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**Choice Based Credit Course Structure and Syllabi**

## B. Sc. (Pass) - Physics

# Department of Physics

## Faculty of Sciences

## Academic Session: 2021-2024

(Prof. Y.K. Vijay) (Dr. Nishant Rana) (Dr. Abhishek Sharma)

Dr Pramod Kesarwani Chandan Joshi

(Dr. Chandan Joshi)

# DEPARTMENT OF PHYSICS

FACULTY OF SCIENCE

**STUDY SCHEME**

**Details of Scheme for B Sc. (Passcourse.) with various Courses and their credits with contact hours are given below:**

**Semester I**

| S.No. | Subject | Lecture (Hr.) | Tutorials (Hr.) | Practical (Hr.) | Credits | | | Total Credits | Paper Category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | | |
| **1.** | **Mechanics & Optics** | **4** | **-** | **2** | **4** | | **1** | **5** | **Core** |
| **2.** | Subject B (Course 1) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| **3.** | Subject C (Course 1 ) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| **4.** | Fundamental of Computers | 2 | - | | 2 | | | 2 | **Fundamental** |
| **5.** | Fundamental of Computers lab | | | 2 | | | 1 | 1 | **Fundamental** |
| **6.** | Environment Studies | 3 | | 2* | 3 | | 1 | 4 | **Fundamental** |
| **7.** | Communication Skills | 2 | 0 | 0 | 2 | 0 | 0 | 2 | **Foundation** |
| **8.** | Communication Skills Lab | 0 | 0 | 2 | 0 | 0 | 1 | 1 | **Foundation** |
| **9.** | Culture Education I | 2 | - | | 2 | | | 2 | **Foundation** |
| | | **21** | | **12** | **21** | | **6** | **27** | |

***Field/ Project Work and Report**

**Semester II**

| S.No | Subject | Lecture (Hr.) | Tutorial (Hr.) | Practical (Hr.) | Credits | | | Total Credits | Paper Category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | | |
| 1. | **Thermodynamics & Waves and Vibrations** | **4** | **-** | **2** | **4** | | **1** | **5** | **Core** |
| 2. | Subject B (Course 2) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| 3. | Subject C (Course 2) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| 4. | Computer Application-II ( Advanced MS-Excel ) | | - | 2 | | | 1 | 1 | **Fundamental** |
| 5. | Professional Skills | 2 | 0 | 0 | 2 | 0 | 0 | 2 | **Foundation** |
| 6. | Professional Skills Lab | 0 | 0 | 2 | 0 | 0 | 1 | 1 | **Foundation** |
| 7. | Culture Education-2 | 2 | 0 | 0 | 2 | 0 | 0 | 2 | **Foundation** |
| | | **16** | | **10** | **16** | | **5** | **21** | |

(Prof. Y. K. Vijay)

(Dr. Nishant Gaur)

Dr Kanav Saxena

(Dr. Abhishek Shar

Chandan Joshi

( Dr. Chandan Jos

## Semester III

| S.No | Subject | Lecture (Hr.) | Tutorial (Hr.) | Practical (Hr.) | Credits | | | Total Credits | Paper Category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | | |
| **1.** | **Mathematical Physics & Electronics** | **4** | **-** | **2** | **4** | | **1** | **5** | **Core** |
| 2. | Chemistry B (Course3) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| 3. | Mathematics C (Course3) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| 4. | Computer Application -III ( MS- Projects) | | - | 2 | | | 1 | 1 | **Fundamental** |
| 5. | Life Skills1(Aptitude) | 1 | 0 | 2 | 1 | 0 | 1 | 2 | **Foundation** |
| 6. | Value Education-1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | **Foundation** |
| 7. | Open Elective I | 3 | | 0 | 3 | | 0 | 3 | **Interdisciplinary** |
| | | **17** | | **10** | **17** | | **5** | **22** | |

## Semester IV

| S.No | Subject | Lecture (Hr.) | Tutorials (Hr.) | Practical (Hr.) | Credits | | | Total Credits | Paper Category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | | |
| **1.** | **Solid State Physics & Nuclear and Particle Physics** | **4** | **-** | **2** | **4** | | **1** | **5** | **Core** |
| 2. | Chemistry (Course4) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| 3. | Mathematics (Course 4) | 4 | - | 2 | 4 | | 1 | 5 | **Core** |
| 4. | Computer Application -IV ( Web Designing ) | 2 | - | | 2 | | | 2 | **Fundamental** |
| 5. | Computer Application -IV ( Web Designing ) Lab | | | 2 | | | 1 | 1 | **Fundamental** |
| 6. | Life Skills-2 (Personality Development) | 1 | 0- | 2 | 1 | 0 | 1 | 2 | **Foundation** |
| 7. | Value Education-2 | **1** | **0** | **0** | **1** | **0** | **0** | **1** | **Foundation** |
| | | **16** | | **10** | **16** | | **5** | **21** | |

(Prof. Y. K. Vijay)

(Dr. Nishant Laws)

