B.Sc. (H) PHYSICS
THREE-YEAR FULL-TIME PROGRAMME
(Six-Semester Course)

COURSE CONTENTS
(Effective from the Academic Year 2010-2011)

UNIVERSITY OF DELHI
DELHI – 110 007
## Course Structure

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In addition, there shall be one qualifying paper in self-learning mode called Environmental Studies offered in Semester-2
### YEAR-2

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<td>Numerical Analysis</td>
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# YEAR-3

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<td>PHHT - 622</td>
<td>Nuclear and Particle Physics</td>
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Paper-1-PHHT-101: Mathematical Physics-I

THEORY

Marks: 100

Vector Calculus


(12 Lectures)


(8 Lectures)

Orthogonal Curvilinear Coordinates


(5 Lectures)

Multiple Integrals


(5 Lectures)

Some Special Integrals

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

(4 Lectures)

Theory of Errors


(4 Lectures)

Fourier Series


(10 lectures)
Suggested Books:

Fundamentals of Dynamics


(3 Lectures)


(5 Lectures)

Elastic and Inelastic Collisions between particles. Centre of Mass and Laboratory Frames.

(4 Lectures)

Rotational Dynamics


(6 Lectures)

Gravitation and Central Force Motion


(3 Lectures)


(6 Lectures)

Elasticity

Relation Between Elastic Constants. Twisting Torque on a Cylinder or Wire.

(3 Lectures)
Fluid Motion


(2 Lectures)

Inertial and Non-Inertial Systems


(6 Lectures)

Special theory of Relativity


(10 Lectures)

Suggested Books:

5. University Physics by F W Sears, M W Zemansky and H D Young (Narosa Publishing House, 1982)
THEORY

Bonding

Covalent Bonding : Qualitative approach to Valence Bond Theory and its Limitations. Hybridization, Equivalent and Non-equivalent Hybrid Orbitals, Bent’s Rule and Applications. (3 Lectures)

Molecular Orbital Theory : Symmetry and Overlap. Molecular Orbital Diagrams of diatomic and simple polyatomic systems (O2, C2, B3, CO, NO and their ions; HCL, BeF2, CH4, BCl3) (Idea of Sp3 Mixing and Orbital Interaction to be given). (4 Lectures)

Organization of Solids


Coordination Compounds and Inorganic Reaction Mechanisms


Organic Chemistry
**Stereochemistry**: Bonding in Organic Molecules and its effects on Shape Chirality and RS Nomenclature as applied to Chiral Centers. Treatment of Chirality up to three chiral centers. Conformation of Acyclic and Cyclic Systems, Conformational Analysis of Di-substituted Cyclohexanes. Geometrical Isomerism and E-2 Nomenclature.

(4 Lectures)


(5 Lectures)


(5 Lectures)


(4 Lectures)

**Polymerization**: Types of Polymerization. Forms of Polymers. (1) Condensation Polymerization, (2) Ring Opening Polymerization, (3) Addition Polymerization, and (4) Ziegler-Natta Polymerization. Natural and Synthetic Rubbers.

(3 Lectures)

**Suggested Books**: 

1. P S Sindhu, Modern Chemistry, S. Chand & Sons.
2. J.D. Lee, A New Concise Inorganic Chemistry, E.L.B.S.

**Paper-4-ENAT-101: Technical Writing & Communication in English**

**THEORY**

Marks: 100

**Unit 1**

Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

**Unit 2**

Writing Skills: Selection of topic, thesis statement, developing the thesis; introductory,
developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing.

Unit 3
Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

SUGGESTED READINGS

2. L. Hamp-Lyons and B. Heasely: Study Writing; A course in written English. For academic and professional purposes, Cambridge Univ. Press.

Additional Reference Books

Physics Lab I

PRACTICALS

Marks: 100

1: General

1. To use a Multimeter for measuring (a) Resistances, (b) A/C and DC Voltages, (c) AC and DC Currents, (d) Capacitances, and (e) Frequencies.
2. To test a Diode and Transistor using (a) a Multimeter and (b) a CRO.
3. To measure (a) Voltage, (b) Frequency and (c) Phase Difference using a CRO.
4. To study Random Errors.
5. To determine the Height of a Building using a Sextant.
6. To study the Characteristics of a Series RC Circuit.

2: Mechanics

1. To determine the Acceleration due to Gravity and Velocity for a freely falling body, using Digital Timing Techniques.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille’s method).
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell’s needle.
6. To determine the Elastic Constants of a Wire by Searle’s method.

