Discussion of bound states, Other problems in three dimensions: The anisotropic oscillator, the isotropic oscillator, normal modes of coupled systems of particles.

**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 to 4.17 and 4.20 to 4.22

**Reference Book:**

1. Quantum Physics of atoms, Molecules solids Nuclei and Particles, R. Eisberg and R. Resnick, John Wily & Sons;
2. Quantum Mechanics : Theory and Applications by A. Ghatak and S. Lokanathan, Macmillan India Limited.
3. Quantum Mechanics by F. Schwabl, Narosa Publishing House

**Unit-IV : Quantum Mechanics****1. 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, The algebra of Rotation generators, transformation of dynamical variables, Symmetries and conservation laws, the space inversion, time reversal.

**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 to 7.14.

**Reference Book**

1. Quantum Theory, Groups and Representations: An Introduction by P. Woit, Department of Mathematics, Columbia University,
2. Quantum Mechanics : Theory and Applications by A. Ghatak and S. Lokanathan, Macmillan India Limited.
3. Quantum Mechanics by F. Schwabl, Narosa Publishing House.

# PHYSICS: Paper – 308 ( Credits – 04 ) 48 Lectures

## UNIT- I : MOLECULAR PHYSICS

### 1. Separation of Electronic and Nuclear Motion:

The Born-Oppenheimer approximation, Types of molecular energy states and associated spectra, Types of spectra, Pure rotational spectra: Salient features of rotational spectra, The molecule as a rigid rotator: Explanation of rotational spectra, Diatomic molecule as a Non-rigid rotator, Validity of the theory: Determination of the inter-nuclear distance(Bond length) and moment of inertia, Isotope effect in rotational spectra, Rotational spectra of polyatomic molecules, Raman effect and its salient features, Observation of Raman spectra, Related Numerical.

#### Text Books:

1. **Molecular structure and Spectroscopy** G Aruldas, Prentice-Hall of India Private Limited
2. **Elements of Spectroscopy**, S L Gupta, V Kumar, R C Sharma, Pragati Prakashan

## UNIT- II: STATISTICAL MECHANICS

1. **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, Related Numerical.

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

#### 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 : SOLID STATE PHYSICS

1. **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.

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

#### Reference book:

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

## UNIT- IV: SOLID STATE PHYSICS

### 1. Super conductivity

Experimental Survey, Occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, Heat capacity, energy gap, Microwaves and infrared properties, Isotope effect, Theoretical Survey, London equation, BCS theory of superconductivity, Flux quantization in a superconducting ring, Type -I & Type -II superconductors.

**Text Book: Introduction to Solid State Physics** by C. Kittel. (8th Edition) John Wiley and Sons. Articles from Chap. 10.

### 2. Fibre Optics

Introduction, Optical Fibre, Necessity of Cladding, Optical Fibre System, Optical Fibre Cable, Propagation of Light Through an Optical Fibre, Critical angle of Propagation, Acceptance, Fractional Refractive Index Change, The Three Types of Fibres, Single Mode Step Index Fibre, Multi Mode Step Index Fibre, Graded Index Fibre, Materials, Glass Fibres, Plastic Fibres, PCS Fibres, Characteristics and applications of optical Fibres,.

**Text Book: A Textbook of Optics** by Dr. N. Subrahmanyam, Brijlal, Dr. M.N. Avadhulu (Revised Edition), S.Chand Publication. Articles from Chap. 24.

# PHYSICS: Paper – 309 ( Credits – 04 ) 48 Lectures

## UNIT- I : PLASMA PHYSICS

### 1. 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.

**Text book: Elements of Plasma Physics** by S. N. Goswami, New Central Book Agency (P)  
Ltd. Article Nos.: 2.1 – 2.12

## UNIT- II : PLASMA PHYSICS

### 1. 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.

**Text book: Elements of Plasma Physics** by S. N. Goswami, New Central Book Agency (P)  
Ltd. Article Nos.: 3.1 – 3.8,

#### Reference Book:

1. Introduction to Plasma Physics by F.F. Chen, Plenum Press, 2<sup>nd</sup> ed

## UNIT- III : NUCLEAR PHYSICS

### 1. The liquid drop model of the nucleus

Introduction, Binding energies of nuclei : plot of B/A against A., Weizsacher's semi empirical mass formula Nucleon emission.

### 2. Nuclear Energy

Introduction, Neutron induced fission, Asymmetrical fission- Mass Yield, Emission of delayed neutrons by fission fragments, Energy released in the fission of  $^{235}\text{U}$ , Fission on lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor, Nuclear reactors.

**Text Book: Nuclear Physics - An Introduction** by S.B. Patel, New Age International.  
Article Nos.: 5.1, 5.2, 5.3, and 5.7, 6.1 to 6.9

#### 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.



## **UNIT- IV : NUCLEAR PHYSICS**

### **1. Elementary particles**

Introduction, Antiparticles and Antimatter, Feynman diagrams, Estimation of a Pion Mass, The four fundamental forces of nature, W Bosons and Gluons, Conservation rules, The Nucleon isospin, The Gell-Mann-Nishijima Relation: Isospin of particles, The Quark model, The “Beauty” and “Truth”, The generation of matter, The QCD-Colour quantum number, Colours for quarks and gluons.

**Text Book: Nuclear Physics - An Introduction** by S.B. Patel, New Age International.

Article Nos.: 10.1 to 10.14

### **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 Irving Kaplan
4. Concept of Modern Physics by A. Beiser, McGraw Hill International Ed., 4th Ed

# PHYSICS: Paper – 310 ( Credits – 04 ) 48 Lectures

## UNIT – I : ELECTRONICS

### 1. Negative Feedback in transistor amplifier:

General theory of feedback, reasons for negative feedback, loop gain, types of negative feedback in transistor circuits.