Dr Pranav Sexena

(Dr. Abhishek Shyam

Chandan Joshi

(Dr. Chandan Jo

## Semester V

| S.No | Subject | Lecture (Hr.) | Tutorials (Hr.) | Practical (Hr.) | Credits | | | Total Credits | Paper Category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | | |
| 1. | **Quantum Mechanics & Electromagnetic Theory** | 4 | - | 2 | 4 | | 1 | 5 | Core |
| 2. | Subject B(Course5 | 4 | - | 2 | 4 | | 1 | 5 | Core |
| 3. | Subject C(Course5) | 4 | - | 2 | 4 | | 1 | 5 | Core |
| 4. | Project | | | 12 | | | 6 | 6 | Discipline Specific |
| | | 12 | | 18 | 12 | | 9 | 21 | |

## Semester VI

| S.No | Subject | Lecture (Hr.) | Tutorials (Hr.) | Practical (Hr.) | Credits | | | Total Credits | Paper Category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | | |
| 1 | **Atomic and Molecular Physics & Renewable Energy** | 4 | 1 | - | 4 | 1 | 0 | 5 | Core |
| 2 | Chemistry (Course 6) | 4 | - | 2 | 4 | | 1 | 5 | Core |
| 3 | Mathematics (Course 6) | 4 | | 2 | 4 | | 1 | 5 | Core |
| 4 | Open Elective- II | 3 | | | 3 | | | 3 | Interdisciplinary |
| 5 | Open Elective –III | 3 | | | 3 | | | 3 | Interdisciplinary |
| | | 18 | | 6 | 18 | | 3 | 21 | |

# Total Credits

| Credits | I Sem | II Sem | III Sem | IV Sem | V Sem | VI Sem | Total |
|---|---|---|---|---|---|---|---|
| | 27 | 21 | 22 | 21 | 21 | 21 | 133 |

(Prof. V.K. Vijay)

(Dr. Nishant Gaur)

(Dr Abhishek Sharma)

Dr Kumar Sourav

Chandan Joshi

(DS Chandan Joshi)

**JECRC University, Jaipur**

**Department of Physics (Faculty of Sciences)**

# BOARD OF STUDIES - PHYSICS

## Minutes of the Meeting

Date: January 20, 2022

Following members of Board of Studies committee were present:

1. Prof. Widhi Dubey, Dean (SOS)
2. Prof. Pranav Saxena (Head & Chairperson)
3. Dr. Nishant Gaur (Associate Professor)
4. Dr. Chandan Joshi (Asstt Professor)
5. Dr Abhishek Sharma (Asstt. Professor)

The meeting was chaired by the chairperson and welcomes the Dean (SOS) and members of BOS. A meeting of Board of Studies (Physics) took place at 2:00 PM on January 20, 2022 to approve the changes in the CODES of the courses offered in BSc (Pass) program for the academic session 2021. The logical reason behind changing the codes is to have proper discrimination between the codes offered in BSc (Honors) Physics and BSc (Pass) course as the codes are well defined with BPH for Honors program. Thus, it is necessary for BSc (Pass) course, the codes should redefine starting with BSP….. The committee agrees and approves with common consensus the changes in the codes only for BSc (Pass) course. In view of this, the list of newly defined codes for all courses offered in BSc (Pass) course is enclosed.

(Prof. Pranav Saxena)
Head, Chairperson

HEAD
Department of Physics
JECRC University, JAIPUR

(Dr. Chandan Joshi)
Assistant Professor

(Dr. Abhishek Sharma)
Assistant Professor

(Dr. Nishant Gaur)
Associate Professor

(Prof. Widhi Dubey)
Dean, School of Sciences

DEAN
School of Sciences
JECRC University, Jaipur-303905

## Code and Credit Structure of Physics Courses Offered in BSc (Pass) Program

| # | CODE | COURSE NAME | CREDIT | CATEGORY |
|---|---|---|---|---|
| | | **SEMESTER – I** | | |
| 1 | BSP001A | Mechanics & Optics | 4 | Core |
| 2 | BSP002A | Mechanics & Optics Lab | 1 | Core |
| | | **SEMESTER – II** | | |
| 3 | BSP003A | Thermodynamics & Waves and Vibrations | 4 | Core |
| 4 | BSP004A | Thermodynamics & Waves and Vibrations Lab | 1 | Core |
| | | **SEMESTER – III** | | |
| 5 | BSP005A | Mathematical Physics & Electronics | 4 | Core |
| 6 | BSP006A | Mathematical Physics & Electronics Lab | 1 | Core |
| | | **SEMESTER – IV** | | |
| 7 | BSP007A | Solid State Physics & Nuclear and Particle Physics | 4 | Core |
| 8 | BSP008A | Solid State Physics & Nuclear and Particle Physics Lab | 1 | Core |
| | | **SEMESTER – V** | | |
| 9 | BSP009A | Quantum Mechanics & Electromagnetic Waves | 4 | Core |
| 10 | BSP010A | Quantum Mechanics & Electromagnetic Waves Lab | 1 | Core |
| | | **SEMESTER – VI** | | |
| 11 | BSP011A | Atomic and Molecular Physics & Renewable Energy | 4 | Core |
| 12 | BSP012A | Atomic and Molecular Physics & Renewable Energy (Seminar) | 1 | Core |

HEAD
Department of Physics
IFCRC University, JAIPUR

## PROGRAM OBJECTIVES (PO):

**PO1: Core competency**: The graduates are expected to know the fundamental concepts of Science and other subjects. These fundamental concepts would reflect the latest understanding of the subject and in allied subject areas. Students will learn to investigate, experiment, relate information and draw logical conclusions based on scientific reasoning.

