Date :- 15/06/2026

# NOTIFICATION

Sub :- CBCS syllabus of B.Sc. in Physics (Sem V & VI)

Ref. :- Decision of the Academic Council at its meeting held on 10/06/2026

The syllabus of B.Sc. in Physics (Sem V & VI) as per **NATIONAL EDUCATION POLICY - 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2026-27.

A copy of the syllabus shall be downloaded from the college website (www.kcesmjcollege.in).

**Sd/-**
**Chairman,**
**Board of Studies**

**To :**

1. The Head of the Dept., M. J. College, Jalgaon.
2. The office of the COE, M. J. College, Jalgaon.
3. The office of the Registrar, M. J. College, Jalgaon.

Khandesh College Education Society's

# Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon-425001

KNOWLEDGE IS POWER

ESTD. 1945

# STRUCTURE AND SYLLABUS

## B.Sc. Honours/Honours with Research (T.Y.B.Sc.-Physics)

**Under Choice Based Credit System (CBCS)**

**and**

**as per NEP-2020 Guidelines**

**[w.e.f. Academic Year: 2025-26]**

## Preface

The National Education Policy (NEP) framework's T.Y. B.Sc. Physics curriculum aims to give students a substantial foundation in both basic and applied physics. To ensure a **well-rounded** educational experience, this curriculum integrates **core principles** with **advanced** fields of study and technology.

As a fundamental field of study, physics is essential to comprehending both technology developments and natural events. The updated curriculum offers flexibility and interdisciplinary learning possibilities while adhering to the Choice-Based Credit System (CBCS). Students can improve both theoretical knowledge and practical abilities through the combination of core courses, discipline-specific electives, skill enhancement courses, On-Job training (OJT), internship and research-based projects.

The course is designed to equip students with experimental techniques, computational methods, and practical applications, preparing them for higher education, research, and industry careers. Core subjects include Solid state physics, Quantum Mechanics, Nuclear Physics, Electronics, and Computational Physics, Renewable and sustainable energy sources complemented by elective courses that reflect modern scientific advancements. Each course in the syllabus has been thoughtfully designed to maintain a balance between theoretical knowledge and practical application. Our experienced faculty, experts in their respective domains, will lead you through interactive lectures, laboratory experiments, and research projects that enhance critical thinking, problem-solving skills, and a deeper grasp of the subject.

We believe this syllabus will train students with essential critical thinking, problem-solving skills, and practical experience, enabling them to thrive in their careers. We sincerely appreciate the contributions of academic experts, educators, and stakeholders who played a vital role in shaping this curriculum to align with the ever-evolving landscape of science and technology.

Our hope is that this syllabus ignites curiosity, fosters creativity, and cultivates a deep passion for physics, guiding students toward becoming future scientists, researchers, and innovators.

Hence, **Board of Studies in Physics** in its meeting held on **23rd May 2026, Saturday** resolved to accept the revised syllabus for T. Y. B. Sc. (Physics) based on Choice Based Credit System (CBCS) of UGC, NEP-2020 and the Government of Maharashtra guidelines.

## Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

| PO No. | Programme Outcome |
|---|---|
| PO1 | **Disciplinary knowledge:** Show thorough understanding of the core principles, theories and concepts of the chosen science discipline, and how they relate to other fields. |
| PO2 | **Practical and technical skills:** Perform laboratory techniques safely, handle instruments correctly, and record, analyse and interpret experimental data. |
| PO3 | **Critical thinking and problem solving:** Analyse problems logically and apply scientific methods and reasoning to find evidence-based solutions. |
| PO4 | **Communication:** Present scientific information clearly and accurately in speech, in writing and with visual tools. |
| PO5 | **Research aptitude:** Frame questions, design and conduct basic investigations, and report findings using appropriate research methods. |
| PO6 | **Teamwork and leadership:** Work effectively in diverse teams, respect other perspectives, and take initiative in group work. |
| PO7 | **Lifelong learning:** Learn independently, adapt to new technologies and advances, and keep up with current research. |
| PO8 | **Digital literacy:** Use ICT, software, databases and digital tools to access, process and present scientific information. |
| PO9 | **Ethics and social responsibility:** Practise scientific integrity, avoid plagiarism, and apply knowledge to environmental sustainability and community needs. |
| PO10 | **Employability and entrepreneurship:** Apply skills to jobs, higher studies or self-employment, with an innovative and entrepreneurial mindset. |

**Programme Specific Outcome (PSO) for B.Sc. Physics Honours/Honours with Research:**

After completion of this program, students are expected to learn/understand the:

| PO No. | PSO |
|---|---|
| **1** | Develop a strong conceptual foundation in core areas of physics, including solid state physics, Quantum Mechanics, Nuclear Physics, Electronics, and Computational Physics. Utilize mathematical and computational approaches to examine physical phenomena and tackle intricate scientific challenges. |
| **2** | Gain exposure to emerging fields such as nanotechnology, renewable energy, electronics, and computational modeling. |
| **3** | Approach scientific challenges with logical reasoning, problem-solving abilities, and quantitative analysis & develop innovative solutions by integrating knowledge by collaborating other disciplines. |
| **4** | Nurture research-driven skills in Physics by designing experiments, and conducting scientific investigations to foster innovation and technological advancements through interdisciplinary collaborations. |
| **5** | Acquire practical expertise in advanced experimental methods by performing accurate experiments, gathering data, analyzing outcomes, and interpreting findings using statistical and computational techniques. |
| **6** | Apply physics knowledge to address societal and environmental challenges, promoting sustainable development & cultivate a mindset for continuous learning to advancements in such as biophysics, material science, artificial intelligence, and space research. |

**Multiple Entry and Multiple Exit options:**

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

| Levels | Qualification Title | Credit Requirements | | Semester | Year |
|---|---|---|---|---|---|
| | | Minimum | Maximum | | |
| **4.5** | UG Certificate | 40 | 44 | 2 | 1 |
| **5.0** | UG Diploma | 80 | 88 | 4 | 2 |
| **5.5** | Three Year Bachelor's Degree | 120 | 132 | 6 | 3 |
| **6.0** | Bachelor's Degree- Honours<br>**Or**<br>Bachelor's Degree- Honours with Research | 160 | 176 | 8 | 4 |

## Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

**F.Y. B.Sc.**

| Year (Level) | Sem | Subject-I (M-1) | Subject-II (M-2) | Subject-III (M-3) | Open Elective (OE) | VSC, SEC (VSEC) | AEC, VEC, IKS | CC, FP, CEP, OJT, RP | Cumulative Credits/Sem | Degree/ Cumulative Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| **I (4.5)** | I | DSC-1(2T)<br>DSC-2(2P) | DSC-1(2T)<br>DSC-2(2P) | DSC-1(2T)<br>DSC-2(2P) | OE-1(2T) | --- | AEC-1(2T) (Eng)<br>VEC-1(2T) (ES)<br>IKS(2T) | CC-1(2T) | 22 | **UG Certificate** |
| | II | DSC-3(2T)<br>DSC-4(2P) | DSC-3(2T)<br>DSC-4(2P) | DSC-3(2T)<br>DSC-4(2P) | OE-2(2T)<br>OE-3(2P) | --- | AEC-2(2T) (Eng)<br>VEC-2(2T) (CI) | CC-2(2T) | 22 | |
| | **Cum.** | **8** | **8** | **8** | **6** | **---** | **10** | **4** | **44** | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Cr.** | | | | | | | | | |
| **Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.** | | | | | | | | | | |

## S.Y. B.Sc.

| **Year (Level)** | **Sem** | **Subject-I (M-1) Major*** | | **Subject-II (M-2) Minor #** | **Subject-III (M-3)** | **Open Elective (OE)** | **VSC, SEC (VSEC)** | **AEC, VEC, IKS** | **CC, FP, CEP, OJT/Int/RP** | **Cumulative Credits/Sem** | **Degree/ Cumulative Credit** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Mandatory (DSC)** | **Elective (DSE)** | **(MIN)** | | | | | | | |
| **2 (5.0)** | III | DSC-5(2T) DSC-6(2T) DSC-7(2P) | --- | MIN-1(2T) MIN-2(2T) MIN-3(2P) | --- | OE-4(2T) | SEC-1(2T) | AEC-3(2T) (MIL) | CC-3(2T) CEP(2) | 22 | **UG Diploma** |
| | IV | DSC-8(2T) DSC-9(2T) DSC-10(2P) | --- | MIN-4(2T) MIN-5(2P) | --- | OE-5(2T) | SEC-2(2T) SEC-2(2P) | AEC-4(2T) (MIL) | CC-4(2T) ۞ FP(2) | 22 | |
| | **Cum. Cr.** | **12** | **---** | **10** | **---** | **4** | **6** | **4** | **8** | **44** | |
| | **Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.** | | | | | | | | | | |

***** Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

# Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

۞ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

## T.Y. B.Sc.

| **Year (Level)** | **Sem** | **Subject-I (M-1) Major** | | **Subject-II (M-2) Minor** | **Subject-III (M-3)** | **Open Elective (OE)** | **VSC, SEC (VSEC)** | **AEC, VEC, IKS** | **CC, FP, CEP, OJT/Int/RP** | **Cumulative Credits/Sem** | **Degree/ Cumulative Credit** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Mandatory (DSC)** | **Elective (DSE)** | **(MIN)** | | | | | | | |
| **3 (5.5)** | V | DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P) | DSE-1A/B (2T) DSE-2A/B (2P) | --- | --- | --- | VSC-1(2T) VSC-2(2P) | --- | OJT/Int (4) | 22 | **UG Degree** |
| | VI | DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P) | DSE-3A/B (2T) DSE-4A/B (2P) | --- | --- | --- | VSC-3(2T) VSC-4(2P) | --- | --- | 22 | |
| | **Cum. Cr.** | **24** | **8** | **---** | **---** | **---** | **8** | **---** | **4** | **44** | |
| | **Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor** | | | | | | | | | | |

## Fourth Year B.Sc. (Honours)

| **Year (Level)** | **Sem** | **Major Core Subjects** | | **Research Methodology (RM)** | **VSC, SEC (VSEC)** | **OE** | **AEC, VEC, IKS** | **CC, FP, CEP, OJT/Int/RP** | **Cumulative Credits/Sem** | **Degree/ Cumulative Credit** |
|---|---|---|---|---|---|---|---|---|---|---|
| **IV (6.0)** | VII | DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P) | DSE-5A/B (2T) DSE-6A/B (2P) | RM(4T) | --- | --- | --- | --- | 22 | **UG Honours Degree** |
| | VIII | DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P) | DSE-7A/B (2T) DSE-8A/B (2P) | --- | --- | --- | --- | OJT/Int (4) | 22 | |
| | **Cum. Cr.** | **28** | **8** | **4** | **---** | **---** | **---** | **4** | **44** | |
| | **Four Year UG Honors Degree in Major and Minor with 176 credits** | | | | | | | | | |

## Fourth Year B.Sc. (Honours with Research)

| **Year (Level)** | **Sem** | **Major Core Subjects** | | **Research Methodology (RM)** | **VSC, SEC (VSEC)** | **OE** | **AEC, VEC, IKS** | **CC, FP, CEP, OJT/Int/RP** | **Cumulative Credits/Sem** | **Degree/ Cumulative Credit** |
|---|---|---|---|---|---|---|---|---|---|---|
| **IV (6.0)** | VII | DSC-23(4T) DSC-24(4T) DSC-26(2P) | DSE-5A/B (2T) DSE-6A/B (2P) | RM(4T) | --- | --- | --- | RP(4) | 22 | **UG Honours with Research Degree** |
| | VIII | DSC-27(4T) DSC-28(4T) DSC-30(2P) | DSE-7A/B (2T) DSE-8A/B (2P) | --- | --- | --- | --- | RP(8) | 22 | |
| | **Cum. Cr.** | **20** | **8** | **4** | **---** | **---** | **---** | **12** | **44** | |
| | **Four Year UG Honours with Research Degree in Major and Minor with 176 credits** | | | | | | | | | |

**Sem**- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **OE/GE**- Open/Generic elective, **VSC**- Vocational Skill Course, **SEC**- Skill Enhancement Course, **VSEC**- Vocation and Skill Enhancement Course, **AEC**- Ability Enhancement Course, **IKS**- Indian Knowledge System, **VEC**- Value Education Course, **T**- Theory, **P**- Practical, **CC**-Co-curricular **RM**- Research Methodology, **OJT**- On Job Training, **FP**- Field Project, **Int**- Internship, **RP**- Research Project, **CEP**- Community Extension Programme, **ENG**- English, **CI**- Constitution of India, **MIL**- Modern Indian Laguage.

