**AC_____**
**Item No. _____**

# UNIVERSITY OF MUMBAI

## Program: B.Sc.

## Course: Physics

## Syllabus for Semester: III & IV

(Choice Based and Credit System with effect from the Academic year 2023-24)

**AC_____**
**Item No. _____**

# UNIVERSITY OF MUMBAI

## Syllabus for Approval

| Sr. No. | Heading | Particulars |
|---|---|---|
| 1 | Title of the Course | B.Sc. in Physics |
| 2 | Eligibility for Admission | |
| 3 | Passing Marks | |
| 4 | Ordinances / Regulations (if any) | |
| 5 | No. of Years / Semesters | 06 Semesters |
| 6 | Level | UG |
| 7 | Pattern | Semester |
| 8 | Status | Revised |
| 9 | To be implemented from Academic Year | From Academic Year: 2023-2024 |

Date: Signature:

Name Prof.(Dr.) Shivram S. Garje
Dean, Science and Technology

Dr.Vaishali Bambole
Chairman of BOS of Physics

# Syllabus for B.Sc.Physics (Theory & Practical)

As per Choice Based and Credit System
Second Year B.Sc 2023-2024

The revised syllabus in Physics as per Choice Based and Credit System for the Second Year B.Sc Course will be implemented from the academic year 2023-2024.

**Preamble:**
The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.

**Objectives:**

- To develop analytical abilities towards real world problems
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem-solving, hands-on activities, study visits, projectsetc

| Course Code | Title | Credits |
|---|---|---|
| | **Semester III** | |
| USPH301 | Thermodynamics and Temperature Transducers | 02 |
| USPH302 | Electronics | 02 |
| USPH303 | Mathematical Methods & Applied Physics I | 02 |
| USPHP3 | Practical 3 | 02 |
| | | Total = 08 |
| | **Semester IV** | |
| USPH401 | Optics & Applied Physics II | 02 |
| USPH402 | Electrodynamics | 02 |
| USPH403 | Quantum Physics | 02 |
| USPHP4 | Practical 4 | 02 |
| | | Total = 08 |

**Scheme of Examination:**

- Each theory paper of each semester will have 25% Internal Assessment (IA) and 75% External Assessment (EA). All external examinations will be held at the end of each semester and will be conducted by the University as per existing norms
- There will be no internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc Physics as per the minimum requirement. There will be three experiments (one from each group) through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

**Semester III**

| Name of the Programme | Duration | Semester | Subject |
|---|---|---|---|
| B.Sc.in Physics | Six semesters | III | **Physics** |
| Course Code | Title | Credits | |
| USPH301 | Thermodynamics and Temperature Transducers | 2 | |

## USPH301 Thermodynamics and Temperature Transducers

**Learning Outcomes**:

On successful completion of this course, students will be able to:

i) Comprehend the basic concepts of thermodynamics & its applications in physical situation.

ii) Learn about situations in low temperature.

iii) Demonstrate tentative problem solving skills in all above areas.

**UNIT I** **(15 Lectures)**

Reversible and irreversible process, Heat Engines, Carnot's cycle, Effective way to increase Efficiency, Carnot's Engines and refrigerator, Coefficient of performance, Second Law of Thermodynamics - Statements, Carnot Theorem, Steam Engine, Otto Engine, Diesel Engine.

BSH: 4.20, 4.23, 4.24, 4.25, 4.26, 4.27, 4.28,4.29, 4.30, 4.31& 4.33.

Maxwell's thermodynamics relations (No derivation required), Applications of Maxwell's thermodynamic relations: Specific Heat Equation, Joule Thomson Cooling, Temperature Change in Adiabatic Process, Clausius – Clapeyron equation

BSH: 6.3, 6.4.1, 6.4.2, 6.4.6&6.4.7

**UNIT II** **(15 Lectures)**

Concept of Entropy, Change in Entropy, Change in Entropy in Adiabatic Process, Change in Entropy in Reversible cycle, Principle of increase of Entropy, Change in Entropy in Irreversible Process, T – S diagram, Physical Significance of Entropy, Entropy of a perfect gas, Kelvin's thermodynamic Scale of temperature, (Omit alternative method using Carnot cycle), The size of a Degree, Zero of Absolute scale, Identity of perfect Gas Scale and Absolute scale.Third Law of

thermodynamics, Zero-point energy, Negative temperatures (Not possible), Heat Death of the Universe.