### 2. Transistor Oscillators

Introduction, Effect of positive feedback, requirements for oscillations, the phase shift oscillator, Wien bridge oscillator, Resonant circuit oscillators (Colpitt and Hartley oscillators), the maximum frequency of oscillation of a transistor.

**Text Book: Electronic Devices and circuits – An introduction by Allen Mottershead**  
Article Nos.: 17.1 to 17.4, 18.1-18.3, 18.5 to 18.7

#### Reference Book:

1. Hand Book of Electronics by Gupta and Kumar

## UNIT – II : ELECTRONICS

### 1. Field effect transistor amplifier

Introduction, Advantages and disadvantages of the FET, Basic construction of the JFET (Revision), 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(Revision), Common source AC amplifier

### 2. Operational Amplifier

Introduction, The operational amplifier, the inverting differential operational amplifier, the non inverting differential operational amplifier, the differential amplifier, General purpose IC operational amplifier, Applications of operational amplifier.

**Text Book: Electronic Devices and circuits – An introduction by Allen Mottershead**  
Article Nos.: 21.1 to 21.7, 21.9 and 23.1, 23.2, 23.5, 23.6, 23.7, 23.12

#### Reference Book:

1. Integrated Electronics by Millman Halkias

## UNIT – III : ELECTRONICS

### 1. Network Transformations

Reduction of complicated network, conversion between T and  $\pi$  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 Network Analysis by G K Mithal

## **UNIT – IV : ELECTRONICS**

### **1. 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. Mottershead** Article Nos.: 28.2 to 28.4

### **2. 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.

# PHYSICS: Paper – 312: Practical

(Credits – 05) (5 credit : 12 hrs/week)

Total : 200 Marks (Internal : 60 Marks, External : 140 Marks)

## GROUP-A

1. Acceleration due to gravity by Kater's pendulum (variable knife edges).
2. Susceptibility of ferromagnetic substance by Quink's method (Magnetic fluid).
3. Determination of dead time of G.M. tube.  
Comparison of relative intensities of different sources using G.M. Tube.
4. Fresnel's Biprism
5. Use of Excel for data analysis.

## GROUP-B

1. Michelson interferometer –Determination of “d” .
2. Absorption spectrum of Iodine molecule.
3. Refractive index of liquid by total internal reflection.
4. To determine the charge on electron by Millikan's experiment.
5. To analyze elliptically polarized light using Babinet compensator.

## GROUP-C

1. Determination of capacity of Scherering Bridge
2. To find the value of permeability of free space
3. Numerical differentiation by computer
4. A.C. Circuit analysis by C.R.O. Measurement of frequency and phase difference
5. 741 IC-OPAMP

## GROUP-D

1. Colpitts oscillator.
2. Parallel resonance. To find the band width and Q value of a coil.
3. Frequency response of a common source FET amplifier.
4. To measure a threshold current of a LASER diode at room temperature.
5. Study of Hysteresis using C.R.O.

## 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.

**B. Sc. (PHYSICS) Semester – V & VI**

**Effective from Academic year 2018**

**List of Elective Courses (2 Credit : 2 hrs/week)**

**Students have to select any one course as elective course from the following University approved elective courses in**

**B. Sc. SEM-V (as P-305) and SEM-VI (as P-311).**

- 1. Nanoscience and nanotechnology**
- 2. Atmospheric Science**
- 3. Basic Instrumentation Skills**
- 4. Weather Forecasting**
- 5. National Service Scheme**

**1. Nanoscience and nanotechnology**

**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

**Unit – III: Special Nanomaterials:**

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

**Unit – IV: 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 Book :**

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

## 2. Atmospheric Science

### **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,

### **Unit – IV: Air Pollution and atmospheric effects:**

Air pollution: Sources of anthropogenic pollution, Emission Inventory, Atmospheric effects- smog, visibility. Measurements of Particulate matters, SO<sub>x</sub>, NO<sub>x</sub> 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

### 3. Basic Instrumentation Skills

#### **UNIT-I: Basic of Measurement:**

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Electronic Voltmeter: Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters

#### **UNIT-II: Cathode Ray Oscilloscope:**

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes.

#### **UNIT-III: Signal Generators and Analysis Instruments:**

Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

#### **UNIT-IV: Digital Multimeter:**

Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

#### **Reference Books:**

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill

## 4. Weather Forecasting

### **UNIT-I: Introduction to atmosphere:**

Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics.

### **UNIT-II: Measuring the weather:**

Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws.

**UNIT-III: Weather systems:** Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. (3 Periods)  
Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate.

### **UNIT-IV: Basics of weather forecasting:**

Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.

### **Reference books:**

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman & Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press



## **5. National Service Scheme**

### **UNIT-I: Introduction And Basic Concepts Of NSS**

History and Growth of NSS, Aims and Objectives of NSS.  
The Motto, NSS Symbol, NSS Badge , NSS Day, NSS Song etc.,  
Part I : Chap 1 & 2.

### **UNIT-II: NSS Programmes And Activities**

Basic Concept and components, Aims of NSS program activities,  
Classification of NSS program, NSS Regular Activities in adopted villages, slums and with  
voluntary organizations.  
Part II : Chap 1 & 2.

### **UNIT-III: Special Camping Program**

Special Camping Program, Planning and preparation of special camping program  
Part III : Chap 1 & 2.

### **UNIT-IV: Implementation of NSS Programs**

NSS at Institution Level- organization and administration of NSS  
Program Officer- Appointment, Duties and Function  
Part VI : Chap 1 & 2.

**Reference Book** : National Service Scheme Manual Revised 2006 GOI.  
Part I, II, III & VI.