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

# Details of T.Y. B.Sc. (Physics)

| Course | Course Type | Course Code | Course Title | Credits | Teaching Hours/ Week | | | Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | T | P | Total | Internal | | External | |
| | | | | | | | | T | P | T | P |
| ***Semester V, Level – 5.5*** | | | | | | | | | | | |
| DSC-11 | DSC | PHY-DSC-351 | Mathematical Physics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-12 | DSC | PHY-DSC-352 | Solid State Physics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-13 | DSC | PHY-DSC-353 | Classical Mechanics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-14 | DSC | PHY-DSC-354 | Practical on Mathematical & Solid State Physics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| DSC-15 | DSC | PHY-DSC -355 | Practical on Classical Mechanics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| DSE-1A | DSE | PHY-DSE-351A | Laser Physics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSE-1B | DSE | PHY-DSE-351B | Forensic Physics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSE-2A | DSE | PHY-DSE-352A | Practical on Laser Physics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| DSE-2B | DSE | PHY-DSE-352B | Practical on Forensic Physics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| VSC-1 | VSC | PHY-VSC-351 | Renewable Energy | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| VSC-2 | VSC | PHY-VSC-352 | Practical on Renewable Energy | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| OJT/Int | OJT | PHY-OJT-351 | On Job Training | 4 | --- | 8 | 8 | --- | 40 | --- | 60 |
| ***Semester VI, Level – 5.5*** | | | | | | | | | | | |
| DSC-16 | DSC | PHY-DSC-361 | Classical Electrodynamics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-17 | DSC | PHY-DSC-362 | Nuclear Physics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-18 | DSC | PHY-DSC-363 | Quantum Mechanics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-19 | DSC | PHY-DSC-364 | Atomic Physics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-20 | DSC/IKS | PHY-DSC-365 | Physics Behind Historical Monuments | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSC-21 | DSC | PHY-DSC-366 | Practical on Electrodynamics and Nuclear Physics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| DSC-22 | DSC | PHY-DSC-367 | Practical on Quantum Mechanics and Atomic Physics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| DSE-3A | DSE | PHY-DSE-361A | Advanced Electronics | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSE-3B | DSE | PHY-DSE-361B | Introduction to Atmospheric and Space Sciences | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| DSE-4A | DSE | PHY-DSE-362A | Practical on Advanced Electronics | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| DSE-4B | DSE | PHY-DSE-362B | Practical on Atmospheric and Space Sciences | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |
| VSC-3 | VSC | PHY-VSC-361 | Computational Physics using C language | 2 | 2 | --- | 2 | 20 | --- | 30 | --- |
| VSC-4 | VSC | PHY-VSC-362 | Practical on Computational Physics and C | 2 | --- | 4 | 4 | --- | 20 | --- | 30 |

# Examination Pattern

**Theory /Practical examination Paper Pattern:**

- 20 (Internal)+ 30 (External) for 2 credits

# Theory Examination:

- The overall theory course, exam marks distribution is as follows

**Overall Marks Distribution**

| Component | Weightage | Marks (for 50M) |
|---|---|---|
| Continuous & Comprehensive Evaluation (CCE) | 30% | 15 |
| Internal Assessment Test (IAT) | 10% | 05 |
| **Continuous Internal Evaluation** | **40%** | **20** |
| **Semester-End Examination (External Examination)** | **60%** | **30** |
| **Total** | **100%** | **50** |

**Continuous Internal Evaluation (20 marks):**

**Rules of Continuous Internal Evaluation (CIE):**

The Continuous Internal Evaluation (CIE) shall comprise two components:

**1. Continuous & Comprehensive Evaluation (CCE) – 30%**

- CCE carries a maximum of 30% of the total course marks:
  - 15 marks for 50 marks course.
- At the beginning of each semester, the subject teacher shall select any three assessment methods from the approved list.
- Each selected method carries 10 marks (or 5 marks, where applicable).
- At the beginning of the semester, the subject teacher must inform students about:
  - The three CCE methods selected.
  - The syllabus unit mapped to each CCE method.
  - The unit reserved for the IAT.

The available methods are:

1. Individual Assignments
2. Seminars / Classroom Presentations / Quizzes
3. Group Discussions / Class Discussions / Group Assignments
4. Case Studies / Case lets
5. Participatory & Industry-Integrated Learning / Field Visits
6. Practical Activities / Problem-Solving Exercises
7. Participation in Seminars / Academic Events / Symposia, etc.
8. Mini Projects / Capstone Projects
9. Book Review / Article Review / Article Preparation
10. Any other academic activity

Unit Mapping:
Each of the three selected CCE methods must be linked to a different unit of the syllabus. Thus, three units must be assessed through CCE.

**2. Internal Assessment Test (IAT) – 10%**

- IAT carries a maximum of 10% of the total course marks:
  - 10 marks for a 100-mark course, or
  - 5 marks where the applicable total is 50 marks.

- The IAT shall be conducted at the end of the semester.
- It shall assess the one remaining unit that was not covered through CCE.
- The subject teacher may decide which three units will be assessed through CCE and which unit will be assessed through IAT.
- Internal theory exam will be of 10 marks:
  - Q1 attempt any 2 out of 3 sub-questions. Each question will be of 3 marks.
  - Q2 attempt any 1 out of 2 sub-questions. Each question will be of 4 marks.

**External Theory Examination (Semester -End Examination 30M):**

- External examination will be of 1½ hours duration
- There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
  - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
  - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

# Practical Examination

**Internal Practical Examination (20 marks):**

- The Internal Practical Examination shall be conducted by the respective department as per the schedule provided.
- For the Internal Practical Examination, each student shall perform **either:**
  - One experiment carrying 10 marks, **or**
  - Two experiments carrying 5 marks each.
- The remaining 10 marks shall be awarded as follows:
  - Certified Journal: 5 marks
  - Viva Voce: 5 marks

**External Practical Examination (30 marks):**

- The External Practical Examination shall be conducted by the respective department at the end of the semester as per the schedule provided.
- For the External Practical Examination, each student shall perform **either:**
  - Two experiment carrying 10 marks each, **or**
  - Four experiments, questions carrying 5 marks each, **or**
  - One experiment with four sub questions carrying 5 marks each
- The remaining 10 marks shall be awarded as follows:
  - Certified Journal: 5 marks
  - Viva Voce: 5 marks
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation condition is required.

# SEMESTER-V

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-V**
**PHY-DSC-351: Mathematical Physics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course objectives** | • To impart knowledge about various mathematical tools employed to study physics problems.<br>• To understand the essential mathematical concepts like vector analysis, differential equations, complex analysis and probability.<br>• To understand and apply mathematical methods to solve problem in various areas of physics.<br>• To understand the various applications of vector analysis, differential equations, complex analysis and probability in physics. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Understand the concept of vector integration for solving mechanics and electrodynamics problems.<br>• Able to solve linear and partial differential equation that arises in physics like classical mechanics, electrodynamics, etc.<br>• Understand the concept of complex analysis and probability to solve the problems in quantum mechanics, electromagnetism and fluid dynamics.<br>• Able to interpret the physical meaning of mathematical results. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Vector Analysis**<br>• Gauss' Divergence Theorem, Green's Theorem,<br>• Green's Theorem in plane, Stokes Theorem (Statements, proofs and problems). | **08** |
| **Unit II** | **Partial Differential Equations**<br>• Introduction to Partial differential equations (PDE),<br>• General methods for solving second order PDE,<br>• Method of separation of variables,<br>• Two dimensional Laplace's equation in Cartesian co-ordinate system,<br>• Singular points ($x = x_0$),<br>• Statement of Fuch's theorem,<br>• Frobenius method of series solution.<br>• Examples | **07** |
| **Unit III** | **Complex Analysis**<br>• Complex numbers and their graphical representation,<br>• Argand diagram, Conjugate of a complex number,<br>• Basic mathematical operations with complex numbers,<br>• Euler's formula, De-Moivre's theorem,<br>• Roots of complex numbers, Functions of complex variables,<br>• Analyticity and Cauchy - Riemann conditions, Singular functions,<br>• Examples, | **08** |
| **Unit IV** | **Special Theory of Relativity**<br>• Newtonian relativity, absolute space, absolute time<br>• Galilean transformations, postulates of special theory of relativity,<br>• Lorent'z transformation equations,<br>• Length contraction, time dilation, relativity of simultaneity,<br>• Examples | **07** |