**PO2: Disciplinary knowledge and skill:** To learn and apply the knowledge in understanding research and addressing practical problems and to apply various scientific methods to address different questions by formulating the hypothesis, data collection and critically analyze the data. The student will be inquisitive about processes and phenomena happening during experiments in laboratories and seeks answers through the research path..

**PO3: Skilled communicator**: Communicate effectively on various scientific issues with the with society at large, They are expected to read and understand documents with in-depth analyses and logical arguments. Graduates are expected to be well-versed in speaking and communicating their idea.

**PO4: Critical thinker and problem solver**: Critical thinking and analytical reasoning and the scientific knowledge will help to develop scientific temper that will be more beneficial for the society. The student will be able to draw logical conclusions based on a group of observations, facts and rules.

**PO5: Team player**: The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based work, project and industry.

**PO6: Moral and ethical awareness**: Graduates are expected to be responsible citizen of India and be aware of moral and ethical baseline of the country and the world.. Emphasis be given on academic and research ethics, including fair Benefit Sharing, Plagiarism, Scientific Misconduct and so on.

**PO7: Skilled project manager**: Graduates are expected to be familiar with decision making process and basic managerial skills to become a better leader by acquiring knowledge about project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

**PO8: Digitally literate**: The student will acquire knowledge in understanding and carrying out data analysis, use of library search tools, and use of software and related computational work. Students will acquire digital skills and integrate the fundamental concepts with modern tools.

**PO9: Environment and sustainability** Apply the knowledge of basic science and allied fields to protect environment and to prevent environmental degradation as science graduate, to stay firm on the value systems, of their culture, including their own for a healthy socio cultural environment.

**PO10: Lifelong learner:** Graduates will acquire the ability to engage independent and self-learning as well as to successfully pursue their career objectives in advanced education and in professional courses, through the use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability.

(Prof. Y.K. Vijay) (Dr. Nishant Chauhan) (Dr. Abhishek Sharma, Chandan Joshi / Dr. Chandan Joshi)

Dr. Pranav Sedani

## PROGRAM SPECIFIC OBJECTIVES (PSOs)

This undergraduate course would provide the specific attributes of physics to the students:

**PSO1**: To understand the basic laws and explore the concepts of physics, significance of the various physical phenomena and carry out experiments to understand fundamentals of basic physics.

**PSO2**: To acquire a wide range of problem solving skills, both analytical and technical and to apply them

**PSO3**: To enhance the student's academic abilities, personal qualities and transferable skills that excel in the competencies and values required for leadership to serve a rapidly evolving global community.

(Prof. V. K. Vijay) (Dr. Nishant Kaur) (Dr. Abhishek Sharma)

(Dr. Pramod Sharma) (Dr. Chandan Joshi)

SEMESTER I

# MECHANICS & OPTICS

**CODE: BPH151A** **Credits: 4**

**UNIT-I**

**Work and Energy Theorem**: Work and Kinetic Energy Theorem. Conservative and Non-Conservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy.

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

**UNIT-II**

**Rotational Dynamics:** Angular Momentum of a Particle and System of Particles. Torque. Conservation of Angular Momentum. Rotation about a Fixed Axis. Moment of Inertia. Calculation of Moment of Inertia for Rectangular, Cylindrical, and Spherical Bodies. Kinetic Energy of Rotation. Motion involving both Translation and Rotation.

**UNIT-III**

**Inertial and Non- Inertial Systems:** Reference Frames: Inertial Frames and Galilean Transformations. Galilean Invariance and Conservation Laws. Non-inertial Frames and Fictitious Forces. Uniformly Rotating Frame. Physics Laws in Rotating Coordinate Systems. Centrifugal forces: Coriolis Force and its Applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

**UNIT-IV**

**Geometrical Optics :** Fermat's Principle: Fermat's Principle of Least Time and Extremum Path. Laws of Reflection and Refraction, Laws of Refraction at Spherical Surface, Thin lens Formula.

**Wave Optics:** Nature of Light :- Theories of Light. Electromagnetic Nature of Light, Definition of a Wave Front. Propagation of a Wave Front. Huygens Principle of Secondary Wavelets.

**Coherence**: Wave Train, Temporal Coherence - Coherence length and Coherence time Spectral Purity. Spatial Coherence and Size of the Source. Visibility as a Measure of Coherence, Applications of coherence.

**UNIT-V**

**Interference:** Interference: Division of Amplitude and Division of Wavefront. Young's Double Slit Experiment. Fresnel's Biprism. Phase Change on Reflection: Stoke's treatment. Newton's Rings: Measurement of Wavelength and Refractive Index. Michelson's Interferometer: (1) Idea of form of fringes (No Theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index.