BSH:5.1 to 5.9, 5.11 to 5.18

Low temp physics: Different methods of liquefaction of gases, Method of freezing, Cooling by Evaporation under reduced Pressure, Cooling by Adiabatic Expansion, Principle of Regenerative Cooling, Liquefaction of Oxygen.

BSH: 7.1, 7.2, 7.3, 7.4, 7.7&7.9

**References:**

BSH: Brijlal, Subramanyam and Hemne, Heat Thermodynamics and Statistical Physics, S Chand,Revised, Multi-coloured,2007 Ed.

**Additional References:**

M W Zemansky and R H Dittman, Heat and Thermodynamics, McGraw Hill.

D K Chakrabarti, Theory and Experiments on Thermal Physics, (2006 Ed) Central books.

Evelyn Guha,Basic Thermodynamics (Narosa Publications)

Philip M. Morse,Thermal Physics (W. A. Benjamin Inc, New York)

Robert and Miller,Heat & Thermodynamics(E LBS)

Saha and Srivastava,A treatise of Heat

ABG: AB Gupta and H. Roy, Thermal Physics, Book and Allied (P) Ltd, Reprint 2008, 2009.

**UIII Temperature Transducers (15 Lectures)**

Introduction to Temperature Transducers, Resistance Temperature Detector (RTD), Platinum Thin Film Sensors, Resistance Thermometer: its types, working principles and applications, Thermistors, Thermocouple, Semiconductor Diode Temperature Sensor, IC Type Sensor, Pyrometers, Total Radiation Pyrometer (TRP), Infrared Pyrometers, Optical Pyrometer,Ultrasonic Temperature Transducer

**Reference:**

Electronic Instrumentation. 3rd edition, H. S. Kalsi, Tata McGraw Hill Education Private LimitedNEW DELHI. (Article no. 13.20.1 to 13.20.13 page no. 456-478)

**Semester III**

| Name of the Programme | Duration | Semester | Subject |
|---|---|---|---|
| B.Sc.in Physics | Six semesters | III | **Physics** |
| Course Code | Title | Credits | |
| USPH302 | Electronics | 2 | |

## USPH302 Electronics

**Learning Outcomes**:

On successful completion of this course, students will be able to:

1. Understand the basics of transistor biasing, operational amplifiers, their applications

2. Understand the basic concepts of oscillators and be able to perform calculations using them

3) Demonstrate quantitative problem solving skill in all the topics covered

**Unit I Analog Electronics** **15 Lectures**

1.Faithful amplification, Transistor Biasing, Inherent Variations of Transistor Parameters, Essentials of a Transistor Biasing Circuit, Methods of Transistor Biasing, Base Resistor Method, Emitter Bias Circuit, Circuit analysis of Emitter Bias, Voltage Divider Bias Method.

**References:** Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand – Multicolour revised edition)

Articles : 9.1 , 9.2 , 9.3 , 9.5, 9.7, 9.8, 9.9 , 9.10 , 9.12

2. General amplifier characteristics**:** Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance, frequency response, Decibel gain and Band width. General theory of feedback, reasons for negative feedback, loop gain.

**References:** Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd.– EEE – 1986)

**Articles :** 7.1, 7.2 , 7.3 , 7.4, 7.5, 7.6, 7.7. , 8.1, 8.7, 8.8 , 17.1 , 17.2, 17.3

**Unit II: Analog Electronics** **15 Lectures**

1. Oscillators**:** Introduction, effect of positive feedback. Requirements for oscillations, phase shift oscillator, Wien Bridge Oscillator, Colpitt's oscillator.

**References:** Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd.– EEE – 1986)

**Articles :** 18.1 , 18.2 , 18.3 , 18.5 , 18.6

2. **Operational Amplifiers:** Introduction, Schematic symbol of OPAMP, Output voltage from OPAMP, , Bandwidth of an OPAMP, Slew rate, Frequency Response of an OPAMP, Virtual ground concept , gain , offset voltage and current , OPAMP with Negative feedback, Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower, Summing Amplifier, Applications of Summing amplifier, OPAMP Integrator and Differentiator, Critical frequency of Integrator, Comparator.