| | | |
|---|---|---|
| **Study Resources** | • Arfken G. B., Weber H. J, Harris F. E. (2013), Mathematical Methods for Physicists, 7th edition, USA<br>• Boas M. L., (2006), Mathematical methods in the physical sciences, 3rd edition, John Willy and Sons publication, De Paul University.<br>• Narlikar J. V., (2010), An Introduction to Relativity, 1st edition, Cambridge university press.<br>• Gupta B. D., (2010), Mathematical physics, 4th Edition, Vis Publishing House Pvt. Ltd., New Delhi.<br>• Dass H. K., (2014) Mathematical Physics, 7th Revised edition, S. Chand and Company Pvt. Ltd, New Delhi. | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-V**
**PHY-DSC-352: Solid State Physics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To impart knowledge of basic concepts in Solid state Physics.<br>• To understand the different types of crystal structures and symmetries, and the relationship between real and reciprocal space.<br>• To understand behavior and role of electrons for the formation of bands and band gaps in solids, which affects an electrical conductivity of solid.<br>• To study various properties like magnetic and dielectric of materials based on band gaps. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Understand arrangements of atoms, Crystal, Lattice, Unit cell, Translation vectors.<br>• Apply the concept and use knowledge of Solid State Physics to study material characteristics.<br>• Comprehend free electrons, cohesive energy and band theory of solids.<br>• Use solid state physics in development of new materials and technologies | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Crystal Structure**<br>• Classification of solids, Lattice, Basis & crystal structure, translational vector, Unit &Primitive unit cell,<br>• Symmetry operations, Fundamental types of lattices (2D & 3D),<br>• Miller indices and Interplaner distances formula,<br>• Co-ordination number, atomic radius and packing fraction for SC, BCC and FCC structures, Study of NaCl and ZnS structures<br>• Concept of reciprocal lattice and its properties with proofs.<br>• Applications of Crystallite Materials in- LEDs, biomedical field (enlist)<br>• Numericals. | **09** |
| **Unit II** | **X-Rays Diffraction**<br>• Crystal as a grating for X-rays, Bragg's diffraction condition in direct lattice and reciprocal lattice, Ewald's construction,<br>• X-ray Diffraction methods (Laue, Rotating crystal and Powder method)<br>• Applications: DNA study and forensic science.<br>• Numericals | **08** |
| **Unit III** | **Cohesive energy & Bonding in solids**<br>• Cohesive energy and formation of molecules, Definition of dissociation energy of molecule.<br>• Types of bonding:Ionic bond, Covalent bond, Molecular bond, Metallic bond – with properties, Madelung energy & constant for one 1D ionic crystal.<br>• Deformation in solid (enlist)<br>• Numericals | **06** |
| **Unit IV** | **Lattice vibrations & Band theory in Solids**<br>• Lattice heat capacity,Classical theory of specific heat, Einstein's model, Debye's model, Drude-Lorentz model, Sommerfield's Free electron gas in 1-D.<br>• Hall Effect: Introduction, derivation, factors affecting Hall effect<br>• Applications: Hall effect sensors, power & current sensors.<br>• Numericals | **07** |
| **Study Resources** | **References:**<br>• Charles Kittle (2019), Kittel's Introduction to Solid State Physis, Willey India Edition<br>• A.J. Dekkar (2008), Solid State Physics, Pan Macmillan.<br>• S.O. Pillai (2018), Solid State Physics, 9th Edition, New Age International Publishers.<br>• Dr. S. L. Gupta, Dr. V. Kumar (2018), Solid State Physics, K. Nath & CO. Meerut.<br>• C. Hemraja, S. L. Kakani (2005) Solid State Physics: Theory, Applications & | |

| | | |
|---|---|---|
| | Problems 4th Edition, Sultan Chand & Sons.<br>• C. M. Kachhava (2003), Solid State Physics, Solid State Devices & Solid State Electronics, New Age International Publishers.<br>• R. L. Singhal, P. A. Alvi (2011), Solid State Physics: KNRN Publisher.<br>• B.S. Saxena, R.C. Gupta, P.N. Saxena (2020), Fundamentals of Solid State Physics, Pragati Prakashan, Meerut<br>• J.N. Mandal (2016), Concepts of Solid State Physics, Pragati Prakashan, Meerut.<br>• R. K. Puri and V. K. Babbar (2010), Solid State Physics, S. Chand & CO. Ltd. | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-V**
**PHY-DSC-353: Classical Mechanics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • Describe methods of solving equations of motions.<br>• Explain necessity of considering constraints.<br>• Apply different techniques to find solutions of problems in Mechanics.<br>• Compare and contrast Newtonian, Lagrangian and Hamiltonian approaches. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Understand the motion of a charged particle in electric and magnetic field, as well know the applications of Kepler's laws of planetary motion.<br>• Learn the fundamental equations of motion, conservation principles of momentum and energy.<br>• Study the concepts of scattering of particles in different frames of references.<br>• Learn the formulation of Lagrangian and Hamiltonian mechanics for different systems. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Introduction to Classical Mechanics**<br>▪ Overview of classical mechanics<br>▪ Newton's laws of motion and their limitations<br>▪ Types of forces: Gravitational, Lorentz, Hooke's, Frictional forces<br>▪ Fundamental forces of nature.<br>▪ Numericals | **06** |
| **Unit II** | **Langrangian Formulation**<br>• Degrees of freedom, Constraints, Holonomic Constraints, Nonholonomic Constraints, Generalized coordinates,<br>• D'Alemberts Principle of virtual work, Langrangian equation from D'Alembert's principle, Application of Langrangian equation (harmonic oscilator, Atwood machine), Importance of Langrangian equation.<br>• Numericals | **08** |
| **Unit III** | **Motion in Central Force Field**<br>▪ Concept and properties of central force,<br>▪ Reduction of two-body problem to equivalent one-body problem,<br>▪ Motion under inverse squre law force field (Kepler's problem), equation of orbit,<br>▪ Kepler's laws of planetary motion (statement only),<br>• Numericals | **08** |
| **Unit IV** | **Scattering of Particles**<br>▪ Elastic and inelastic scattering: Definition and properties<br>▪ Elastic scattering: Laboratory and center of mass systems,<br>▪ Inelastic scattering and its types,<br>▪ Differential cross-section, impact Parameter, total cross-section.<br>▪ Numericals | **08** |
| **Study Resources** | • Introduction to Classical Mechanics: R.G. Takawale, P.S. Puranik, Tata McGraw Hill Publishing Company Ltd., New Delhi.<br>• Classical Mechanics: J.C. Upadhyaya, Himalaya Publishing Houses.<br>• Classical Mechanics: Herbert Goldstein, Narosa Publishing House.<br>• Classical Mechanics: N.C. Rana and P.S. Joag, Tata McGraw Hill Education Private Limited, New Delhi.<br>• Classical Mechanics: P.V. Panat, Publishing House. | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-V**
**PHY-DSC-354: Practical on Mathematical and Solid state Physics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • To learn basics of solid state physics using crystal<br>• To understand atomic arrangement and crystal structures using XRD.<br>• To learn appropriate data analysis using mathematical techniques for interpretation of XRD pattern.<br>• To use this knowledge in various field. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Read and understand the XRD pattern.<br>• Apply mathematical physics in practical problems.<br>• Solve the problems based on vector integration, differential equation, complex analysis and probability.<br>• Apply the mathematical concepts on various concepts of physics. |
| **Sr. No.** | **Contents** |
| **1** | To study the crystal structure of a given specimen (b.c.c., f.c.c., h.c.p). |
| **2** | To study bravais lattices with the help of models. |
| **3** | If u,v,w are point functions and uv= $\nabla$ w, then prove that v.curl v = 0<br>(Ref. B. D. Gupta ) |
| **4** | Plot the given complex numbers on Argand's diagram. |
| **5** | To estimate temperature of Na flame. |
| **6** | To determine the human audibility. |
| **7** | Study of I-V characteristics of solar cell. |
| **8** | Determination of fill factor and efficiency of solar cell. |
| **9** | To find equivalent focal length and principal points of system of lenses using Searle's Goniometer |
| **10** | To study Hall effect using given Hall Set-up. |
| **11** | To determine specific heat of solid. |
| **12** | Prove that for any two complex numbers $z_1$ and $z_2$<br>$\|z_1 + z_2\|^2 + \|z_1 - z_2\|^2 = 2\|z_1\|^2 + 2\|z_2\|^2$ |
| **13** | Verify Stokes theorem for given data. |
| **14** | The modulus of difference of two complex numbers is greater than or equal to difference of their modulii. ( Ref B. D. Gupta 5.11) |
| **15** | Verify Green's 1st and 2nd theorem for given data. |
| **16** | Verify Gauss divergence theorem for given data. |
| **Study Resources** | • Nishant Patel, Gautam Sharma (2010) Experiments in Solid State Physics, Campus Books Inrenational, ISBN-13978-8180302725.<br>• Dr. Alok Kumar Gupta Senior Secondary Course Physics Laboratory Manual National Institute of Open Schooling (An autonomous organisation under MHRD, Govt. of India) A-24-25, Institutional Area, Sector-62, Noida-201309 (U.P.) Website: www.nios.ac.in, Toll Free No. 18001809393.<br>• Harlard Ibach, Hans Luth (1991) Solid-State Physics-An Introduction to Theory & Experiment Springer Verlag |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-V**
**PHY-DSC-355: Practical on Classical Mechanics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | ▪ To determine Young's modulus, coefficient of viscosity, moment of inertia & verify fundamental laws of physics experimentally.<br>▪ To study the behavior of mechanical systems, such as oscillations of a cantilever beam, motion under gravity, and rotational dynamics.<br>▪ To analyze forces and frictional effects by determining the coefficient of friction and understanding limiting friction.<br>▪ To understand electromagnetism through experiments, such as studying the Lorentz force and verifying electromagnetic principles. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>▪ Ability to measure and analyze material properties like elasticity and rigidity using experimental methods.<br>▪ Proficiency in using laboratory instruments such as viscometers, pendulums, and optical measurement tools.<br>▪ Application of theoretical physics in real-world problems, such as planetary motion, mechanical stability, and energy conservation.<br>▪ Development of data analysis and error estimation skills, leading to accurate scientific conclusions based on experimental results. |

| Sr. No. | Contents |
|---|---|
| **1** | To study the Lorentz force using Electromagnetic field. |
| **2** | To determine Moment Inertia of Rod |
| **3** | To determine Moment of Inertia of Solid Sphere & Hollow sphere |
| **4** | To measure of Velocity & Distance of free falling object for various time. |
| **5** | To determine Young Modulus using bending beam. |
| **6** | To verify the law of conservation of given body.<br>[Total Energy= K.E. &P.E.(Visocity-medium -scale)] |
| **7** | To study the relation between force of limiting friction & normal reaction. |
| **8** | A point particle of mass m is constrained to move in one dimension on the x-axis.<br>The force acting on the particle can be derived from the velocity-dependent potential U = F(dx/dt)t.<br>Write down (a) the Lagrangian, (b) the Hamiltonian, (c) Hamilton's equations. |
| **9** | To find a natural frequncy of Cantilever beam. |
| **10** | To determine the Centre of Mass of any Random shaped. |
| **11** | To study the Kelper Laws. |
| **12** | g by bar pendulum. |
| **13** | g by simple pendulum. |
| **14** | To determine the length of second pendulum. |
| **15** | g by Katers pendulum. |
| **16** | To find the coefficient of friction between surface of a moving block and that of a horizontal surface. |