**Fresnel's Diffraction:** Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave.

**Fraunhoffer Diffraction:** Diffraction due to (1) a Single Slit, (2) a Plane Transmission Grating. Rayleigh's criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

**Suggested Books**


1. University Physics; F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
2. An introduction to Mechanics; Daniel Kleppner, Robert J. Kolenkow, McGraw-Hill, 1973.
3. Mechanics; D. S. Mathur, S. Chand & Company Limited, 2000.


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4. Fundamentals of Optics; F. A. Jenkins and Harvey Elliott White, McGraw-Hill, 1976.
5. Priciples of Optics; B. K. Mathur, 1995, Gopal Printing
6. A Text Book of Optics; N Subrahmanyam, Brij Lal and Avadhanulu, S. Chand.
7. Contemporary Optics; A. K. Ghatak & K. Thyagarajan, Plenum Press, 1978.

**Course Outcomes:**

After the completion of course, student shall be able to

CO1: Understand laws of motion and their application, various laws of conservation, collisions and idea about center of mass and laboratory frames.
CO2: Understand of moment of inertia about the given axis for different uniform mass distributions, the basics of kinematics and dynamics linear and rotational motion.
CO3: Learn about inertial and non-inertial systems and fictitious forces in a non-inertial frame.
CO4: Understand geometrical approximation, Fermat's and Huygen's principles, and the paraxial matrix formalism for refractive and reflective surfaces, including Guass thin lens formula.
CO5: Learn the basic understanding of Interference and diffraction phenomena with different interferometric devices and analytical understanding of fringes formation in various applications.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | H | | | L | | | | L | | L | H | M | L |
| CO2 | M | | | M | | | | | | | | M | |
| CO3 | | H | | M | | | | | | | M | | L |
| CO4 | | H | | | | | | | | | H | M | |
| CO5 | | | | M | | | | L | | L | H | L | |

H = Highly Related; M = Medium L = Low

## MECHANICS & OPTICS LAB

**CODE: BPH152A** **Credit: 1**

Student has to perform any ten experiments out of following experiments:-

**Mechanics**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the height of a building using a Sextant.
3. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
4. To determine the elastic constants of a wire by Searle's method.
5. To find the Torque and angular acceleration of a fly wheel
6. To determine the moment of inertia of fly wheel.
7. To study the torsional oscillation of pendulum in different liquids and determine the rigidity modulus of the suspension wire using torsion pendulum.
6. To determine Resolving power of Telescope.

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7. To determine the wavelength of prominent lines of Mercury by using plane Diffraction Grating.
8. To determine Dispersive Power of a Prism using Mercury light source and Spectrometer.
9. To determine the Specific Rotation of Glucose/Sugar Solution by Polarimeter.
10. To determine the wavelength of Sodium light using diffraction grating and spectrometer.
11. To determine wavelength of sodium light using Fresnel Biprism.
12. To determine wavelength of Sodium light by Newton's Rings' experiment.
13. To determine the Dispersive Power of a Plane Diffraction Grating.
10. To determine transmission coefficient of a semi-transparent glass plate using LB Photometer.
11. To determine the resolving power of a prism
12. To study the polarization of light using He-Ne laser

**Suggested Books**


1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced Level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.


**Course Outcomes**

CO1: Student shall be able to demonstrate the mechanics, linear dynamics (compound pendulum), rotational dynamics (Flywheel)

CO2: Student shall be able to demonstrate the elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method)

CO3: The wave optics part of the lab will give the student a thorough fundamental knowledge within interferometry, coherence, polarization and diffraction.

CO4: To understand various optical phenomena, principles, workings and applications optical instruments like biprism, interferometer, diffraction grating and prism

CO5: Student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | H | L | H | | M | M | | H | H | |
| CO2 | L | H | M | H | M | M | | | L | L | H | | M |
| CO3 | H | M | | M | | | L | | | | | | M |
| CO4 | | | | L | | | | | | M | | | |
| CO5 | H | M | M | L | | M | L | | | | | | M |

H = Highly Related; M = Medium L = Low

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SEMESTER II

# THERMODYNAMICS & WAVES AND VIBRATIONS

**CODE: BPH153A** **Credits: 4**

**UNIT-I**

**Laws of Thermodynamics**: Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Reversible and Irreversible Changes. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot Cycle. Carnot Engine and its Efficiency. Refrigerator and its Efficiency. Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

**UNIT-II**

**Entropy**: Change in Entropy, Entropy of a State, Clausius Theorem. Clausius Inequality. Second Law of Thermodynamics in terms of Entropy. Entropy of a Perfect Gas. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Impossibility of Attainability of Absolute Zero: Third Law of Thermodynamics. Temperature-Entropy Diagrams. First and second order Phase Transitions.

**UNIT-III**

**Statistics**: Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space,Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function. Bose Einstein's distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, Fermi-Dirac Statistics**:** Fermi-Dirac Distribution Law

**UNIT-IV**

**Oscillations in Arbitrary Potential Well**: Simple Harmonic Oscillations. Differential Equation of SHM and its Solution. Amplitude, Frequency, Time Period and Phase. Velocity and Acceleration. Kinetic, Potential and Total Energy and their Time Average Values. Reference Circle. Rotating Vector Representation of SHM.