Note

1. Each College should set up all the Practicals from the above list.
2. Each Student is required to perform at least 8 Practicals by taking at least 3 Practicals from each of the units 105.1 and 105.2.

Suggested Books:

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5. Nelson and Jon Ogborn, Practical Physics.

Paper-3-CHCP-101: Chemistry Lab
1. Separation of Cations and Anions by Paper Chromatography
2. Preparation of
   (ii) Tetrammine copper (II) Sulfate and estimation of copper as CuCNS gravimetrically in the above complex.
3. Preparation of
   (i) Aspirin (ii) Hippuric Acid (Benzoylglycine) (iii) Methyl Orange or Phenolphthalein. Characterisation by mp, mmp, and TLC.
4. Two-step Preparations
   (i) Nitrobenzene from Benzene, Purification of Nitrobenzene and characterization by refractive index, further nitration.
   (ii) P-bromoacetanilide from Aniline.
5. Preparation of Lactose and Casein from Milk or isolation of Caffeine from Tea Leaves (mp, color test).
6. Estimation of Glucose, Saponification Value or Iodine Value of a fat or oil.
7. Potentiometric Titration of Mohr’s salt with \( \text{K}_2\text{Cr}_2\text{O}_7 \) or \( \text{KMnO}_4 \) using Digital Multimeter or low cost Potentiometer.
8. Conductometric Titration of a solution of HCL or \( \text{CH}_3\text{COOH} \) with NaOH by a direct reading Conductometer.
10. The effect of Detergent on the Surface Tension of Water. (Variation of Surface Tension with Concentration to be studied).
11. Determination of the Rate Law for one of the following reactions. All solutions needed to be provided.
   (i) Persulphate-iodine Reaction.
   (ii) Iodination of Acetone.
12. To study the Kinetics of Inversion of Cane Sugar (Polarimetrically).

**Suggested Books:**

THEORY

Differential Equations
Classification: Ordinary and Partial, Order and Degree, Linear and Nonlinear, Homogeneous and Non-homogeneous. Solution: Explicit and Implicit, Number of Arbitrary Constants.

(2 Lectures)

Linear Ordinary Differential Equations
First order: (1) Separable Equations. Initial Value Problem. (2) Exact Equations. Integrating Factor. (3) Linear Equations. Lagrange’s Method of Variation of Parameters.

(8 Lectures)


(16 Lectures)

Coupled Differential Equations: Solution by Method of Elimination.

(2 Lectures)

Calculus of Variations

(14 Lectures)

Constrained Maxima and Minima. Lagrange’s Method of Undetermined Multipliers and its Application to Simple Problems in Physics.

(6 Lectures)
Suggested Books:
THEORY

Oscillations


(4 Lectures)


(5 Lectures)

Superposition of Two Collinear Harmonic Oscillations :- Linearity and Superposition Principle. (1) Oscillations having Equal Frequencies and (2) Oscillations having Different Frequencies (Beats). Superposition of N Collinear Harmonic Oscillations with (1) Equal Phase Differences and (2) Equal Frequency Differences.

(5 Lectures)

Superposition of Two Perpendicular Harmonic Oscillations :- Superposition of Two Mutually Perpendicular Simple Harmonic Motions with Frequency Ratios 1:1 and 1:2 using Graphical and Analytical Methods. Lissajous Figures and their Uses.

(5 Lectures)


(6 Lectures)


(6 Lectures)

Waves


(4 Lectures)


Suggested Books:

Paper-7-PHHT-205: Electricity and Magnetism

THEORY

Electric Circuits

AC Circuits :: Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

(4 Lectures)

Network theorems :: Ideal Constant-voltage and Constant-current Sources. Network Theorems: (1) Thevenin theorem, (2) Norton theorem, (3) Superposition theorem, (4) Reciprocity theorem, and (5) Maximum Power Transfer theorem.

(3 Lectures)

Electric Field and Electric Potential


(6 Lectures)


(9 Lectures)

Electrostatic Energy of (1) a Point Charge, (2) a System of Point Charges, (3) a Uniform Sphere, (4) a Capacitor.

(2 Lectures)

Dielectric Properties of Matter

Magnetic Field


(4 Lectures)


(2 Lectures)

Magnetic Properties of Matter


(4 Lectures)

Electromagnetic induction


(4 Lectures)

Ballistic Galvanometer


(4 Lectures)

Suggested Books:

Paper-8-PHHT-206: Digital Electronics

THEORY

Introduction to CRO

Analog Circuits


Timers (Use Black Box approach) :- 555 Timer and its Applications : Astable and Monostable Multivibrator.