**References:** Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand – Multicolour revised edition)

**Articles**: 25.1 , 25.16 , 25.17 , 25.19, 25.20, 25.21, 25.22 , 25.24 , 25.26, 25.27, 25.32, 25.33 , 25.35 , 25.36, 25.37, 25.38 , 25.39.

**Unit – III**

**Digital Electronics: 15 Lectures**

Flip Flops : RS Flip-Flops (only NOR gate latch, NAND gate latch) , Gated Flip-Flops, Edge-Triggered RS Flip-Flop, Edge- Triggered D Flip-Flop, Edge-Triggered J-K Flip-Flop, JK Master- Slave Flip-Flops.

**Types of registers:** SISO , SIPO, PISO , PIPO [in this chapter the teacher should make all IC specific diagrams into general diagrams ie. Ignore pin numbers and IC numbers]

Asynchronous counter -3 bit (ignore IC specific diagrams), Synchronous counter only mod 8, Decade Counters Mod 5 and Mod 10

**Reference**: Digital Principles and Applications - Leach, Malvino, Saha_ 6th ed

**Articles:**

FFs: 8.1 to 8.5, 8.7

Registers: 9.1 to 9.5

Counters: 10.1, 10.3( upto fig 10.12)

10.5( upto fig 10.22).

**Semester III**

| Name of the Programme | Duration | Semester | Subject |
|---|---|---|---|
| B.Sc.in Physics | Six semesters | III | **Physics** |
| Course Code | Title | Credits | |
| USPH303 | Mathematical Methods & Applied Physics - I | 2 | |

## USPH303 Mathematical Methods & Applied Physics – I

**Learning Outcomes:**

On successful completion of this course students will be able to:

1. The ability to apply the principles of physics to solve new and unfamiliar problems.
2. Learn Mathematical Techniques required to Physical phenomena at the under graduate level and get exposure to important ideas of differential equations.
3. Solve non homogeneous differential equation and partial differential equation using simple methods.
4. Describe and recognize different types of differential equation in program.
5. Understand the basic mathematical concepts and applications of them in physical situations.
6. Students will be exposed to contextual real-life situations.
7. Students will appreciate the role of Physics in 'interdisciplinary areas related to Acoustics and Radio Communication' and understand the scope of the subject in Industry.

**Unit I** **15 Lectures**

**Differential Equations:** Introduction, Ordinary differential equations: first order homogeneous and non- homogeneous differential equations with variable coefficients, Variable separable method, exact differentials equation

General first order Linear Differential equation and Second-order homogeneous differential equations with constant coefficients. Problems depicting physical situations like LC and RL circuits.

**Unit II** **15 Lectures**

Second-order non homogeneous equations with constant coefficients, partial differential equations, some important partial differential equations in physics, method of separation of variables.

Applications of Partial differential Equation: Modeling of vibrating stretched string and two dimensional heat flow equation, Laplace's equation in two dimensions, Solution of wave equation and Helmoltz's equation.

**Reference:**

Higher Mathematical Physics, 1st Edition, 2014, by H.K. Dass and Dr. Rama Verma, S.Chand Publishing ,New Delhi -110 055(Article no.12.1 to 12.7 , page no :273-305)

**Additional References:**

1. Mathematical Physics, B.D. Gupta-Vikas Publishing House, 4th Edition (2006)
2. Mathematical Physics, Sathya Prakash, Sultan Chand, 6th edition (2014)
3. Mathematical Physics Rajput, Pragathi Prakasan Pub., (2017)
4. Mathematical Physics, H.K. Dass, S. Chand & Co., Eighth edition (2018)
5. Mechanics and mathematical methods by R Murugeshn, S Chand. Elements of mechanics by Gupta.
6. Mathematical physics- Piyoosh kumar tyagi , RBSA Publishers
7. Mathematical Methods for Physicists: A concise introduction, - Tai L. Chow - Cambridge University Press.

**Unit III: Acoustics and Radio Communication:** **15 Lectures**

**1. Acoustics of Buildings:** Reverberation, Explanation and Importance of Sabine's formula, Absorption Coefficient, Acoustics of Buildings,Factors Affecting Acoustics of Buildings, Sound Distribution in an Auditorium.