| | |
|---|---|
| **Study Resources** | ▪ B.L. Worsnop & H.T. Flint, *Advanced Practical Physics for Students*, Methuen & Co Ltd.<br>▪ Squires, G.L., *Practical Physics*, Cambridge University Press.<br>▪ Indu Prakash & Ramakrishna, *A Textbook of Practical Physics*, Kitab Mahal Publishers.<br>▪ K. K. Mahajan, *A Textbook of Practical Physics*, S. Chand Publishing.<br>▪ S. Chattopadhyay, *Practical Physics*, New Central Book Agency.<br>▪ R.C. Smith & J. M. Smith, *Mechanics: Experimental Methods*, Oxford University Press.<br>▪ J. B. Marion & S. T. Thornton, *Classical Dynamics of Particles and Systems*, Cengage Learning.<br>▪ W. M. Smart, *Textbook on Spherical Astronomy*, Cambridge University Press.<br>▪ B.S. Agarwal, *Laboratory Manual of Physics for Undergraduate Students*, CBS Publishers. |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-V**
**PHY-DSE-351A: Laser Physics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Learning objectives** | • To learn basic phenomenon of energy transmission for laser formation.<br>• To learn the fundamental concepts and characteristics of Laser.<br>• To develop experimental knowledge of various types of atomic/molecular spectra.<br>• To learn the basic techniques of experimental spectroscopy. | |
| **Course outcomes** | After successful completion of this course, students are expected to:<br>• Know the theoretical and experimental background of atomic as well as molecular spectra.<br>• Understand various types of Lasers, their working and applications.<br>• Understand basic components of spectroscopic instruments and their functions.<br>• Know about measurements of atomic/molecular spectra using spectrometers. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Introduction to LASER**<br>• Ordinary light and LASER light, Interaction of radiation with matter, Energy levels,<br>• Population inversion, Population density, Boltzmann distribution, Transition Lifetimes, Allowed and Forbidden Transitions, Stimulated Absorption,<br>• Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Einstein's relations | **08** |
| **Unit II** | **LASER Action**<br>• Characteristics -Directionality, Monochromaticity, Coherence, Brightness, Condition for large stimulated emission, Population inversion Condition for light amplification,<br>• Gain coefficient Active medium, Metastable states Pumping schemes: three levels and four levels. | **07** |
| **Unit III** | **Types of LASER**<br>• Principle, Construction and working of He-Ne Laser, Nitrogen LASER, Ruby LASER, Nd-YAG LASER, Semiconductor LASER, Tunable dye LASER. | **08** |
| **Unit IV** | **Application of LASER**<br>• Study of ultra high resolution LASER spectroscopy, Propagation of light in a medium with variable refractive index, Optical fibers, LASER in communication,<br>• Qualitative treatment of medical and engineering applications of LASER, Material processing. | **07** |
| **Study Resources** | • B. Laud, Laser and Non-linear optics, Wiley Eastern Ltd., (1991).<br>• A.K. Ghatak and K. Thyagarajan, optical electronics, Cambridge University Press (1991).<br>• S.C Gupta Optoelectronic devices and systems , Prentice Hall of India.<br>• (WH) Wilson and Hawkes: Optoelectronics, Prentice Hall of India.<br>• Yariv, Optical Electronics in Modern Communications, Oxford University Press (1997),<br>• Laser Spectroscopy- Basic concepts and instrumentation by Demtroder (ed. 3, Springer)<br>• Avadhanulu M. N. An introduction to Lasers – theory and applications, S. Chand and Co. New Delhi 2001, ISBN 9788121920711 | |

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-V**
**PHY-DSE-351B: Forensic Physics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Learning objectives** | • To identify and analyze forensic problems using standard method based on scientific approach.<br>• To apply ethical principles and commit to professional ethics, responsibilities and norms of forensic practices.<br>• To understand and analyze the impact of forensic solutions to the society and criminal justice setup.<br>• To design novel solution of regular or complex problem based on study outcomes. | |
| **Course outcomes** | After successful completion of this course, students are expected to:<br>• Understand basic concepts of crime, criminology, victimology and forensics.<br>• Understand the causes of vehicle accidents and to analyze it.<br>• Understand the phenomenon of crime scene photography and perform case study.<br>• Analyze and examine the weapons used in crime. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Forensic Photography**<br>• Definition of photography, basic concepts of videography, Basic principles and techniques of Black & White and colour photography. Cameras and its working, attachments of camera, types of camera lenses Image sensors, spectral sensitivity of photographic materials,<br>• WorkingofCamera,DevelopingandPrinting,Digitalphotography andadvancedCrime scene and Laboratory photography, forensic application, Case studies. | **08** |
| **Unit II** | **Ballistics**<br>• Introduction to Ballistics, Types of ballistics:internal, external and terminal Ballistics, Velocity recoil, Theory of recoil, Barrel pressure measurement, Ballistic coefficient, Angle of elevation of the barrel,<br>• Bulletanditstypes,Shotgunslugs | **07** |
| **Unit III** | **Investigation of Vehicular Accidents-**<br>• Primarycausesofroadaccident,Typesofroadaccident,Tireandothermarks, Pedestrian impacts and vehicle speed, vehicle condition, vehicle speed and damage,<br>• Types of skid marks, curved scuffmarks, speed estimation from skid/scuffmarks. Time anddistance,reactiontimeandperipheralvisionofadriver,Photographyandplans,<br>• BrakesystemandSteeringfailure,Motorvehicleexamination. | **08** |
| **Unit IV** | **Crime Scene Evidence**<br>• Classification of crime scene evidence – physical and trace evidence. Locard principle. Collection, labeling, sealingofevidence. Hazardous evidence. Preservation ofevidence. Reconstruction of crime scene.<br>• **Soil**- types of soil, Composition and color of soil, Forensic examination, Interpretation of evidence.<br>• **Fiber analysis:** Types offabrics, Yarns, Fabric construction, Fabric characteristics, Microscopy characteristic, Fluorescence Microscopy, Chemical properties,<br>• **Voice/Tape Authentication:** Introduction to human Voice, Nature of voice and production of speech, perception of voice and speech | **07** |
| **Study Resources** | • B. Laud, (1991)Laser and Non-linear optics, Wiley Eastern Ltd.,.<br>• A.K. Ghatak and K. Thyagarajan, (1991) Optical electronics, Cambridge University Press.<br>• S.C Gupta Optoelectronic devices and systems, Prentice Hall of India.<br>• (WH) Wilson and Hawkes: Optoelectronics, Prentice Hall of India.<br>• Yariv, (1997)Optical Electronics in Modern Communications, Oxford University Press. | |

| | | |
|---|---|---|
| | • Demtroder, 3rd Edition Laser Spectroscopy- Basic concepts and instrumentation (Springer)<br>• Avadhanulu M. N. (2001) An introduction to Lasers – theory and applications, S. Chand and Co. New Delhi, ISBN 9788121920711.<br>• Sirohi R. S. (1995) Experiments with HeNe Laser, 2nd Edition.<br>• Anuradha De. Optical fibre and Laser – Principle and applications, New Age International Publishers, Second edition. 2009, ISBN 10: 8122421393 ISBN 13: 9788122421392. | |

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-V**
**PHY-DSE-352A: Practical on Laser Physics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • To develops the students practical and technical skills required for physics experimentation.<br>• It develops student logical thinking, skill for collecting, analysis and extracting relevant information from experimental outcomes.<br>• To give basic understanding regarding basic concepts LASER and it applications.<br>• Understand the principles of gas laser and laser characteristics |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Students will understand the concept of LASER and its applications as well as fundamental concepts related to optics.<br>• It develops student's skill for handling sophisticated and sensitive instrumentation.<br>• It develops deeper understanding of phenomenon related to optics such as diffraction, interference, polarization and properties and application of LASER.<br>• The students will also able to work effectively and safely in the laboratory environment independently and as well as in teams. |

| Sr. No. | Topic Particular |
|---|---|
| **1** | To determine diameter of a given wire by diffraction. |
| **2** | Verification of Brewster‟s law of polarization using He-Ne laser |
| **3** | To determine the wavelength of a LASER source using an engraved scale as a reflecting diffraction grating. |
| **4** | Measurement of reflectivity and transferability of thin film by using He-Ne laser. |
| **5** | To verify Heisenberg uncertainty principle using He-Ne laser source. |
| **6** | Measurement of Refractive Index of Liquids using Laser |
| **7** | Measurement of laser parameters. |
| **8** | To measure the intensity using photo sensor and laser in diffraction patterns of Double slit |
| **9** | Refractive index of the given materials |
| **10** | Refractive index of the Air at different pressure. |
| **11** | Semiconductor lasers- Study of output characteristics and determination of threshold current, differential quantum efficiency and divergence. |
| **12** | Wavelength and Particle Size Determination. |
| **13** | To measure the intensity using photo sensor and laser in diffraction patterns of Single slit |
| **14** | Determination of circular aperture of LASER |
| **15** | Determination of wavelength of He Ne Laser by transmission grating |
| **16** | Beam divergence of diode LASER. |
| **17** | Measurement of focal length of given convex lens using a laser. |
| **18** | Study of LASER characteristics. |

| | |
|---|---|
| **Study Resources** | • Michelson Interferometer Advanced Practical Physics -Worsnop and Flint<br>• Analysis of sodium spectrum a Atomic spectra- H.E. White b Experiments in modern physics – Mellissinos<br>• h/e by vacuum photocell a Advance practical physics - Worsnop and FlintbExperiments in modern Physics – Mellissinos<br>• Study of He-Ne laserMeasurement of divergence and wavelength a A course of experiments with Laser - Sirohi b Elementary experiments with Laser G. White<br>• Susceptibility measurement by Quincke's method /Guoy's balance method Advance practical physics - Worsnop and Flint<br>• Absorption spectrum of specific liquids Advance practical physics - Worsnop and Flint<br>• Coupled Oscillations HBCSE Selection camp 2007 Manual |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-V**
**PHY-DSE-352B: Practical on Forensic Physics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • To develop the student practical and technical skills required for forensic physics experimentation.<br>• It develops student logical thinking, skill for collecting, analysis and extracting relevant information from experimental outcomes.<br>• To give basic understanding regarding basic concepts science in forensics.<br>• To design novel solution of regular or complex problem based on study outcomes |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Students will understand the concept of forensic physics and its applications in crime investigation.<br>• It develops student's skill for handling sophisticated and sensitive instrumentation.<br>• It develops deeper understanding of phenomenon related to optics, ballistics, vehicle accident, etc.<br>• It develops students skill of analyze and examine the weapons used in crime. |

| Sr. No. | Contents |
|---|---|
| **1** | Standard operation procedure forVerniercaliper,micrometer screw and travelling microscope. |
| **2** | Study of road design and road measurements |
| **3** | Examination of tire/othermarks |
| **4** | Physical examination of accidental vehicle. |
| **5** | Peripheral vision measurement. |
| **6** | Side wall information of tire |
| **7** | Analysis of accident/crime scene photography |
| **8** | Physical examination of accidental vehicle. |
| **9** | Trajectory simulation (sample calculations). |
| **10** | Remaining velocity (sample calculations). |
| **11** | Determine the thickness of thin foil using air wedge. |
| **12** | Sample calculations of radio active dating to determine time of death. |
| **13** | 35 mm Film SLR Camera<br>A. Understanding Parts,Functions and Operation.<br>B. Understanding the concepts:Exposure, ISO, Shutter Speed, F-Stops, Depth of Field, and Focus. |
| **14** | 35 mm digital SLR Camera<br>A. Understanding Parts, Functions and Operation.<br>B. Understanding Close Up/Mid-Range/Overall Photographs. |
| **15** | Evidence photography by Digital camera. |
| **16** | Study of forensic sample under stereomicroscope. |
| **17** | Sample calculations-application of collision theory to accidental cases. |