Digital Circuits


Data processing circuits :- Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoders, Parity Checkers.

Memories :- Read-only memories (ROM), PROM, EPROM.


Suggested Books:

1. Digital principles and applications By Donald P. Leach & Albert Paul Malvino, (Glencoe, 1995).
3. Digital Electronics by R.P. Jain,
PRACTICALS

1: Compound Pendulums
   1. To determine g by Bar Pendulum.
   2. To determine g by Kater’s Pendulum.

2: Springs
   1. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g, and (c) Modulus of Rigidity
   2. To investigate the Motion of Coupled Oscillators.

3: Melde’s Experiment
   1. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde’s Experiment.
   2. To verify $\lambda^2 - T$ Law by Melde’s Experiment.

4: Resistance
   1. To determine a Low Resistance by Carey Foster’s Bridge.
   2. To determine a Low Resistance by a Potentiometer.
   3. To determine High Resistance by Leakage of a Capacitor.

5: Ballistic Galvanometer
   1. To determine the (a) Charge Sensitivity and (b) Current Sensitivity of a B.G.
   2. To determine the (a) Logarithmic Decrement and (b) CDR of a B.G.

6: Capacitance
   1. To determine the Ratio of Two Capacitances by de Sauty’s Bridge.
   2. To determine the Dielectric Constant of a Dielectric placed inside a parallel plate capacitor using a B.G.

7: Self & Mutual Inductance
   1. To determine Self Inductance of a Coil by Anderson’s Bridge using AC
   2. To determine Self Inductance of a Coil by Rayleigh’s Method.
   3. To determine the Mutual Inductance of Two Coils by Absolute method using a B.G.

8: A.C. Circuits
   1. To study the response curve of a Series LCR circuit and determine its (a) Resonant Frequency, (b) Impedance at Resonance and (c) Quality Factor Q, and (d) Band Width.
   2. To study the response curve of a Parallel LCR circuit and determine its (a) Anti-Resonant Frequency and (b) Quality Factor Q.

Note
1. Each College should set up all the Practicals from the above list.
2. Each Student is required to perform at least 8 Practicals by taking at least 1 Practical from each of the units 205.1 to 205.8.

**Text and Reference Books**

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5. Nelson and Jon Ogborn, Practical Physics.
1 : Combinational Logic
5. To verify and design AND, OR, NOT and XOR gates using NAND gates.
6. To design a combinational logic system for a specified Truth Table.
7. To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.
8. To minimize a given Logic Circuit.

2 : Decoders
1. To study TTL ICs of (a) Binary Decoder, (b) 7-segment Decoder, and (c) Schmit Trigger.
2. To design a Seven-Segment Display driver.

3 : Arithmetic and Logic Units (ALU)
1. Half Adder, Full Adder and 4-bit Binary Adder.
2. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.

4 : Flip-Flops, Counters and Shift Registers
1. To build Flip-Flop Circuits using elementary gates (RS, Clocked RS, D-type, and JK Flip-Flop).
2. To build a 4-bit Counter using D-type/JK Flip-Flop.
3. To make a Shift Register from D-type/JK Flip-Flop.
4. Serial and Parallel shifting of data.

5 : Analog/Digital Conversion
1. To design an analog to digital converter of given specifications.
2. To design a digital to analog converter of given specifications.

6 : Op-Amp
1. To design an Inverting Amplifier of given gain using Op-amp 741 and to study its Frequency Response.
2. To design a Non-Inverting Amplifier of given gain using Op-amp 741 and to study its Frequency Response.
3. To design and study a precision Differential Amplifier of given I/O specification using Op-amp 741.

7 : Timer
1. To design an Astable Multivibrator of given specifications using 555 Timer.
2. To design a Monostable Multivibrator of given specifications using 555 Timer and to measure the Pulse-Width of its output.

**Note**

1. Each college should set up all the Practicals from the above list.
2. Each student is required to perform at least 8 Practicals by taking at least 1 Practical from each of the units 206.1 to 206.7.
Complex Variables


(2 Lectures)


(6 Lectures)

Power Series of a Complex Variable. Taylor and Laurent Series.  

(4 Lectures)

Residue and Residue Theorem. Contour Integration and its Applications to Evaluation of Integrals.  