RK: 5.9, 5.10, 5.12, 5.13, 5.14 & 5.15

**Reference:**

RK: Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, SChand & Co.Ltd. (2005-Ed)

**2. Radio communication:**

**i) Basics of Communication:** Block diagram of communication system, types ofcommunication system: simplex, duplex, analog and digital communication,base band and broad band communication. Noiseconcept and types, signal to noise ratio, noise figure, noise temperature.

LF: 1.2,1.3,1.4,1.5,9.5

**ii) Amplitude Modulation:** Need of modulation, concept of modulation, AMwaveform, mathematical expression of AM, AM Receiver: TRF and super heterodyne receiver.

KD: 1.3,3.1.1,3.1.2,6.1,6.2.1

**iii) Frequency Modulation:** Definition, mathematical representation, frequencyspectrum.

KD: 5.1.1,5.1.2,5.1.3

**iv) Concept of ASK, PSK, FSK, PAM, PWM, PPM, PCM.**

KD: Electronic Communication Systems George Keneddy , Bernard Devis, Fourth Edition, TMH Publications

**References:**

1. LF: Communication Electronics: Principles and applications by Louis E Frenzel, 3rd edition TMH Publications.
2. KD: Electronic Communication Systems George Keneddy , Bernard Devis, Fourth Edition, TMH Publications.

**Additional References:**

1. VT: Telecommunication Switching Systems and Network by Vishwanathan andThiagarajan, PHI publication.
2. RC: Electronics Communication Systems by Denis Roddy and John Coolen, PHIpublication.

## PHYSICS PRACTICAL COURSE –USPHP 3 (Credit -02)

**Instructions:**

1. All the measurements and readings should be written with proper units in SI system only.
2. After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
3. While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
4. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

**Learning Outcomes:**

**On successful completion of this course students will be able to:**

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation**.**

- For practical examinations, the learner will be examined in three experiments (one from each group).
- Each experiment will be of three lecture hours' duration.
- A Minimum 4 from each group and in all minimum 12 experiments must be reported in journal.
- All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.

A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester III as per the minimum requirements.

**GROUP A**

1. Helmholtz resonator- determination of unknown frequency
2. Young's modulus by Koenig's method/ Y by bending.
3. Flat spiral spring (Y)
4. Flat spiral spring (n)
5. Determination of acceleration due to gravity using BAR pendulum
6. Log Decrement using Simple Pendulum
7. LCR parallel resonance
8. Verification of Stefan's law (Electrical method)

**GROUP B**

1. G By shunting using MCG
2. Thevenin's Theorem OR Norton's Theorem: To verify the theorems for DC circuits (using same circuit)
3. Opamp: Inverting amplifier with different gains OR Non-inverting amplifier with different gains & Voltage Follower (BB)
4. CE amplifier: determination of bandwidth
5. CE amplifier: variation of gain with load
6. To verify the Reciprocity/ Maximum Power Transfer Theorems
7. Phase shift oscillator /Wien bridge oscillator
8. Colpitt's oscillator/ Hartley oscillator

**GROUP C**

1. Square wave oscillator using gates
2. Study of MS-JK flip flop
3. MOD 2 , MOD 5 & MOD 10 counter using IC 7490
4. Half adder and full adder (7486, 7408)
5. Opamp – Difference Amplifier /Opamp- Summing Amplifier
6. Opamp: Differentiator
7. Opamp: Integrator
8. Shift registers

**Skill Experiments:**

1. Soldering technique
2. Wiring of a simple circuit using bread board
3. Use of DMM- for component testing- diode and transistor
4. Use of oscilloscope- for phase-shift measurement
5. Radius of ball bearings (single pan balance)
6. PC simulations: graph, curve fitting, etc

**Note:** Minimum **12** experiments (Four From each group) and **4** Skill experiments should be completed and reported in the journal, in the first semester. **Certified Journal is a must,** to be eligible to appear for the semester end practical examination.

**Semester End Practical Examination:**

**Scheme of Examination:**

There will be no internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc. Physics as per the minimum requirement. The duration of the practical examination will be two hours per experiment. There will be three experiments (one from each group) through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

**References:**

1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit& B Saha. (6th Edition) Book and Allied Pvt.Ltd.