Free Oscillations of Systems with One Degree of Freedom: (1) Mass-Spring system, (2) Simple Pendulum, (3) Torsional Pendulum, (4) Oscillations in a U-Tube, (5) Compound pendulum: Centres of Percussion and Oscillation, and (6) Bar Pendulum

**UNIT-V**

**Wave Motion**: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

**Velocity of Waves**: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid, in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

**Suggested Books**


1. Enrico Fermi: Thermodynamics, Courier Dover Publications, 1956.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3. Meghnad Saha, B. N. Srivastava, A Treatise on Heat: Including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics, Indian Press, 1958.
4. A. P. French, Vibrations and Waves, CBS Pub. & Dist., 1987.


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Chandan Joshi

(Dr. Chandan Joshi)

5. K. Uno Ingard, Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.
6. N.K. Bajaj, Waves and oscillations, Tata McGraw Hill, New Delhi 1988

**Course Outcomes:** After completion this course, student shall be able to

CO1: Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics and their applications.
CO2: Understand the concept of entropy and the associated theorems.
CO3: Understand the application of BE and FD statistical distribution law to understand macroscopic properties of degenerate systems.
CO4: Learn the fundamentals of oscillating system having one degree of freedom.
CO5: Understand the nature of waves, relationship between the velocity and physical properties of waves and different modes of vibration in stretched string / fluid or in pipe.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | | | | L | | | | L | | L | H | M | |
| CO2 | H | | | M | | | | | | | L | M | L |
| CO3 | | H | | M | | | | | | | H | | L |
| CO4 | H | M | | | | | | | | | M | M | |
| CO5 | | | | | | | | L | | L | H | | L |

H = Highly Related; M = Medium L = Low

## THERMODYNAMICS & WAVES AND VIBRATIONS LAB

**CODE:BPH154A** **Credit:1**

Student has to perform any eight experiments out of the following experiments:-

1. To study Adiabatic changes using Clement and de-Sorme experiment.
2. To determine the mechanical equivalent of heat (J) by Electrical method (Joule's Calorimeter)
3. To verify Newton's cooling law of different materials and different liquid.
4. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
5. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calculate the natural frequency and damping ratio of a spring-mass system, experimentally; and compare the results with theoretical values.
8. To calculate the natural frequency and damping ratio for free vibration of a single DOF cantilever beam with a lumped mass at free end, experimentally; and compare the results with theoretical values.

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9. To calculate the natural frequency and damping ratio for forced vibration of a single DOF cantilever beam with a lumped mass at free end, experimentally; and compare the results with theoretical values
10. To study the Simple Harmonic motion
11. To determine the frequency of an electrically maintained tuning fork by, (a) Transverse mode of vibration, (b) Longitudinal mode of vibration

**Course Outcomes**

CO1: Ability to understand the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium.
CO2: Ability to conduct experiments regarding the measurement and calibration of temperatures and pressures in groups.
CO3: Apply knowledge of electricity and magnetism to explain natural physical processes .
CO4: Develop an understanding of various aspects of harmonic oscillations and waves specially.
CO5: Understand the dynamics of various types of mechanical waves and their superposition

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | H | L | H | | M | M | | H | | |
| CO2 | | H | M | | M | H | | | L | L | M | | M |
| CO3 | H | M | | M | | | M | | | | | H | |
| CO4 | M | | L | L | | | | | | M | | | |
| CO5 | | H | | | L | M | L | | | | | | L |

H = Highly Related; M = Medium L = Low

## SEMESTER III

## MATHEMATICAL PHYSICS & ELECTRONICS

**CODE: BPH155A** **Credits: 4**

**UNIT-I**

**Vector Calculus:** Vector Differentiation. Scalar and Vector Fields. Ordinary and Partial Derivative of a Vector w.r.t. coordinates. Space Curves. Unit Tangent Vector and Unit Normal Vector (without Frenet- Serret Formulae). Directional Derivatives and Normal Derivative. Gradient of a Scalar Field and its Geometrical Interpretation. Divergence and Curl of a Vector Field. Del and Laplacian Operators. Vector Identities.

**Vector Integration:** Ordinary Integral of Vectors. Line, Surface and Volume Integrals. Flux of a Vector Field. Gauss' Divergence Theorem, Green's Theorem and Stokes Theorem.

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**UNIT-II**

**Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

**UNIT-III**

**Number System and Codes:** Decimal, Binary, Octal and Hexadecimal number systems, base conversions, BCD code. Binary, octal and hexadecimal-,BCD- Excess3, graycode-Alphanumeric codes.

**Digital Logic Families:** Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, comparison of TTL and CMOS families. Truth Tables of OR, AND, NOT, NOR, NAND, EXOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra. Demorgan's Theorem.

**Unit-IV**

**Diodes and Applications**: p and n Type Semiconductors. Energy Level Diagram. Conductivity and Mobility. Fabrication and Barrier Formation in p-n junction diode. Current Flow Mechanism in Forward and Reverse Biased Diode (Recombination, Drift and Saturation of Drift Velocity), Diode characteristics: Static and Dynamic Resistance.