(10 Lectures)

Second Order Differential Equations and Special Functions


(8 Lectures)


(18 Lectures)

Suggested Books:

4. Special Functions for Scientists and Engineers By W. W. Bell (Dover Publishers, 1968)
THEORY


(6 Lectures)

Intel 8085 Microprocessor Architecture


(7 Lectures)


(7 Lectures)

Microprocessor Programming :- Algorithm and Flowcharts. Simple programming Exercises : Addition, Subtraction, Multiplication and Division - Both 8 and 16 bit etc.

(4 Lectures)

C & C++ Programming Languages


(1 Lectures)


(1 Lecture)


(3 Lectures)

I/O Statements :- printf, scanf, getc, getch, getchar, getche, etc. Streams : cin and cout. Manipulators for Data Formatting: setw, width, endl and setprecision etc. Ascii Files I/O.

(3 Lectures)

Preprocessor :- #include and #define directives.

(4 Lectures)

Arrays and Structures :- One and Two Dimensional Arrays. Idea of Structures.

(1 Lectures)


(2 Lectures)


(3 Lectures)

Idea of Strings and Pointers.

(1 Lectures)


(4 Lectures)

Suggested Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085 By Ramesh S. Gaonkar, (Prentice Hall, 2002).

Paper -11-PHHT-309: Thermal Physics
Thermodynamics


(4 Lectures)


(8 Lectures)


(6 Lectures)


(6 Lectures)


(6 Lectures)

Kinetic Theory of Gases


(6 Lectures)
Molecular Collisions: Mean Free Path, Collision Probability, Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

(4 Lectures)


(8 Lectures)

Suggested Books:
1. Thermodynamics By Enrico Fermi (Courier Dover Publications, 1956)

(16 Lectures)

Functions of a Real Variable. Limits, Continuity and Differentiability of Functions. Uniform Continuity. Continuity on (a, b) implying Uniform Continuity and Boundedness. Intermediate Value Theorems and Taylor’s Theorem for Analytic Functions. Taylor’s and Mclaren’s Series of Elementary Analytic Functions.

(12 Lectures)

Functions of two and three Real Variables, their Continuity and Differentiability. Schwarz and Young’s Theorems, Implicit Function Theorem, Taylor’s Theorem. Maxima and Minima.

(8 Lectures)


(12 Lectures)

Suggested References

Physics Lab III

PRACTICALS

1 : Mechanical Equivalent of Heat

1. To determine J by Callender and Barne’s constant flow method.

2 : Thermal Conductivity

1. To determine the Coefficient of Thermal Conductivity of Copper by Searle’s Apparatus.
2. To determine the Coefficient of Thermal Conductivity of Copper by Angstrom’s Method.
3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton’s disc method.

3 : Resistance Temperature Devices

2. To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement.

4 : Thermocouples

1. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
2. To Calibrate a Thermocouple to measure Temperature in a Specified Range using (1) Null Method (2) Direct Measurement using an Op-Amp Difference Amplifier and to determine Neutral Temperature.

Note

1. Each college should set up all the Practicals from the above list.
2. Each student is required to perform at least 6 Practicals by taking at least 1 Practical from each of the units 305.1 to 305.4.

Text and Reference Books

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5. Nelson and Jon Ogborn, Practical Physics.
PRACTICALS Marks: 100

1 : Assembly Language Programming (using 8 bit processor).

1. Addition and Subtraction of Numbers using Direct Addressing Mode.
2. Addition and Subtraction of Numbers using Indirect Addressing Mode
4. Division by Repeated Subtraction.
5. Handling of 16-bit Numbers.
6. Use of CALL and RETURN Instruction.
7. Block Data Handling.
8. Other Exercises (e.g. Parity Check etc.).

2 : C & C++ Programming

1. To evaluate a Polynomial :- (1) Converting Temperature from Fahrenheit to Celsius, (2) Area of a Circle, (3) Volume of Sphere etc.
2. To find the Roots of a Quadratic Equation : Real and Distinct, Repeated and Imaginary.
3. To locate a Number in a Given List (linear search).
4. (i) To find the Largest of Three Numbers.
   (ii) To find the Largest Number in a Given List of Numbers.
5. (i) To check whether a Given Number is a Prime Number.
   (ii) To calculate the first 100 prime numbers.
6. To rearrange a List of Numbers in Ascending and Descending Order.
7. (i) To calculate Factorial of a Number.
   (ii) To calculate the first few Factorials.
8. Manipulation of Matrices
   (i) To Add and Subtract two Matrices.
   (ii) To Multiply two Matrices.