2. B.Sc PRACTICAL Physics – Harnam Singh S.Chand& Co. Ld. 2001

3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)

4. B.Sc. Practical Physics – CL Arora (1st Edition) -2001 S.Chand and Co Ltd.

5. Practical Physics CL Squires (3rd Edition) Cambridge University

6. University Practical Physics – DC Tayal. Himalaya Publication

**7.** Advanced Practical Physics – Worsnop&Flint.

**Semester IV**

| Name of the Programme | Duration | Semester | Subject |
|---|---|---|---|
| B.Sc.in Physics | Six semesters | IV | **Physics** |
| Course Code | Title | Credits | |
| USPH401 | Optics & Applied Physics II | 2 | |

## USPH401 Optics & Applied Physics II

**Learning Objectives:**

To acquire knowledge of applied Optics and Electronics

**Learning Outcomes:**

After successful completion of the course, the student will be able to:

1. Understand the diffraction, polarization processes and applications of them in physical situations.

2. Understand the applications of interference in design and working of interferometers.

3. Understand the resolving power of different optical instruments.

4. To develop assembly language programming skills and learn the real time applications of microprocessor.

6. Demonstrate quantitative problem solving skill in all the topics covered.

**UI Diffraction and Polarization (15 lectures)**

**1. Fresnel diffraction**: Introduction, Huygens-Fresnel's theory, Fresnel's assumptions, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction, Diffraction pattern due to straight edge: positions of maximum and minimum intensity

SBA: 17.1, 17.2, 17.3, 17.6, 17.7, 17.10, 17.10.1

**2. Fraunhoffer diffraction**: Introduction, Fraunhoffer diffraction at a single slit, intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at double slit, Distinction between single slit and double slit diffraction patterns

SBA: 18.1, 18.2, 18.2.1, 18.4, 18.4.2

**3. Polarization**: Introduction, Malus' Law, Production of Polarized light: The wire grid polarizer and a Polaroid, Polarization by Reflection, Polarization by Double Refraction

Interference of Polarized light: Quarter wave plates and half wave plates (Qualitative)

Ordinary and Extra Ordinary Rays, Positive and Negative crystals

AG: 22.1, 22.2, 22.3, 22.3.1, 22.3.2, 22.3.3, 22.6

SBA: 20.11.2, 20.11.3

**UII Interferometers and Resolving Power (15 Lectures)**

**1. Michelson's Interferometer**: Principle, construction, working, circular fringes, localized fringes, White light fringes, Visibility of fringes.

Applications of Michelson Interferometer: a) Measurement of wavelength b) Determination of the difference in the wavelength of two waves c)Thickness of a thin transparent sheet d) Determination of the refractive index of gases

SBA: 15.7, 15.7.1 to 15.7.7, 15.8, 15.8.1 to 15.8.4

**2. Resolving Power**:Introduction, Rayleigh's criterion, Resolving power of optical instruments, Criterion for resolution according to Lord Rayleigh, Resolving power of a telescope, Resolving power of a prism, Resolving power of a plane transmission grating.

SBA: 19.1, 19.2, 19.5, 19.6, 19.7, 19.11, 19.12

**References:**

1. (SBA) Dr. N. Subrhmanyam, Brijlal, and Dr. M. N. Avadhanulu A Textbook of Optics, 25th Revised Edition (2012) S. Chand

2. (AG) Ajoy Ghatak, Optics 6E Mc Graw Hill Education

**Unit: III - Microprocessors 15 lectures**

**1) Building Concept of Microprocessor:**Introduction, Study of Memory, Input Device, Output Device, Input/output Device, Central Processing Unit.

Chapter 3: 3.1, 3.2 , 3.3 (3.3.1 , 3.3.2 , 3,.3.3) , 3.4. , 3.5 , 3.6 , 3.7

**2) 8085 Microprocessor:** Introduction, Features of Inter 8085, Pin Diagram of 8085, 8085 CPU Architecture ,Arithmetic and Logical Group, Register Group, Interrupt Control , Serial I/O Control Group ,Instruction Register , Decoder and Control Group

Chapter 4: 4.1 ,4.2, 4.3, 4.4 , 4.5 (4.5.1 , 4.5.2 , 4.5.3 , 4.5.4) , 4.6 (4.6.1 , 4.6.2 , 4.6.3), 4.7, 4.8, 4.9 (4.9.1 , 4.9.2 , 4.9.3)

**3) 8085 Instruction Set:** Introduction, Flowchart, Classification of Instruction, Notations used in Instructions and Opcode , Data Transfer Group ,Program Examples for Data Transfer Group , Arithmetic Operation Group , BranchGroup , Logical Group , Addressing Modes , 8085 Programmers Model.