| | | |
|---|---|---|
| **18** | Sample calculations-velocity of freely falling bodies in air and ponds. | |
| **19** | Photography of 3-D/2-D shoe/bearfoot prints. | |
| **20** | Casting of 3-D Shoeprint using plaster of Paris/dental stone in mud or clay. | |
| **21** | Footwear sizing. | |
| **22** | Examination of Fire Arm according to Arms Act 1 | |
| **23** | Dismantling and assembling of firearms | |
| **Study Resources** | • Michelson Interferometer Advanced Practical Physics -Worsnop and Flint<br>• Analysis of sodium spectrum a Atomic spectra- H.E. White b Experiments in modern physics – Mellissinos.<br>• h/e by vacuum photocell a Advance practical physics - Worsnop and Flint b Experiments in modern Physics – Mellissinos<br>• Study of He-Ne laserMeasurement of divergence and wavelength a A course of experiments with Laser - Sirohi b Elementary experiments with Laser G. White<br>• Susceptibility measurement by Quincke's method /Guoy's balance method Advance practical physics - Worsnop and Flint.<br>• Absorption spectrum of specific liquids Advance practical physics - Worsnop and Flint.<br>• Coupled Oscillations HBCSE Selection camp 2007 Manual | |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Vocational)**
**Semester-V**
**PHY-VSC-351: Renewable Energy**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To develop the resource in Renewable Energy sector is the present need of the country.<br>• To provide physics students with an introduction to energy systems and renewable energy resources.<br>• To explore society's present needs and future energy demands; it will examine conventional energy sources and systems.<br>• To help create self-employment, promote research and help develop the skills required in the energy sector | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• To find exact need of energy and use it accordingly.<br>• To use available energy sources charily.<br>• To generate and use renewable and sustainable energy.<br>• Develop different energy devices. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Energy Sources & Availability**<br>• Introduction to Renewable Energy Sources: Sun, Wind, Hydropower, Biomass and Geothermal energy sources,<br>• Introduction to Non-renewable Energy Sources: Fossil fuel, coal, Natural gas and Nuclear energy,<br>• An overview of developments in offshore. | **05** |
| **Unit II** | **Solar energy**<br>• 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.<br>• solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. | **08** |
| **Unit III** | **Other Energy Sources**<br>• Wind Energy: Introduction to wind energy, Atmospheric circulations, Factors influencing wind, Variation of wind speed with height and time, Wind energy conversion principles and components, Enlist Classification of WECS<br>• Ocean Energy: Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy<br>• Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.<br>• Geothermal Energy: Geothermal Resources, Geothermal Technologies. | **09** |
| **Unit IV** | **Energy Audit**<br>• Need of Energy audit, Types of energy audit, Energy management (audit) approach, understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements,<br>• Duties and responsibilities of energy auditors, Energy audit instruments, Procedures and Techniques, Commercial energy production<br>• Energy needs of growing economy, sector reforms, conservation and its importance<br>• Energy Conservation Act-2001, strategy for the future | **08** |
| **Study Resources** | • G.D Rai (2004) Non-conventional energy sources, Khanna Publishers, New Delhi.<br>• M. P. Agarwal (2021) Solar energy, S Chand and Co. Ltd. | |

| | | |
|---|---|---|
| | • S. P. Sukhatme, J. K. Nayak (2017) 4th Edition, Solar energy, Tata McGraw-Hill Publishing Company Ltd.<br>• Godfrey Boyle, (2004) "Renewable Energy, Power for a sustainable future", Oxford University Press, in association with The Open University.<br>• Dr. P Jayakumar (2009) Solar Energy: Resource Assessment Handbook.<br>• Mehmet Kanoglu , Yunus A. Cengel, John M. Cimbala, (2010) Fundamentals And Applications Of Renewable Energy, McGraw Hill, ISBN-13 978-9390385638.<br>• J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). | |

**T.Y. B.Sc. PHYSICS (Vocational)**
**Semester-V**
**PHY-VSC-352: Practical on Renewable Energy**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • To take an Operational experience on solar energy kits/set-ups.<br>• To study I-V characteristic of Mono-Crystalline, Poly-Crystalline PV module & observeenergy band gap of semiconductor.<br>• To study illumination using Lux meter & shadow analysis at a given site.<br>• To study working principles & various parameters of different renewable energy conversion systems. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Understand importance of energy and prefer to switch for renewable energy.<br>• Understand solar parameters like Isc, Voc & FF.<br>• Working principle of different energy source plants.<br>• Use various combination of solar panels circuits. |
| **Sr. No.** | **Contents** |
| **1** | Study of solar photovoltaic module. |
| **2** | To demonstrate the I-V and P-V characteristics of PV Module. |
| **3** | To determine of the Energy Band Gap of Germanium Diode. |
| **4** | To show the effect of variation in tilt angle on PV module power. |
| **5** | To study the thermal performance of a Box-Type Solar Cooker and determine F1 & F2. |
| **6** | To study the thermal performance of a Box-Type Solar Cooker (a) with air and (b) with water. |
| **7** | To demonstrate the effects of radiant energy on LDR & to show how radiant energy on LDR can be used to control electronic circuits. |
| **8** | Study I-V characteris cs of solar panel at different tilt angles |
| **9** | Evaluate UL (Heat loss coefficient) of solar thermal kit in thermo-symphonic mode of flow with fixed input parameters. |
| **10** | To measure the effect of shading on PV module output power for the given module. |
| **11** | To build, simulate, and analyze solar PV energy system using MATLAB under loaded conditions, and to understand the characteristic of solar PV energy system. |
| **12** | To build, simulate, and analyze wind energy power system using MATLAB under loaded conditions, and to understand the characteristic of wind energy power system. |
| **13** | To draw the I-V and P-V characteristics of PV module with varying radiation and Calculate the fill factor for the given module. |
| **14** | To evaluate the cut-in speed of wind. |
| **15** | To evaluate the Tip Speed ratio (TSR) at different wind speeds. |
| **16** | To prepare heat balance sheet for a given Boiler. |
| **Study Resources** | • V V N Kishore, Renewable Energy Engineering And Technology Principles and Practice, Teri Press, ISBN 9788179932216<br>• Travis Bradford (2006), Solar Revolution: The Economic Transformation of the Global Energy Industry, Mit Pr. ISBN-13 978-0262026048<br>• Chetan Singh Solanki (2008) Renewable Energy Technologies: A Practical Guide for Beginners, Prentice Hall India Learning Private Limited.<br>• D. P. Kothari , K. C. Singal , 2nd Edition Rakesh Ranjan , Renewable Energy Sources And Emerging Technologies, ISBN 9788120344709, Prentice Hall India Learning Private Limited. |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

## T.Y. B.Sc. PHYSICS (On Job Training)
## Semester-V
## PHY-OJT-351: On Job Tranining

**Total Hours: 120** **Credits:4**

| | |
|---|---|
| **Course objectives** | • To provide the students with actual work experience<br>• To make aware prescribe standards and guidelines at work<br>• To develop the employability of participating student<br>• To avail an opportunities to eventually acquire job experiences |
| **Course outcomes** | After successful completion of this course, students are expected to:<br>• Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and proceduralsystems<br>• Acquaint the knowledge related to working hours, work protocols and guidelines<br>• Understand the roles and responsibilities of employee as well as team work<br>• Justify job experiences that match their potentials, skills, and competencies |

**Internship**

An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills.

**On the job training**

On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc.

**Internship / OJT Mechanism:**

1. **Pre-Approval**: Students should seek approval from the college before starting the Internship / OJT. This ensures that the Internship / OJT aligns with the curriculum and meets the necessary criteria.
2. **Mentor and Supervisor**: Each student should have an assigned mentor at the organization/industry where they are interning. Additionally, an Internship / OJT supervisor from the college will be appointed to guide and monitor the progress.
3. **Regular Reporting:** Students should maintain regular communication with their supervisor and mentor, providing progress reports and seeking feedback.
4. **Professional Conduct**: Students must adhere to professional conduct throughout the Internship / OJT, including punctuality, respect for colleagues, and adherence to the organization's/industry's policies and guidelines.
5. **Student Diary**: Students should maintain a diary to document their experiences, challenges faced, and lessons learned during the Internship / OJT.
6. **Final Report**: At the end of the Internship / OJT, students should submit a comprehensive final report, summarizing their accomplishments, contributions, and key takeaways.
7. **Evaluation**: The Internship / OJT is worth 4 credits (equivalent to 100 marks), and the evaluation will be divided into two categories: one by the mentor and the other by the Internship / OJT supervisor. The mentor's evaluation (internal examination) will carry 40 marks, and it will be based on the student's performance during the Internship / OJT. External examination will be conducted by mentor and supervisor which will be based on the student's diary, the final report prepared by the student, and their performance in the final viva voce, and will carry 60 marks. The total marks obtained by the students in both evaluations will be added together for the purpose of final evaluation. The evaluation of the students will be conducted by the mentor using the evaluation sheet provided by the college.

**Internal Evaluation Criteria for Students by the Mentor:**

1. **Quality of Work** (10 marks): How well did the student perform their assigned tasks during the

Internship / OJT? Evaluate the accuracy, thoroughness, and attention to detail in their work.

2. **Initiative and Proactiveness** (10 marks): Did the student show initiative in taking on additional responsibilities or tasks beyond their assigned role? Did they demonstrate a proactive attitude towards problem-solving?
3. **Communication Skills** (10 marks): Assess the student's ability to communicate effectively with colleagues, superiors, and clients (if applicable). Consider both written and verbal communication.
4. **Problem-Solving Skills and Time Management** (10 marks): Evaluate the student's ability to analyze problems, propose solutions, and implement effective strategies to overcome challenges. How well did the student manage their time during the Internship / OJT? Were they able to meet project deadlines and handle multiple tasks efficiently?

**External Evaluation Criteria for Students by the Supervisor and Mentor:**

1. **Student Diary** (15 marks): Review the student's diary to understand their reflections, insights gained, and self-assessment of their performance during the Internship / OJT.
2. **Final Report** (15 marks): Evaluate the quality and comprehensiveness of the student's final report, including the clarity of their achievements and contributions.
3. **Presentation of Student in Viva Voce** (30 marks): Evaluate the responses given by the student to the questions asked by the faculty in the Viva Voce.

**Evaluation Criteria for Final Viva Voce:**

1. Presentation Skills
2. Knowledge of the Internship / OJT Project
3. Practical Application and Work Experience
4. Problem-Solving and Critical Thinking
5. Communication and Professionalism