Suggested Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085 By Ramesh S. Gaonkar, (Prentice Hall, 2002).
THEORY

Linear Vector Spaces


(9 Lectures)

Matrices


(6 Lectures)


(9 Lectures)

Partial Differential Equations


(11 Lectures)


(13 Lectures)
**Suggested Books:**

2. Linear Algebra Theory and Applications by Ward Cheney and David Kincaid (Jones & Bartlett).
THEORY

Geometrical Optics

Fermat’s Principle :- Optical Path. Fermat’s Principle of Least Time or Extremum Path. Examples of Fermat’s Principle:- (1) Reflection and (2) Refraction.

(1 Lecture)


(8 Lectures)

Wave Optics


(3 Lecture)

Interference


(10 Lectures)

Michelson’s Interferometer:- (1) Idea of form of fringes (No Theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, (5) Standardization of Meter and (6) Visibility of Fringes.

(4 Lectures)


(2 Lectures)
Diffraction
Fresnel diffraction:- Fresnel’s Assumptions. Fresnel’s Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Comparison of a Zone plate with a Convex lens. Diffraction due to (1) a Straight Edge and (2) a Rectangular Aperture (Slit), (3) a Small Circular Aperture and (4) an Opaque Circular Disc. Fresnel’s Integrals, Cornu’s Spiral : Fresnel Diffraction Pattern due to (1) a Straight Edge, (2) a Slit, and (3) a Wire (Qualitatively using Cornu’s Spiral).

(12 Lectures)

Fraunhofer diffraction : Diffraction due to (1) a Single Slit, (2) a Double Slit and (3) a Plane Transmission Grating. Rayleigh’s criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

(6 Lectures)


(2 Lectures)

Suggested Books :

6. Introduction to Optics by Khanna and Gulati
Analysis


(14 Lectures)


(10 Lectures)

Statistics (35)


(4 Lectures)


(10 Lectures)


(10 Lectures)

Suggested References:


Errors and Iterative Methods

Solution of Algebraic and Transcendental Equations

Matrices and Linear System of Equations
Solution of Linear Equations :- (1) Gauss Elimination Method and (2) Gauss-Seidel Iterative Method.

Eigenvalues and Eigenvectors :- Computation of Eigenvalues and Eigenvectors of Matrices by using Iterative Methods.

Interpolation

Curve Fitting, B-Splines and Approximation

Numerical Differentiation
Numerical Integration


(7 Lectures)

Solution of Ordinary Differential Equations (ODE’s)


(6 Lectures)


(2 Lectures)

Suggested Books:

Physics Lab IV

PRACTICALS Marks: 100

1: Reflection, Refraction and Dispersion

1. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
2. To determine the Refractive Index of a Liquid by Total Internal Reflection using Wollaston’s Air-film.
3. To determine the Refractive Index of (1) Glass and (2) a Liquid by Total Internal Reflection using a Gaussian Eyepiece.
5. To determine the value of Cauchy Constants.
6. To determine the Resolving Power of a Prism.

2: Interference

1. To determine wavelength of sodium light using Fresnel Biprism.
2. To determine wavelength of sodium light using Newton’s Rings.
3. To determine the Thickness of a Thin Paper by measuring the Width of the Interference Fringes produced by a Wedge-Shaped Film.
4. To determination Wavelength of Sodium Light using Michelson’s Interferometer.

3: Diffraction

1. To determine the Diameter of a Thin Wire by studying the Diffraction Produced by it.
2. To determine the wavelength of Laser light using Diffraction of Single Slit.
3. To determine the wavelength of (1) Sodium and (2) Mercury Light using Plane Diffraction Grating.
5. To determine the Resolving Power of a Plane Diffraction Grating.
7. To study the Polarization of Light by Reflection and to determine the Polarizing Angle for air-glass interface.
8. To measure the Intensity using Photosensor and Laser in diffraction patterns of single and double slits.

Note

1. Each college should set up at least 14 Practicals from the above list.
2. Each student is required to perform 8 Practicals by taking at least 2 Practicals from each of the three units 405.1 to 405.3

Text and Reference Books

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5. Nelson and Jon Ogborn, Practical Physics.
PHHP-414: Numerical Analysis Lab

PRACTICALS                          Marks: 100

1 : Algebraic & Transcendental Equations
   1. To find the Roots of an Algebraic Equation by Bisection Method.
   2. To find the Roots of an Algebraic Equation by Secant Method.
   3. To find the Roots of an Algebraic Equation by Newton-Raphson Method.
   4. To find the Roots of a Transcendental Equation by Newton-Raphson Method.