Chapter 6: 6.1, 6.2, 6.3 6.4 , 6.5 , 6.6 , 6.7 , 6.8 (6.8.1 , 6.8.2 , 6.8.3 , 6.8.8 , 6.8.9, 6.8.10 ,6.8.11 (A part Block Transfer)) , 6.9 (6.9.1 upto 6.9.19) , 6.12 , 6.13

**Reference Book:**

Microprocessor and Applications by V.J. Vibhute& P.B. Borole, Fifth Revised Edition, Technova Publications, Pune.

**Additional References:**

1. G: Microprocessor Architecture, programming and Applications with the8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India.

2. Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH

**Semester IV**

| Name of the Programme | Duration | Semester | Subject |
|---|---|---|---|
| B.Sc.in Physics | Six semesters | IV | **Physics** |
| Course Code | Title | Credits | |
| USPH402 | Electrodynamics | 2 | |

## USPH402 Electrodynamics

**Unit I Electrodynamics and Vector calculus: (15 lectures)**

Line, surface, volume integrals, Fundamental thermos of Gradient,

Curvilinear co-ordinates, Divergence and Curl.

**DG**: 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.4, 2.2.2, 2.2.4

**Unit II Electromagnetism (Electrostatics & Magnetostatics) (15 lectures)**

Coulomb's law, Comments on potential, Poisson's equation and Laplace's equation.

Solution and properties of 1D Laplace equation. Properties of 2D and 3D Laplace equation (without proof). First & Second Uniqueness theorem

**DG**: 2.1.2, 2.1.3, 2.3.2, 2.3.3, 3.3.2, 3.3.3, 3.3.4, 3.1.5, 3.1.6

**Unit III Magnetostatics : (15 lectures)**

Magnetization, The Divergence and Curl of B, Ampere's law in magnetized materials, Comparison of Magnetostatics and Electrostatics ,

Bound currents and their physical interpretation, Magnetic susceptibility and permeability.

**DG**: 5.2.1, 5.2.2, 5.3.1, 5.3.2, 5.3.3, 5.3.4, 6.1.4, 6.2.1, 6.2.2, 6.4.1

**References :**

DG : Introduction to Electrodynamics : David J. Griffiths (3rd Ed) Prentice Hall of India.

**Additional References**:

1. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat. Narosa Publishing House.

2. Engineering Electrodynamics : William Hayt Jr. & John H. Buck (TMH).

3. Electricity and Magnetism :Navina Wadhwani (PHI – 2010).

**Semester IV**

| Name of the Programme | Duration | Semester | Subject |
|---|---|---|---|
| B.Sc.in Physics | Six semesters | IV | **Physics** |
| Course Code | Title | Credits | |
| USPH403 | Quantum Mechanics | 2 | |

## USPH403 Quantum Mechanics

**Learning Outcomes:**

On successful completion of this course students will be able to :

1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics.

2) Demonstrate quantitative problem solving skills in all the topics covered.

**Background Reading (Review):**

Origin of Quantum Mechanics:

1) Review of Black body radiation, b) Review of photoelectric effects.

2) Matter waves-De Broglie hypothesis. Davisson and Germer experiment.

3) Wave particle duality

4) Concept of wave packet, phase velocity, group velocity and relation between them

5) Heisenberg's uncertainty principle with thought experiment, different forms of uncertainty.

**Unit I: The Schrodinger wave equation**: **15 Lectures**

1. Concept of wave function, Born interpretation of wave function.

2. Concepts of operator in quantum mechanics examples – position, momentum and energy operators.

3. Eigenvalue equations, expectation values of operators.

4. Schrodinger equation.

5. Postulates of Quantum Mechanics.

6. Analogy between Wave equation and Schrodinger equation.

7. Time dependent and time independent (Steady State) Schrodinger equation, Stationary State

8. Superposition principle.

9. Probability current density, Equation of continuity and its physical significance.

**Unit-II: Applications of Schrodinger steady state equation-I** **15 Lectures**

1. Free particle.
2. Particle in infinitely deep potential well (one - dimension).
3. Particle in finitely deep potential well (one - dimension).
4. Step potential.
5. Particle in three dimension rigid box, degeneracy of energy state.