**Rectifiers**: Half wave and full wave rectifiers, Calculation of Ripple Factor and Rectification. Efficiency, Qualitative idea of C, L and $\pi$ - Filters. Centre – tapped and Bridge rectifiers, Zener Diode and Voltage Regulation

**UNIT V**

**Transistors**: NPN and PNP Transistors. Characteristics of CB, CE and CC Configurations. Current gains $\alpha$, $\beta$ and $\gamma$ and Relations between them, Bias stability, Load Line Analysis of Transistors, DC Load line and Q-point, Mechanism of Current Flow. Active, Cutoff, and Saturation Regions. Qualitative idea of Class A, B and C amplifiers.

**Suggested Books**


1. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.
2. A. P. French: Vibrations and Waves, CBS Pub. & Dist., 1987.
3. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
4. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
5. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
6. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
7. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill


**Course Outcomes**: After completion this course, student shall be able to-

CO1: Learn the basic mathematical structures of vector calculus in solving the problems in various branches of Physics as well as in engineering

CO2: Understand and learn the Curvilinear coordinates to analyze the applications in problems with spherical and cylindrical symmetries

CO3: Understand the basic knowledge of number system and demonstrate fundamental logic gates using of Boolean functions by employing Boolean algebra and Demorgan's Theorem..

CO4: Develop a fundamental understanding of applications of PN junction diode for different type of rectifiers and voltage regulators

CO5: Demonstrate the working of NPN and PNP transistors in different biasing mode and learn characteristics behavior.

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**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | H | | | L | | | | L | | | H | | |
| CO2 | H | | M | | | L | | | | | | M | M |
| CO3 | | | | M | | | | | | | H | | L |
| CO4 | | H | | | | | | | | | | M | |
| CO5 | | | | M | | M | | L | | L | M | | |

H = Highly Related; M = Medium L = Low

## MATHEMATICL PHYSICS & ELECTRONICS LAB

**CODE: BPH156A** **Credit: 1**

**Introduction Knowledge to Software Scilab:** Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initializing variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).

Student has to perform any ten experiments out of the followings:

1. To study and verify the truth table of logic gates.
2. To study and verify the Demorgan's theorems.
3. Designing of all the logic gates using NAND gate IC.
4. Designing of all the logic gates using NOR gate IC.
5. Study the half wave rectification for positive and negative half cycle
6. Study the full wave rectification, centre tapped full wave rectification and Bridge full wave rectification
7. Study the operation of Half Wave rectifier and how Capacitor filter improves the performance
8. Study the operation of centre tapped rectifier and how Capacitor filter improves the performance
9. Study the operation of Bridge rectifier and how Capacitor filter improves the performance.
10. Study the characteristics of Zener diode and Zener diode as a voltage regulator
11. Study the Input and Output characteristics of BJT common base configuration
12. Study the Input and Output characteristics of BJT common emitter configuration

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**Suggested Books**


1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
5. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
6. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson


**Course Outcomes:** After completion this course, student shall be able to -

CO1: Learn the basics of the Scilab software, their utility, advantages and disadvantages.

CO2: Verify the Boolean algebra, and its importance in understanding various fundamental logic gates and construction of these.

CO3: Learn basic concepts of semiconductor diodes and their applications to rectifiers.

CO4: Learn about junction transistor and their applications

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | L | | | H | H | | | | | | | H | |
| CO2 | | H | | | M | H | M | M | L | L | | M | |
| CO3 | M | M | | H | | | M | | | | H | | |
| CO4 | L | | L | L | | M | | L | | M | H | | L |

H = Highly Related; M = Medium L = Low

## SEMESTER IV

## SOLID STATE PHYSICS & NUCLEAR PHYSICS

**CODE: BPH157A** **Credits: 4**

**UNIT-I**

**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of x-rays by Crystals. Bragg's Law.

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Chandan Joshi

(Dr. Chandan Joshi)

**UNIT-II**

**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Einstein and Debye Theories of Specific Heat of Solids. $T^3$ Law.

**UNIT-III**

**Dielectric Properties of Materials:** Dielectric Polarization. Local Electric Field at an Atom. Depolarization Field. Dielectric Constant. Electric Susceptibility. Polarizability. Classical Theory of Electric Polarizability. Clausius- Mosotti Equation. Normal and Anomalous Dispersion. Complex Dielectric Constant

**UNIT-IV**

**General Properties of Nuclei**: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve.

**Radioactivity decay**: Qualitative idea of (a) Alpha decay: basics of α-decay processes, theory of α-emission, (b) β-decay and neutrino hypothesis, (c) Gamma decay.

**UNIT-V**

**Nuclear Models and Reactions**: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model. Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation (Qualitative).

**Suggested Books:**


1. Charles Kittel: Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
3. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
4. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOPInstitute of Physics Publishing, 2004).
6. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
7. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)


**Course Outcomes:** After completion this course, student shall be able to-

CO1: Understand about crystalline and amorphous substances, about lattice structure, concept of Brillouin zones and diffraction of X-rays by crystalline materials.

CO2: Understand the knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.

CO3: Acquire the essence of dielectric properties of materials.