2 : Linear Equations & Eigenvalue Problem
   1. To find the Roots of Linear Equations by Gauss Elimination Method.
   2. To find the Roots of Linear Equations by Gauss-Seidal Iterative Method.
   3. To find the Eigenvalue and Eigenvector of a Matrix by Iterative Method.

3 : Interpolation
   1. To form a Forward Difference Table from a Given set of Data Values.
   2. To form a Backward Difference Table from a Given Set of Data Values.
   3. To find the value of y near the beginning of a Table of values of (x, y).
   4. To find the value of y near the end of a Table of values of (x, y).

4 : Curve Fitting, B-Splines & Approximation
   1. To fit a Straight Line to a given Set of Data Values.
   2. To fit a Polynomial to a given Set of Data Values.
   3. To fit an Exponential Function to a given Set of Data Values.
   4. To fit a natural Cubic B-Spline to a given Data.

5 : Differentiation
   1. To find the First and Second Derivatives near the beginning of a Table of values of (x, y).
   2. To find the First and Second Derivatives near the end of a Table of values of (x, y).

6 : Integration
   1. To evaluate a Definite Integral by Trapezoidal Rule.
   2. To evaluate a Definite Integral by Simpson’s 1/3 Rule.
   3. To evaluate a Definite Integral by Simpson’s 3/8 Rule.
   4. To evaluate a Definite Integral by Gauss Quadrature Formula.

7 : Differential Equations
   1. To solve a Differential Equation by Euler’s Method.
   2. To solve a Differential Equation by Modified Euler’s Method.
   3. To solve a Differential Equation by Second Order Runge Kutta Method.
   4. To solve a Differential Equation by Fourth Order Runge Kutta Method.
Note

1. The above Problems are to be programmed in C/C++.
2. The above Problems can also be solved by using appropriate computer softwares.
3. Each Student is required to write and run at least 14 Programs by taking at least 2 Problems from each of the units from 405.1 to 405.7.

Suggested Books:

Integral Transforms


(6 Lectures)

Laplace Transforms (LTs) :- Existence Theorem. LTs of Elementary Functions. Properties of LTs : (1) Change of Scale Theorem, (2) Shifting Theorem, (3) LTs of Derivatives and Integrals of Functions, (4) Derivatives and Integrals of LTs, (5) LT of Unit Step function, (6) LTs of Periodic Functions, and (6) Convolution Theorem. Inverse LT (Bromwich Integral).

(9 Lectures)

Applications of Laplace Transforms :- (1) Solution of First and Second Order ODEs, (2) Solution of Simultaneous First Order ODEs, (3) Solution of One-Dimensional PDEs : Wave and Diffusion Equations, (4) Evaluation of Definite Integrals.

(6 Lectures)

Dirac Delta Function


(3 Lectures)

Cartesian Tensors


(14 Lectures)
General Tensors


(10 Lectures)

Suggested Books:


Paper-18-PHHT-516: Quantum Mechanics

THEORY Marks: 100

Particles and Waves

Heisenberg’s Uncertainty Principle (Uncertainty Relations involving Canonical Pair of Variables) : Derivation from Wave Packets. γ-ray Microscope.  

**(20 Lectures)**

**Quantum Mechanics**

Basic Postulates and Formalism :- Energy, Momentum and Hamiltonian Operators. 

**(8 Lectures)**

**Applications of Schrödinger Wave Equation:**

Eigen Functions and Eigenvalues for a Particle in a One Dimensional Box.  

**(2 Lectures)**


**(12 Lectures)**


**(6 Lectures)**

**Suggested Books:**

2. E. Merzbacher, Quantum Mechanics, 3rd edition, (John Wiley & Sons, Inc1997)
Paper-19-PHHT-517: Atomic and Molecular Physics

THEORY

Marks: 100

Determination of e/m of the Electron. Thermionic Emission. Isotopes and Isobars.