# SEMESTER-VI

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-VI**
**PHY-DSC-361: Classical Electrodynamics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To understand different terms related to electrostatics.<br>• To understand the concept polarization, electric field in dielectric.<br>• To understand the different terms related to magnetostatics.<br>• To develop the electromagnetic wave equation and study properties of electromagnetic waves. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• know the need and necessity of electrostatic and the magneto static field.<br>• Know the basic concepts of electrostatics charges and polarization of dielectric<br>• Learns different phenomenon of magnetostatics, hysteresis and BH curve<br>• Learn about electromagnetic induction, polarization of light. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Electrostatics**<br>▪ Coulomb's law, Electric field, Electrostatic Potential,<br>▪ Potential energy of system of charges,<br>▪ Electric dipole, Expression for potential due to dipole.<br>▪ Statement of Poisson's equation,<br>▪ Laplace equation and its solution in cartesian coordinate systems,<br>▪ Gauss law, Differential form of Gauss's law,<br>▪ Problems | **08** |
| **Unit II** | **Electrostatic field in dielectrics**<br>▪ Dielectric materials, polar and non -polar molecules,<br>▪ Polarization **P**, Electric displacement **D**, Electric susceptibility, dielectric constant,<br>▪ Bound volume and surface charge densities,<br>▪ Electric field at an exterior and interior point of dielectrics.<br>▪ Problems | **07** |
| **Unit III** | **Magnetostatics**<br>▪ Concepts of magnetic induction, magnetic flux and magnetic field,<br>▪ Biot-Savart's law, Magnetic induction due to straight current carrying conductor,<br>▪ Classification of Magnetic Materials<br>▪ Ampere's circuital law,<br>▪ Equation of continuity, Magnetic susceptibility and permeability,<br>▪ Problems | 08 |
| **Unit IV** | **Electromagnetism**<br>▪ Concept of electromagnetic induction, Faradays law of induction,<br>▪ Lenz's law, displacement current,<br>▪ Maxwell's equations and their physical significance,<br>▪ Wave equation and plane waves in free space,<br>▪ Poynting theorem & Poynting vector,<br>▪ Problems | **07** |
| **Study Resources** | • Capri, A. Z., & Panat, P. V. (2000). Introduction to electrodynamics. Narosa Publishing House.<br>• Griffiths, D. J. (2012). Introduction to electrodynamics (4th ed.). Addison-Wesley.<br>• Gupta, S. L., Kumar, V., & Singh, S. P. (2017). Electrodynamics. Pragati Prakashan.<br>• Jackson, J. D. (1999). Classical electrodynamics (3rd ed.). Wiley.<br>• Reitz, J. R., & Milford, J. (2008). Electricity and magnetism (4th ed.). Addison-Wesley. | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-VI**
**PHY-DSC-362: Nuclear Physics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | ▪ Understand nuclear properties like size, shape, charge, and binding energy.<br>▪ Explore nuclear models and decay processes.<br>▪ Study nuclear reactions and detection techniques.<br>▪ Learn elementary particle classification and fundamental forces.<br>▪ Develop problem-solving skills in nuclear and particle physics. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>▪ Explain nuclear size, mass, spin, isospin, and binding energy.<br>▪ Apply nuclear models to predict nuclear properties.<br>▪ Analyze nuclear reactions and decay mechanisms.<br>▪ Understand elementary particles, conservation laws, and quantum numbers.<br>▪ Solve numerical problems in nuclear and particle physics. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Fundamentals of Nuclear Physics**<br>▪ Introduction to nuclear physics<br>▪ Structure of the nucleus: Nucleons, isotopes, isobars, isotones<br>▪ Nuclear size, mass, and nuclear binding energy<br>▪ Nuclear forces and their properties<br>▪ Overview of nuclear models (Liquid drop model, Shell model)<br>▪ Numericals | **6** |
| **Unit II** | **Radioactivity & Decay Laws**<br>▪ Types of radioactive decay (Fundamental concepts of Alpha, Beta, Gamma dacay with basic reactions)<br>▪ Radioactive decay laws and kinetics<br>▪ Half-life and decay constant<br>▪ Radioactive decay chains and natural radioactivity<br>▪ Artificial radioactivity and induced radioactivity<br>▪ Numericals | **7** |
| **Unit III** | **Nuclear: Reactions & Energy**<br>▪ Types of nuclear reactions (Fission, Fusion)<br>▪ Nuclear fission: Chain reaction, nuclear reactors, power generation<br>▪ Nuclear fusion: Energy production and challenges<br>▪ Semi-empirical mass formula and nuclear stability<br>▪ Numericals | **7** |
| **Unit IV** | **Nuclear Detectors & Applications**<br>▪ Principles and types of nuclear detectors (G. M. counter, Scintillator -Working mechanisms), Junction type Semiconductor detectors<br>▪ Applications in medicine: Imaging and therapy<br>▪ Applications in industrial field: Material analysis and gauging techniques<br>▪ Applications in Archaeology & geology: Carbon dating, other dating techniques<br>▪ Nuclear energy: Power generation, safety considerations<br>▪ Basics of nuclear weapons: Physics and effects | **10** |
| **Study Resources** | ▪ B. Martin, (2011). Nuclear & Particle Physics an Introduction, John Wiley & Sons, Inc., New Jersey, USA.<br>▪ K.S. Krane, (2008). Introductory Nuclear Physics, John Wiley & Sons, Inc., New Jersey, USA.<br>▪ C.A. Bertulani, (2007). Nuclear Physics in a Nutshell, Princeton University | |

| | | |
|---|---|---|
| | Press, Princeton, USA.<br>▪ S.S.M. Wong, (2008). Introductory Nuclear Physics, John Wiley & Sons, Inc., New Jersey, USA.<br>▪ K. Heyde, (2004). Basic Ideas and Concepts in Nuclear Physics An Introductory approach, CRC Press, London, U. K.<br>▪ B. Povh, K. Rith, C. Scholz, (2012). Particles and Nuclei: An Introduction to the Physical Concepts Springer, New York, USA.<br>▪ D.H. Perkin, (2009). Introduction to High Energy Physics, Cambridge University Press, Cambridge, U.K.<br>▪ I.S. Hughes, (1991). Elementary Particles, Cambridge University Press, Cambridge, U.K.<br>▪ W.R. Leo, (2009). Techniques for Nuclear and Particle Physics Experiments, Springer, New York, USA.<br>▪ T. Stefan, (2010). Experimental Techniques in Nuclear and Particle Physics, Springer, New York, USA.<br>▪ D.J. Griffiths, (2008). Introduction to Elementary Particles, Wiley-VCH Verlag GmbH, Germany. | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-VI**
**PHY-DSC-363: Quantum Mechanics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | ▪ Understand the historical development and fundamental principles of quantum mechanics.<br>▪ Explore wave-particle duality, the De Broglie hypothesis, and Heisenberg's uncertainty principle.<br>▪ Study the Schrodinger equation, its physical interpretation, and applications in different quantum systems.<br>▪ Analyze quantum mechanical operators, commutator algebra, and the concept of parity. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>▪ Explain key historical experiments like black body radiation, photoelectric effect, and electron diffraction.<br>▪ Apply the Schrodinger equation to different quantum systems such as free particles and potential wells.<br>▪ Demonstrate understanding of quantum operators, eigenvalues, and eigenfunctions.<br>▪ Solve problems related to tunneling, commutator algebra, and quantum mechanical probabilities. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Origin of Quantum Mechanics:**<br>▪ Historical Background: Black body radiation, photoelectric effects.<br>▪ Matter waves - De Broglie hypothesis.<br>▪ Wave particle duality<br>▪ Concept of wave function, wave packet, phase velocity, group velocity and relation between them .<br>▪ Heisenberg's uncertainty principle, different forms of uncertainty.<br>▪ Problems | **06** |
| **Unit II** | **The Schrodinger equation**<br>• Physical interpretation of wave function, Requirements of wave function.<br>• Schrodinger time dependent and independent equations (Steady state equation).<br>• Probability current density, equation of continuity, and its physical significance.<br>• Expectation value, Ehrenfest's theorem (Only statements).<br>• Problems | **09** |
| **Unit III** | **Applications of Schrodinger Steady state equation:**<br>• Schrodinger's equation in spherical polar co-ordinate system.<br>• Free particle.<br>• Particle in infinitely deep potential well (one - dimension).<br>• Step potential.<br>• Potential barrier. (Qualitative discussion). Barrier penetration and tunnelling effect.<br>• Problems | **09** |
| **Unit IV** | **Operators in Quantum Mechanics**<br>• Hermitian operator.<br>• Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian).<br>• Commutator brackets- Simultaneous Eigen functions.<br>• Commutator Algebra<br>• Commutator bracket using position, momentum and angular momentum operator<br>• Concept of parity according to quantum mechanics, parity operator and its Eigenvalues.<br>• Problems | **06** |

| | | |
|---|---|---|
| **Study Resources** | • Eisberg, Robert M., and Robert Resnick. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles. Wiley, 1985. ISBN: 9780471873730.<br>• Liboff, Richard L. Introductory Quantum Mechanics. Addison Wesley, 2002. ISBN: 9780805387148.<br>• Griffiths, David J. Introduction to Quantum Mechanics. Upper Saddle River, Pearson Prentice Hall, 2005. ISBN: 9780131118928<br>• Feynman, Richard P., Robert B. Leighton, and Matthew L. Sands. The Feynman Lectures on Physics. Addison Wesley, 1989. ISBN: 9780201500646.<br>• P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill publication, ISBN. : 9780070146174<br>• N. Zettili, Quantum Mechanics- Concepts and applications, Wiley publication, ISBN: 978-0-470- 02679-3<br>• AjoyGhatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication, ISBN 978-1-4020-2130-5<br>• G Aruldhas, Quantum Mechanics, Phi Learning Private Ltd., ISBN : 97881203363<br>• Shankar, Ramamurti. Principles of Quantum Mechanics. Springer, 2008. ISBN: 9780306447907.<br>• Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-VI**
**PHY-DSC-364: Atomic Physics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To impart knowledge of development of structure of atom<br>• To understand different types of interaction<br>• To understand concept of Zeeman, Stark,Paschen effect and x-ray.<br>• To provide the knowledge and methodology necessary for solving problems in Physics. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Learn the different quantum numbers and its use to specifies quantum state of electrons.<br>• Learns about different types of coupling interaction.<br>• Learns the phenomenon and application of Stark and Zeeman effect.<br>• Learn to basics of x-ray spectroscopy. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Atomic Structure**<br>• Rutherford model of atom, Bohr atom, Electron orbits, Energy levels and spectra (Introductory),<br>• Vector atom model - Concepts of space quantization and electron spin,Quantum numbers,<br>• Pauli's exclusion principle: statement, spectral notation,<br>• Spectra of single valence electron systems (sodium),<br>• numericals | **08** |
| **Unit II** | **Two Valence Electron System**<br>• Introduction, Spin-spin and orbit-orbit interaction,<br>• L-S and j-j coupling schemes,<br>• Singlet- triplet separations for interaction energy of LS coupling schemes and j-j coupling schemes,<br>• s-p and p-d configuration in L-S coupling and j-j coupling schemes,<br>• Lande Interval rule, Spectra of Helium,<br>• numericals | **08** |
| **Unit III** | **Zeeman & Paschen Back effect**<br>• Introduction, Magnetic dipole moment, Zeeman Effect: Experimental set up,<br>• Normal and Anomalous Zeeman Effect for single valence electron system,<br>• Lande 'g' factor for two valence electron system (L-S and j-j coupling),<br>• Stark effect (Qualitative discussion),<br>• Paschen Back effect for single valence electron system,<br>• numerical. | **08** |
| **Unit IV** | **X ray spectra**<br>▪ X-ray spectra, Origin of Continous X- ray spectra,<br>▪ Origin of Characteristic X-ray spectra,<br>▪ X-ray emission spectra and Moseley's law, Auger effect,<br>▪ The Regular doublets laws and Irregular doublets laws (statement only),<br>▪ Applications of X-ray. | **06** |
| **Study Resources** | • White, H. E. (1938). Introduction to atomic spectra, McGraw-Hill Ltd.<br>▪ Beiser, A. (2003). Concepts of Modern Physics (6th ed.). McGraw-Hill Ltd.<br>• Beiser, A. (1969). Perspectives of modern physics. McGraw-Hill Ltd.<br>• Gupta,kumar,Sharma (2020). Atomic spectra,Pragati Publication.<br>• Kumar, R. (2019). Atomic spectra and molecular spectra ($20^{th}$ ed.). Kedarnath Ramnath Prakashan.<br>• Banwell, C. N. (2016). Fundamentals of molecular spectroscopy ($4^{th}$ ed.). Tata | |