CO4: To describe and explain the properties of nuclei and derive the various theoretical formulation of nuclear disintegration.

CO5: Understand semi empirical mass relation and about the nucleus structure through various models and the interaction of various nuclear radiations with matter.

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Dr Pramod Kumar Chandan Joshi

(Dr. Chandan Joshi)

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES:**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | H | | | | H | | M | | | | | | H |
| CO2 | | | H | | | L | | M | | | L | | |
| CO3 | M | | | M | | | | | L | | | M | L |
| CO4 | M | H | | | | | | L | | | | | M |
| CO5 | | | | M | | M | | L | | L | H | | |

H = Highly Related; M = Medium L = Low

## SOLID STATE PHYSICS LAB

**CODE: BPH158A** **Credit: 1**

Student has to perform any twelve experiments out of the followings:

Student has to perform the following experiments:-

1. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to $150^0$C) and to determine its band gap.
2. To determine the Hall coefficient of a semiconductor sample.
3. Determine the Bandgap of a semiconductor
4. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
5. To study various crystal structures
6. To find the elastic constants of the Perspex beam using Cornus interference method. (i) Young's modulus(Y), (ii) Poisons ratio (σ) , (iii) Bulk modulus (b)
7. To measure the dipole moment of gaseous and liquid substances using dipolemeter.
8. Estimation of precise lattice parameters of cubic crystal
9. To verify the law of Malus for plane polarized light.
10. To determine the specific rotation of sugar solution using Polarimeter.
11. To analyze elliptically polarized Light by using a Babinet's compensator.
12. To study Polarization and double slit interference in microwaves

**Reference Books:**


1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India


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Dr Pranav Garg

Chandan Joshi

(Dr. Chandan Joshi)

**Course Outcomes:** After completion this course, student shall be able to-

CO1: Learn the techniques to determine the properties of semiconductors

CO2: Investigate the crystal structures and properties of solids

CO3: Test and verify the properties of light by polarizations using Polarimeter and Babinet compensator

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | H | | H | | M | | H | | | L | M | | H |
| CO2 | | M | | | M | | | M | L | | L | | |
| CO3 | M | | L | M | | L | M | | | | | M | L |

H = Highly Related; M = Medium L = Low

## SEMESTER V

### QUANTUM MECHANICS & ELECTROMAGNETIC WAVES

**CODE: BPH159A** **Credits: 4**

**UNIT-I**

**Particles and Waves:** Inadequacies in Classical Physics. Blackbody Radiation: Quantum Theory of Light. Photoelectric Effect. Compton Effect. Franck-Hertz experiment. Wave Nature of Matter: De Broglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Wave description of Particles by Wave Packets. Group and Phase Velocities and Relation between them.

**UNIT-II**

Basic Postulates and Formalism: Energy, Momentum and Hamiltonian Operators. Time-independent Schrodinger Wave Equation for Stationary States. Properties of Wave Function. Interpretation of Wave Function. Probability Density and Probability. Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Expectation Values. Wave Function of a Free Particle

**UNIT-III**

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimension across a step potential & rectangular potential barrier. Motion in 3-dimensions, Degeneracy.

**UNIT-IV**

**Maxwell Equations:** Review of Maxwell's equations. Integral and differential form, Physical significance, Displacement Current, Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density.

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**UNIT-V**

**Optical Fibres:-** Introduction, Numerical Aperture, acceptance angle, fractional index, Step and Graded Indices (Definitions Only), Single and Multiple Mode Fibres (Concept and Definition Only) and its uses.

**Suggested Books:**


1. A Text book of Quantum Mechanics, P.M. Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. Arthur Beiser: Prospects in Modern Physics, McGraw-Hill Book Company (1998).
6. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
7. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill


**Course Outcomes:**

After completion this course, student shall be able to-

CO1: Explain the microscopic phenomena, quantum theory formulation through Schrodinger equation, and understand the Operator Mechanism in Quantum Mechanics

CO2: Interpret the wave function of quantum particle and probabilistic nature of its location, construction of Gaussian wave packet.

CO3: Establish the non-existence of stationary ether, and demonstrate and understanding of the basic principles of the special theory of relativity.

CO4: Understand the fundamental of thermodynamic system with their distinguishably or indistinguishably nature, the Gibbs paradox, equipartition of energy and concept of negative temperature.

CO5: Understand the application of FD statistical distribution law, and ability to understand the Chandrasekhar mass limit, stability of white dwarfs against gravitational collapse.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | | H | | | | | M | | | M | | M | |
| CO2 | H | | H | | | L | | H | | | L | | M |
| CO3 | | M | | M | | | | | M | | | | |
| CO4 | H | | | | M | L | | | | | | | L |
| CO5 | | L | | M | | | | L | | L | M | | L |

H = Highly Related; M = Medium L = Low

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Dr Pramod Garg

Chandan Joshi

(Dr. Chandan Joshi)

## QUANTUM MECHANICS & ELECTROMAGNETIC WAVES LAB

**CODE: BPH160A** **Credit: 1**

Student has to perform any eight experiments out of the followings:

1. To write programme to evaluate scalar potential due to electric charge.
2. To compute and plot electric potential due to two point charges.
3. To plot electric field vector due to electric charge(s).
4. To write programme to evaluate Schrödinger's equation of motion.
5. To write a program to calculate the energy eigen values for harmonic oscillator (first 3energies)
6. To write programme to evaluate Heisenberg's equation of motion.
7. To write a program to calculate probability of quantum mechanical tunneling.
8. To verify the law of Malus for plane polarized light.
9. To determine the specific rotation of sugar solution using Polarimeter.
10. To analyze elliptically polarized Light by using a Babinet's compensator.