**Unit-III: Applications of Schrodinger steady state equation –II** **15 Lectures**

1. Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate transmission probability)
2. Theory of alpha particle decay from radioactive nucleus.
3. Harmonic oscillator (one-dimension), correspondence principle.

*[Note: A good number of numerical examples are expected to be covered during the prescribed lectures]*.

**Reference Books**:

1. Concepts of Modern Physics – A. Beiser (6th Ed.) Tata McGraw Hill.
2. Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.
3. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley.
5. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
6. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
7. Quantum Mechanics. - By L. I. Schiff.
8. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub.

## PHYSICS PRACTICAL COURSE –USPHP 4 (Credit -02)

**Instructions:**

1. All the measurements and readings should be written with proper units in SI system only.
2. After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
3. While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
4. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

**Learning Outcomes:**

**On successful completion of this course students will be able to:**

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation**.**

- For practical examinations, the learner will be examined in three experiments (one from each group).
- Each experiment will be of three lecture hours' duration.
- A Minimum 4 from each group and in all minimum 12 experiments must be reported in journal.
- All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.

A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester IV as per the minimum requirements.

**GROUP A**

1. Optical lever: determination of μ

2 Cylindrical obstacle: determination of λ/ Fresnel's bi-prism: determination of λ

3. Determination of Couchy's constants

4. R.P. of telescope/ R.P. of grating

5. Brewster's law: determination of μ

6. Polarimeter: Determination of specific rotation of sugar solution

7. Determination of wavelength of laser using grating

8. Determination of R.I. of liquid by laser

**GROUP B**

1. To determine self inductance of a coil by Maxwell bridge.

2. Plank's Constant using LED (Red colours)

3. Figure of merit of a mirror galvanometer

4. Passive (RC) low pass/High Pass filter

5. Passive band pass filter

6. C1/ C2 by De Sauty's Bridge

7. C1/ C2 by BG/ Determination of Absolute capacitance using BG

8. LCR Transient Response

**GROUP C**

1. Study of 8 Bit D latch

2. Study of 8 Bit Unidirectional Buffer/ Bidirectional Buffer

3. Verification of Inverse square law using LUX meter

4. Gauss Meter: Determination of Magnetic Field with change in current in electromagnet

5. Diode as a temperature sensor

6. 16-bit Data manipulation (Addition, subtraction) Display result on Address field.

7. Write An ALP: a) To Evaluate simple arithmetic Expression (like Y= a x b + c x d where a, b, c and d are 8-bit HEX numbers) / b) To Add parity bit to 7-bit ASCII characters.

8. Write ALP for Addition/ Subtraction/Multiplication of two, 8-bit hex, numbers.

**Demonstrations**

1. Wave form generation using OPAMP- Square wave, triangular wave
2. Slew rate of OPAMP
3. Fresnel diffraction-straight edge, cylindrical obstacle using LASER
4. Fraunhoffer diffraction- Single slit, Double slit, Diffraction grating, reflection grating (steel ruler, CD, etc.), transmission grating (wire gauge, fabric, etc.)
5. Total internal reflection using LASER
6. Concept of beats
7. Coupled oscillations and resonance

**Note:** Minimum **12** experiments (Four From each group) and **4** Skill experiments should be completed and reported in the journal, in the first semester. **Certified Journal is a must,** to be eligible to appear for the semester end practical examination.

**Semester End Practical Examination:**

**Scheme of Examination:**

There will be no internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc. Physics as per the minimum requirement. The duration of the practical examination will be two hours per experiment. There will be three experiments (one from each group) through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

**References:**

1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit& B Saha. (6th Edition) Book and Allied Pvt.Ltd.

2. B.Sc PRACTICAL Physics – Harnam Singh S.Chand& Co. Ld. 2001

3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)

4. B.Sc. Practical Physics – CL Arora (1st Edition) -2001 S.Chand and Co Ltd.

5. Practical Physics CL Squires (3rd Edition) Cambridge University

6. University Practical Physics – DC Tayal. Himalaya Publication

**7.** Advanced Practical Physics – Worsnop&Flint.