(5 Lectures)


(7 Lectures)


(5 Lectures)

Atoms in External Magnetic Fields :- Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

(4 Lectures)


(10 Lectures)


(9 Lectures)


(4 Lectures)


(4 Lectures)

Suggested Books:


6. Optoelectronics by Ghatak and Thyagarajan

7. Principles of Lasers by Svelto

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**Paper-20-PHHT-518: Electronic Devices**

**THEORY**

Marks: 100

Circuit Analysis :- Kirchhoff’s Laws, Mesh and Node Analysis of dc and ac Circuits, Duality in Networks, Equivalent Star (T) and delta (π) Networks of a Given Network, Star to Delta and
Delta to Star Conversion. Wheatstone Bridge and its Applications to Wein Bridge and Anderson Bridge.

(6 Lectures)


(5 Lectures)


(4 Lectures)


(6 Lectures)


(8 Lectures)

Coupled Amplifiers:– RC-Coupled Amplifier and its Frequency Response of Voltage Gain.

(2 Lectures)

Feedback in Amplifiers, Effects of Positive and Negative Feedback on Input Impedance, Output Impedance and Gain, Stability, Distortion and Noise.

(3 Lectures)


(3 Lectures)

Non-Sinusoidal Oscillators – Astable and Monostable Multivibrators.

(3 Lectures)

Three-terminal Devices (UJT and FETs):– (1) UJT : Its Characteristics and Equivalent Circuit. Relaxation Oscillator, (2) JFET : Its Characteristics and Equivalent Circuit. Advantages of JFET. MOSFET (Qualtiative Discussion only).

(4 Lectures)

Suggested Books:

Physics Lab V

PRACTICALS                          Marks: 100

1 : Determination of Fundamental Constants

1. To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode.
2. To determine the value of Planck’s Constant by using a Photoelectric Cell.
3. To determine the value of Planck’s Constant by using LEDs of at least 4 Different Wavelengths.

2 : Atomic & Molecular Physics

1. To determine the value of e/m by (a) Magnetic Focussing or (b) Bar Magnet. To determine the wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg’s Constant.
3. To determine the Absorption Lines in the Rotational Spectrum of Iodine Vapour.

3 : Miscellaneous

1. To determine the Wavelength and the Angular Spread of a He-Ne Laser.
2. To determine the value of Stefan’s Constant.
3. To determine the Wavelength and the Velocity of Ultrasonic Waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the Diffraction of light through an Ultrasonic Grating.

Note

1. Each College should set up all the Practicals from the above list.
2. Each Student is required to perform 6 Practicals by taking at least 1 Practical from each of the units 505.1 to 503.3.

Text and Reference Books

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5. Nelson and Jon Ogborn, Practical Physics.
Physics Lab VI

PRACTICALS                          Marks: 100

1 : Networks

1. To verify the Thevenin, Norton, Superposition, and Maximum Power Transfer Theorem
2. To measure the Input and Output Impedance of an Unknown Network and to convert it into Equivalent T and Pi Circuits.

2 : Power supply

1. To study (a) Half-wave Rectifier and (b) Full-wave Bridge Rectifier and investigate the effect of C, L and π filters.
2. To design a Semiconductor Power Supply of given rating using (a) Half wave, (b) Full wave or (c) Bridge rectifier and investigate the effect of C-filter.
3. To study the Forward and Reverse characteristics of a Zener Diode and to study its use as a Voltage Regulator.
4. To investigate simple regulation and stabilization circuits using Voltage Regulator ICs.

3 : Transducers

1. To determine the Characteristics of p-n junction of a Solar Cell.
2. To study the Characteristics of a Photo-diode.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.

4 : Transistor Applications

1. To study the CE Characteristics of a Transistor.
2. To study the various Transistor Biasing Configurations.
3. To design a CE Amplifier of a given gain (mid-gain) using Voltage Divider Bias.
4. To study the Frequency Response of Voltage Gain of a RC-Coupled Amplifier.
5. To design an Oscillator of given specifications using Transistors.
6. To study the Characteristics of a FET and design a common source amplifier.

Note

1. Each college should set up all the Practicals from the above list.
2. Each student is required to perform at least 8 Practicals by taking at least 2 Practicals from each of the units 506.1 to 506.3.
3. The students should be encouraged to do practicals by using Breadboard or softwares like PSpice wherever possible.