**Reference Books**


1. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press
2. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific &
3. Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer.
4. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
6. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
7. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer


**Course Outcomes:** After completion this course, student will be in a position:

CO1: To understand the basics of quantum mechanics and solve Schrodinger equations for a problem.

CO2: To find wave functions of various simple quantum mechanical one dimensional and three dimensional potentials, and Hydrogen like atoms.

CO3: To demonstrate the properties of light through experiments and develop the skill to demonstrate the light propagation through optical fibre.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | H | | H | M | | H | M | H | | | H | | H |
| CO2 | H | L | | M | | | | | M | L | | M | |
| CO3 | | | L | | M | L | | M | | | M | | L |

H = Highly Related; M = Medium L = Low

Semester VI

## ATOMIC AND MOLECULAR PHYSICS & RENEWABLE ENERGY

**CODE: BPH161A** **Credits: 4**

**UNIT I**

**Introduction to Spectroscopy**: X-rays: Ionizing Power, X-ray Diffraction, Bragg's Law. Bohr Atomic Model, Critical Potentials, X-rays-Spectra: Continuous and Characteristic X-rays, Moseley Law. Photoelectron spectroscopy – the photoelectric effect, UV photoelectron spectroscopy UPES, X-ray photoelectron spectroscopy XPES, electron binding energy, ESCA, Auger electron spectroscopy.

**UNIT II**

**Atoms in Electric and Magnetic Fields**: Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

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

**UNIT III**

**Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity

**UNIT IV**

**Solar energy**: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning.

**UNIT V**

**(Qualitative)**

**Wind Energy harvesting**: Fundamentals of Wind energy, Wind Turbines.

**Ocean Energy**: Ocean Energy, Wave Energy and characteristics, Tide energy and characteristics.

**Hydro Energy**: Hydropower resources, environmental impact of hydro power sources

**Suggested Books**:


1. J M Hollas, Basic Atomic and Molecular Spectroscopy, RSC publishing House Cambridge 2002
2. Rita Kakkar, Atomic and Molecular spectroscopy: Basic Concepts and Applications; Cambridge University Press 2015.
3. J. B. Rajam: (with foreword by Louis de Broglie) Atomic physics, S. Chand & Co., 2007.
4. Solar energy - M P Agarwal - S Chand and Co. Ltd.
5. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
6. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press.
7. *Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009*


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Chandan Joshi
(Dr. Chandan Joshi)

**Course Outcomes:** After completion this course, student shall be able to-

CO1: Learn and understand measurement of e/m, the fundamentals characteristics of spectrum by various diffraction processes.

CO2: Explain the behavior of atoms under the influence of electric and magnetic fields such as Stark effect, Zeeman Effect and Paschen Back effect respectively.

CO3: Learn about the energy resources available natural or developed various alternates.

CO4: Understand the developments and importance of solar energy and its applications.

CO5: Acquire the knowledge of other natural renewable sources of energy off-shore wind energy, tidal energy and Hydro energy.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | H | | H | | | M | | H | | | | H | |
| CO2 | M | | H | | | M | | | L | | H | | H |
| CO3 | | M | | M | | | L | | | M | | M | |
| CO4 | L | M | | | M | | | | | | H | | |
| CO5 | | | | L | - | | | M | | L | | L | |

H = Highly Related; M = Medium L = Low

## SEMINAR

**CODE: BPH162A** **Credit: 1**

**Method of Evaluation:**

During the seminar session each student is expected to prepare and present any topic on alternate energy resources as prescribed in syllabus, for duration of about 20 minutes. The students should address the issues critically with latest developments. Each student is expected to present at least twice during the semester and the internal assessment of the student will be evaluated based on that. At the end of the semester, for external assessment he / she has to submit a report on his / her topic and has to present a seminar, the marks are given based on the total performance.

**Course Outcomes:** After this course student shall be able to-

CO1: Use various teaching aids such as projectors, computers for simulations, power point presentation and demonstrative to applications in quantum mechanics.

CO2: Enhance his knowledge and develop his analyzing power to resolve the environmental and sustainability issues.

CO3: Develop the skill of research attitude to review articles and able to prepare and present technical reports with appropriate conclusions/remarks.

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**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES**

| Course Outcomes | Program Outcomes (POs) | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | | M | M | | | H | | | M | M |
| CO2 | | H | L | H | | M | H | | | L | H | | |
| CO3 | M | | L | M | L | | | L | | L | | L | L |

H = Highly Related; M = Medium L = Low

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Dr Pramar Saran

Chandan Joshi

(Dr. Chandan Joshi)