| | | |
|---|---|---|
| | McGraw-Hill. | |

**T.Y. B.Sc. PHYSICS (Major with IKS)**
**Semester-VI**
**PHY-DSC-365: Physics Behind Historical Monuments**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To develop a rational conceptualization of the Indian Knowledge System.<br>• To sensitize the students to the contributions made by ancient Indians in the field of Science, Philosophy and related applications and concepts.<br>• To appreciate that the course would help to enhance efficiency, effectiveness, quality and excellence in the System of Indian Knowledge.<br>• To gain insight to conduct research and verify Indian knowledge. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Describe the Ancient Indian Concept of Knowledge.<br>• Discuss the importance of Indian Knowledge System in present times.<br>• Analyse Indian Society, Culture & Traditions.<br>• Analyse Indian Architecture and Town Planning. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Structural Stability & Load Distribution**<br>• Load-bearing structures<br>• Arch and dome Physics<br>• Center of gravity<br>• Earthquake resistance<br>• Load transfer calculation<br>• Interlocking stone and defensive architecture<br>• Use of local geological materials and engineering significance<br>• Study place: Daulatabad Fort and other related historical monuments | **08** |
| **Unit II** | **Material Science & Thermal Physics**<br>• Construction materials and their physical properties :Basalt rock<br>• Laterite stone and natural cooling mechanism<br>• Thermal mass effect<br>• Lime mortar and Waterproofing technique<br>• Use of local geological materials<br>• Studyplace:SindhudurgFort and other related historical monuments | **07** |
| **Unit III** | **Acoustics & Sound Engineering**<br>• Echo minimization and reverberation control<br>• Sound amplification<br>• Strategic cannon placements and Doppler effect<br>• Horn-Shaped Entrances and alarm systems<br>• Study place: Vijaydurg Fort and other related historical monuments | **08** |
| **Unit IV** | **Aerodynamics & Defense Strategies**<br>• Wind resistance in caves & cliff-top forts<br>• Narrow and zigzag entrances<br>• Wind tunnels and pressure release slits<br>• Buoyancy and ship defense<br>• Use of hydrodynamic systems<br>• Study place:, Raigad Fort and other related historical monuments | **07** |

| | | |
|---|---|---|
| **Study Resources** | • Ancient Indian knowledge System of Physics (2024, Dr.Anil Tiwari) ISBN: 9788196931742.<br>• A Review of NEP Physics in Context of Vedic Text under Indian Knowledge System (I.K.S), DOI: https://doi.org/10.31305/rrijm.2024.v09.n09.002.<br>• Knowledge Traditions & Practices of India (Mathematics) https://cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_7.pdf.<br>• The Teachings of Gita:A Guide to Modern world of Technology-Reena Sharma http://biotechjournal.in/images/paper_pdffiles/The-5d3c9fd09a297.pdf.<br>• Bhagavad Gita and Modern Life https://www.indianculture.gov.in/ebooks/bhagavad-gita-and-modern-life.<br>• METALLURGICAL HERITAGE OF INDIA https://www.tf.unikiel.de/matwis/amat/def_en/articles/metallurg_heritage_india/metallurgic al_heritage_india.html.<br>• Indian Foundations of Modern Science, Dr. Subhash Kak https://youtu.be/QF2iKJkbYJw . | |

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-VI**
**PHY-DSC-366: Practical on Electrodynamics & Nuclear Physics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | ▪ Understand the working principles and characteristics of radiation detectors like GM tubes and NaI(Tl) detectors.<br>▪ Develop skills to measure efficiency, energy resolution, and absorption coefficients for different radiation sources.<br>▪ Explore magnetic and electric field measurements using solenoids, vibration magnetometers, and parallel conductors.<br>▪ Gain hands-on experience with optical experiments, including light transmission through analyzers. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>▪ Analyze the performance of GM tubes and NaI(Tl) detectors, including efficiency and energy resolution.<br>▪ Conduct experiments on radiation absorption, decay characteristics, and activity measurement of gamma sources.<br>▪ Measure and interpret electric and magnetic field variations in different setups.<br>▪ Apply optics principles to study light transmission and polarization effects. |

| Sr. No. | Contents |
|---|---|
| **1** | To determine magnetic susceptibility of FeCl3 |
| **2** | To determine value of Plank's constant using LEDS of at least four different colours. |
| **3** | Study of I-V characteristics of photocell. |
| **4** | Surface tension by Quinke's method. |
| **5** | To study intensity response of photocell and verify inverse square law of radiations. |
| **6** | Study of Solar still for water distillation. |
| **7** | Study of box type Solar cooker. |
| **8** | Variation of resistance of a filament of a bulb with its temperature. |
| **9** | Y and η by Searl's method. |
| **10** | Y by Koenig's method. |
| **11** | Determination of velocity of sound using ultrasonic Interferometer. |
| **12** | To determine electric field between parallel conductors. |
| **13** | Measurement of field strength B and its variation in a Solenoid (determine dB/dx) |
| **14** | To Study of magnetic field by vibration magnetometer. |
| **15** | Viscosity by rotating cylinder method. |
| **16** | To determine the relation between intensity of transmited light through analyzer |

| | |
|---|---|
| **Study Resources** | ▪ S. S. Kapoor and V. S. Rmanurthy. (1986) Nuclear radiation detectors, (Wiley Eastern Limited, New Delhi,).<br>▪ J. Sabol and P. S. Weng (1995) Introduction to radiation protection dosimetry, (World Scientific),.<br>▪ W. R. Len (1955) Techniques for nuclear and particle physics, (Springer),.<br>▪ K. Sriram, (1986) Nuclear Measurement Techniques, (Affiliated East-West Press, New Delhi),.<br>▪ Leonard C. Feldman and James W. Mayer, (1988) (North Holland, New York).<br>▪ K. Sriram and Y. R. Waghamare, (1991) Introduction to nuclear science and technology, (A. M. Wheeler).<br>▪ W. J. Price (1964)Nuclear radiation detection, (McGraw-Hill, New York),.<br>▪ K. Siegbahn, (1965.) Alphas, beta and gamma-ray spectroscopy,(North Holland, Amsterdam),<br>▪ R. M. Singru, (1974) Introduction to experimental nuclear physics, (John Wiley and Sons).<br>▪ Willaim R. Hendee, (1973) Radioactive isotopes in biological research, (John Wiley and Sons).<br>• Satendra Sharma, (2008) Atomic and Nuclear physics,Pearson Education. |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Major)**
**Semester-VI**
**PHY-DSC-367: Practical on Quantum Mechanics & Atomic Physics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | ▪ Understand fundamental quantum mechanical concepts through experimental verification.<br>▪ Explore the properties of light and matter interactions, including photoelectric effect, diffraction, and absorption spectra.<br>▪ Study atomic and molecular spectra to verify theoretical principles like the Rydberg formula and energy band gaps.<br>▪ Apply magnetic and electrical measurement techniques to determine properties like e/m ratio and magnetic susceptibility. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>▪ Determine fundamental constants like Planck's constant, Stefan's constant, and the energy band gap of semiconductors.<br>▪ Experimentally verify key quantum phenomena, including the photoelectric effect, tunneling, and atomic spectra.<br>▪ Analyze optical properties using diffraction, refraction, and transmission experiments with lasers and prisms.<br>▪ Measure and interpret magnetic properties of materials using methods like Quinck's method. |

| **Sr. No.** | **Contents** |
|---|---|
| **1** | To determine the Planck constant using Photocell (Filters) |
| **2** | To determine the Planck constant using Different LED Lights |
| **3** | To Studies the Photoelectric Effect and Work function. |
| **4** | To determine the Stefan constant and to understand the Black body radiation |
| **5** | To determne the stimulated emission of radiation based on Quantum princples using He-Ne Laser. |
| **6** | To show the Tunneling effect using I-V Characteristics |
| **7** | I-V Characteristics of solar cell. |
| **8** | I-V Characteristics of photo cell. |
| **9** | To Study the Atomic clock. |
| **10** | Fill factor and efficiency of soalr cell. |
| **11** | To study the Diffraction using compack Disk and He-Ne Laser. |
| **12** | To determine the Wavelength of Laser light using slit & Double slits Experiment. |
| **13** | To calculate e/m using Thomson method. |
| **14** | To study of Absorption emission spectra usig Mercury lamp. |
| **15** | To study of Absorption emission spectra usig Sodium lamp. |
| **16** | To study the emission spectrum of hydrogen and verify the Rydberg formula. |
| **17** | To determine the Energy Band Gap of Semiconductor diode (Ge) |
| **18** | To determine the Refractive Index using hollow Prism |
| **19** | To determine Magnetic Susceptibility of given Paramagnetic liquid using Quinck's method. |
| **20** | To record the Transmitted spectrum of Potassium per magnetic material and to measure absorbance coefficient. |

| | |
|---|---|
| **Study Resources** | ▪ Beiser, A. (2003). "Concepts of Modern Physics" (6th ed.). McGraw-Hill.<br>▪ Eisberg, R., & Resnick, R. (1985). "Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles" (2nd ed.). Wiley.<br>▪ Griffiths, D. J. (2018). "Introduction to Quantum Mechanics" (3rd ed.). Cambridge |

| | |
|---|---|
| | University Press.<br>▪ Melissinos, A. C., & Napolitano, J. (2003). "Experiments in Modern Physics" (2nd ed.). Academic Press.<br>▪ Hecht, E. (2016). "Optics" (5th ed.). Pearson.<br>▪ Pedrotti, F. L., Pedrotti, L. S., & Pedrotti, L. M. (2017). "Introduction to Optics" (3rd ed.). Cambridge University Press.<br>▪ Banwell, C. N., &McCash, E. M. (1994). "Fundamentals of Molecular Spectroscopy" (4th ed.). McGraw-Hill.<br>▪ Demtröder, W. (2014). "Laser Spectroscopy: Basic Concepts and Instrumentation" (5th ed.). Springer. |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-VI**
**PHY-DSE-361A: Advanced Electronics**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course objectives** | • To understand the basic concepts of analog and digital electronics<br>• To learn differential amplifier and its applications.<br>• To learn operational amplifier & oscillator circuits in detail.<br>• To acquire the basic knowledge of counters & data processing circuits used in digital electronics. | |
| **Course outcomes** | After successful completion of this course, students are able to:<br>▪ Understand and analyze the IC 741 operational amplifier and its characteristics.<br>▪ Design the solution for linear & non-linear applications using IC741.<br>▪ Design & built oscillator for various applications.<br>▪ Use counters multiplexer, demultiplexer , encoder ,decoder in various applications. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Differential Amplifier**<br>▪ Introduction, black box concept, basic circuit of differential amplifier,<br>▪ Need of constant current source in differential amplifier, different configurations of differential amplifier, Concept of CMRR. | **06** |
| **Unit II** | **Operational Amplifier and its applications**<br>▪ Block diagram, Schematic symbol and Pin diagram of IC 741, Important parameters of OPAMP such as Input impedance, output impedance, input offset voltage, open loop voltage gain, input bias current, slew rate.<br>▪ Ideal and practical parameters of Op-Amp, Concept of virtual ground, inverting and non-inverting amplifier with gain expressions, off-set null, frequency response of operational amplifier,<br>▪ Applications: Adder, Substracter, Integrator, Differentiator, Comparator, logarithmic amplifier, schmitt trigger, precision rectifier. | **08** |
| **Unit III** | **Oscillators**<br>▪ Principle of feedback oscillators, Tuned collector oscillator, Colpitt's oscillator, Hartley oscillator, Phase shift oscillator, Wien bridge oscillator, Crystal oscillator. | **07** |
| **Unit IV** | **Digital Electronics**<br>▪ Flip flops (R - S, J - K, D, T), Shift Registers and Types of Shift Registers.<br>▪ Counters: Types of counters (Asynchronous and Synchronous), 4-bit Asynchronous up counter (Serial counter), modulus of counter, Decade Counter.<br>▪ Data Processing circuits: Multiplexer (4 to 1 line), De-multiplexer (1 to 4 line), Introduction of Decoder and Encoder. | **09** |
| **Study Resources** | ▪ Malvino A. P., (2007), Electronic Principles, 7thedition, Tata McGraw - Hill, New Delhi.<br>▪ Mottershead A., (1973), Electronic Devices & Circuits: An Introduction, Goodyear Publishing Company,<br>▪ Malvino L., (2006), Digital Principles and Applications, 6thedition, Tata McGraw – Hill, New Delhi<br>▪ Jain R.P., (2009), Modern Digital Electronics, 4thedition, McGraw Hill Education<br>▪ Clayton B.G., (1979), Operational Amplifier, 2ndedition, Butterworth-Heinemann, Elsevier.<br>▪ Gaikwad R.A., (1983), Operational Amplifier & Linear Integrated Circuits, 4th edition, Pearson. | |