Text and Reference Books

3. Adrian C. Melissinos, Jim Napolitano, Experiments in Modern Physics.
5. A. P. Malvino, Electronics.
Maxwell’s Equations


(12 Lectures)

Reflection and Refraction of Electromagnetic Waves


(12 Lectures)

Polarization of Electromagnetic Waves


(10 Lectures)


(5 Lectures)

Wave Guides


(6 Lectures)

(3 Lectures)

**Suggested Books:**

THEORY

Classical Statistics


(16 Lectures)

Classical Theory of Radiation


(4 Lectures)

Quantum Theory of Radiation


(8 Lectures)

Bose-Einstein Statistics


(10 Lectures)

Fermi-Dirac Statistics


(10 lectures)
**Suggested Books:**

5. Statistical Mechanics by eyring eyring eyring

THEORY

Marks: 100

Crystal Structure


(8 Lectures)

Elementary Lattice Dynamics


(6 Lectures)

Magnetic Properties of Matter


(8 Lectures)

Dielectric Properties of Materials


(6 Lectures)

Electrical Properties of Materials


(10 Lectures)
Superconductivity:


(6 Lectures)


(4 Lectures)

Reference Books


$\alpha$-decay: Range of $\alpha$-particles, Geiger-Nuttal law and $\alpha$-particle Spectra. Gamow Theory of Alpha Decay. (4 Lectures)

$\beta$-decay: Energy Spectra and Neutrino Hypothesis. (2 Lectures)

$\gamma$-decay: Origin of $\gamma$-rays, Nuclear Isomerism and Internal Conversion. (2 Lectures)


Accelerators: Van de Graaff Generator, Linear Accelerator, Cyclotron, Betatron, and Light and Heavy Ion Synchro-Cyclotron. Idea of Large Hadron Collider. (4 Lectures)


Cosmic Rays: Nature and Properties. (1 Lecture)


(8 Lectures)

**Suggested Books:**

Physics Lab VII

PRACTICALS Marks: 100

1: Polarization

1. To verify the Law of Malus for Plane Polarized Light.
2. To determine the Specific Rotation of cane sugar using Polarimeter.
3. To analyze Elliptically Polarized Light by using a Babinet’s Compensator.
4. To measure the Numerical Aperture of an Optical Fibre.

2: Measurement of Magnetic Field and Related Parameters

1. Measurement of field strength B and its variation in a Solenoid (Determination of dB/dx).
2. To draw the BH curve of iron by using a Solenoid and to determine the energy loss due to Hysteresis.

3: Measurement in Solid State Physics

1. To measure the Resistivity of a Ge Crystal with Temperature by Four-Probe Method (from room temperature to 200 °C) and to determine the Band Gap $E_g$ for it.
2. To determine the Hall Coefficient and the Hall angle of a Semiconductor.
3. To study the PE Hysteresis loop of a Ferroelectric Crystal.
4. To measure the Magnetic susceptibility of Solids and Liquids.

Note

4. Each College should set up at least all the Practicals from the above list.
5. Each Student is required to perform 6 Practicals by taking at least 1 Practical from each of the units 605.1 to 605.3.

Text and Reference Books

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5. Nelson and Jon Ogborn, Practical Physics.
PHHP-606: Physics Lab-VIII

PRACTICALS                          Marks: 100

1 : Multivibrators and Sweep Circuits

1. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
2. To design an Astable Multivibrator of given specifications using 555 Timer.
3. To design a Monostable Multivibrator of given specifications using 555 Timer and to measure the Pulse-Width of its output.
4. To design a Sweep of given Amplitude and Time.

2 : Modulation

1. To study Amplitude Modulation using Transistor.
2. To study Pulse Width / Pulse Position and Pulse Amplitude Modulation using ICs.
3.

3 : Operational Amplifier based Experiments

1. To design an Amplifier of given gain using an op-amp in inverting and non-inverting configurations and to study its response curve.
2. To investigate the use of an op-amp as an Integrator.
3. To investigate the use of an op-amp as a Differentiator.
4. To design an analog circuit to simulate the solution of a first/second order differential equation.
5. To design an op-amp Oscillator.

Note

1. Each college should set up all the Practicals from the above list.
2. Each student is required to perform at least 8 Practicals by taking at least 2 Practicals from each of the units 606.1 to 606.3.
3. The students should be encouraged to do practicals by using Breadboard or Softwares like PSpice wherever possible.

Text and Reference Books

3. Adrian C. Melissinos, Jim Napolitano, Experiments in Modern Physics.
5. A. P. Malvino, Electronics.
**SEMESTER SYSTEM AT THE UNDERGRADUATE LEVEL**

**Course of Study**  
**B.Sc (Honours) Physics**

**Total number of papers: 24**

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