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-VI**
**PHY-DSE-361B: Atmoshperic and Space Sciences**
**(NPTEL Course code:noc25-ph-13)**

**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To understand the fundamental of atmosphere and space.<br>• To study different scientific aspects of atmosphere.<br>• To understand detail ionosphere.<br>• To study about curvature and gradient drifts of spatial body. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Know about fundamental of atmosphere and stellar system.<br>• Know key role of atmospheric layers to deal with space objects.<br>• Learn about different thermodynamical phenomenon related to space.<br>• Undertand plasma and its existance in the universe. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Basics of Atmospheric Constituents**<br>▪ Atmospheric evolution, solar radiation, present day atmospheric constituents, various stages in the evolution of earth's atmosphere, formation of ozone, carbon budget, oxygen chemistry and life on earth, Variation of temperature with height, density and ionization with altitude,<br>▪ classification of atmosphere based on temperature and pressure, hydrostatic equation, hypsometric equation, **:** Fundamental forces, non-inertial forces, momentum equations governing the motions in atmosphere, curvature effect,various scales of atmospheric motions. | **08** |
| **Unit II** | **Thermodynamics Aspects of Earth's Surface**<br>▪ Hydrostatic equilibrium, hypsometric equation, geopotential height, thermodynamic system, equilibrium state, stability, gas laws,<br>▪ Avogadro hypothesis, gas constant, dry air, mixture of gases, mean molecular mass,<br>▪ Humidity variables, moist air, virtual temperature, Enthalpy, adiabatic processes, air parcel, mixing ratio and specific humidity, saturation vapor pressure, relative humidity, dew point, frost point, lifting condensation level, wet-bulb temperature, latent heat, Pseudo-adiabatic processes, equivalent potential temperature, parcel lapse rates, convection of air,<br>▪ Collision and coalescence processes,cloud formation, ascent of clouds and types, cloud morphology, cloud classification | **06** |
| **Unit III** | **Study of Ionosphere**<br>▪ Atmospheric stability conditions, Brunt-vaisala frequency, stable, unstable and neutral atmosphere,<br>▪ Cloud seeding and precipitation, Droplet growth, curvature effect and solute effect, radial growth of droplets by diffusion,<br>▪ Earth's upper atmosphere, Ionosphere, various layers and chemistry of ionosphere, types of reactions, Chapman's theory of layer production, Hydrogen in ionosphere, | **07** |
| **Unit IV** | **Electromaagnetic fields**<br>▪ Debye's shielding and Debye's potential,<br>▪ Particle motion in uniform electric field, particle motion in uniform magnetic field and guiding center, particle motion in gradient magnetic fields,<br>▪ Gradient drift and curvature drift, vacuum drift and planetary ring current, magnetic mirroring and loss cone, airglow and aurora. | **09** |

| | | |
|---|---|---|
| **Study Resources** | ▪ Houghton, J. T. (2002) The Physics of Atmospheres, Cambridge University Press, ISSN 0521011221, 9780521011228.<br>▪ Gombosi, T. I. (2009) Physics of the Space Environment, https://doi.org/10.1017/CBO9780511529474.<br>▪ Kivelson, M. G., & Russell, C. T. (1995) Introduction to Space Physics, Cambridge University Press.<br>▪ Schunk, R. W., & Nagy, A. F. (2018) 2nd Edition, Ionospheres: Physics, Plasma Physics, and Chemistry, Cambridge University Press.<br>▪ Parker, E. N. (1963) Interplanetary Dynamical Processes, Interscience Publishers, ISSN-10 0470659165. | |

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-VI**
**PHY-DSE-362A: Practical on Advanced Electronics**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • To design and analyze the basic applications of the linear IC, mainly the op-amp.<br>• To learn about basic op-amp configurations and various application circuits.<br>• To learn about the formation of oscillators.<br>• To learn about concept advanced of digital electronics like flip flops, registers, counters, multiplexers and demultiplexers. |
| **Course Outcomes** | After successful completion of this course, students are expected to:….<br>• Understand and Design circuits using Analog IC.<br>• To design the Op-Amp as adder, subtractor, differentiator & integrator.<br>• To design test the OP-Amp as oscillators.<br>• To study and design advanced digital circuits like flip flops, registers, counters, multiplexers and demultiplexers. |

| Sr. No. | Contents |
|---|---|
| **1** | Design and verify a precision full wave rectifier. Determine the performance parameters. |
| **2** | Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp. |
| **3** | Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency |
| **4** | Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lower trip point (LTP). |
| **5** | Design and verify the operation of op – amp as an adder |
| **6** | Design and verify the operation of op – amp as a substractor. |
| **7** | Design and verify the operation of op – amp as an integrator. |
| **8** | Design and verify the operation of op – amp as a differentiator. |
| **9** | Study of log amplifier. |
| **10** | To study decade counter using IC 7490. |
| **11** | To build and test Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs. |
| **12** | To build and test Counter using D-type/JK Flip-Flop ICs and study timing diagram |
| **13** | To build and test Flip-Flop (Clocked RS, D-type) circuits using NAND gates. |
| **14** | Study of 4-1 line multiplexer. |
| **15** | Study of 1-4 line de-multiplexer. |
| **16** | Square and traiangular wave generator using op – amp. |

| | |
|---|---|
| **Study Resources** | • Gayakwad R.A., (2003), Op-Amps and Linear IC's, Pearson.<br>• Operational Amplifiers & Linear ICs, David A. Bell, Oxford University Press 3rd Edition 2011.<br>• Operational Amplifiers: Theory and Practice Second Edition Version 1.8.1 James K. Roberge Kent H. Lundberg Massachusetts Institute of Technology April 19, 2007<br>• Education.1.Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)<br>• Networks, Lines and Fields, J.D.Ryder, Prentice Hall of India<br>• J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001) 4. Allen Mottershead, Electronic Devices and Circuits, Goodyear Publishing Corporation. |

| | |
|---|---|
| | • Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., (2011) Tata McGraw<br>• R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)<br>• Digital Electronics, S.K. Mandal (2010) 1st edition, McGraw Hill |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Elective)**
**Semester-VI**
**PHY-DSE-362B: Practical on Atmospheric & Space Sciences**
**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • To understand atmospheric dynamics.<br>• To explore Earth's atmosphere and Ionosphere.<br>• To study effect of Sun radiation on Earth surface.<br>• To study effect of EM field on object mass. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Understand various atmospheric processes.<br>• Measeure the green house effect.<br>• Verify atmospheric pressure at a altitude.<br>• Understand the various atmospheric condition |
| **Sr. No.** | **Contents** |
| **1** | To measure oxygen content in air. |
| **2** | Measurement of solar constant |
| **3** | To study hydrostatic force in stellar bodies. |
| **4** | To determine atmospheric pressure |
| **5** | To calculate masses of various planets |
| **6** | To calculate mass of object on different planets |
| **7** | To study solar ellipse |
| **8** | To study lonar ellipse |
| **9** | To calculate various parameters of rocket motion (Ve, B.E. Vo, etc) |
| **10** | To study the formation of mirage. |
| **11** | To study an effect of EM field on object in atmospheric spheres. |
| **12** | To study latentand specific heat of given mass of water (for all phases) |
| **13** | To measure the humidity of given mixture 1) $K_2SO_4$, 2) $Licl_2$ 3) $Na(OH)_2$ |
| **14** | To demonstrate how greenhouse gases affect temperature. |
| **15** | To demonstrate the principle of hydrostatic equilibrium, which explains how fluid pressure changes with depth and how forces balance in a static fluid. |
| **Study Resources** | ▪ David G. Andrews (2000) 2nd Edition Introduction to Atmospheric Physics, Cambridge University Press.<br>▪ Murry L. Salby (1995) Fundamentals of Atmospheric Physics, Academic Press. https://shop.elsevier.com/books/fundamentals-of-atmospheric-physics/pielke/978-0-12-615160-2<br>▪ Menn N., (2004), Practical Optics, 1stEdision, Academic Press.<br>▪ W. Schroeder, (1965), Practical Astronomy, Philosophical Library.<br>▪ J. J. Nassau, (1948), Practical Astronomy, 2nd Edition, McGraw Hill Text.<br>▪ George L. Hosmer & James M. Robbins, (1963), Practical Astronomy, John Wiley and Sons Inc.<br>▪ Kenneth Glyn Jones, (1998), Handbook of Astronomy and Astrophysics, Cambridge University Press<br>▪ Arora C.L., (1988), Experimental Physics: Principles and Practice, S. Chand Publishing<br>▪ Roy A.E. and Clarke D.,( 2004), Astronomy: Principles and Practice, 4th edition, CRC Press. |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

**T.Y. B.Sc. PHYSICS (Vocational)**
**Semester-VI**
**PHY-VSC-361: Computational Physics Using C Language**
**Total Hours: 30** **Credits: 2**

| | | |
|---|---|---|
| **Course Objectives** | • To introduce fundamental programming concepts through C-language, including algorithms, flowcharts, and structured programming.<br>• To implement numerical methods such as root-finding algorithms, numerical integration, and differential equation solvers in physics-related problems.<br>• To introduce graphical programming in C, including basic graphic functions like line, circle, arc, and bar.<br>• To enhance computational thinking by applying C programming to solve physics problems through iterative and numerical methods. | |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• To write algorithm, flowchart and C program of any problem to solve it using computer.<br>• Learn about concepts of programming such as print data, read data and operate data.<br>• Learn the arrays, pointers and user defined functions required for high performing computational skill.<br>• Improve the problem solving and analytical ability. | |
| **Unit** | **Contents** | **Hours** |
| **Unit I** | **Concepts of Programming and Introduction to C-programming:**<br>▪ Definition and Properties of algorithms, Algorithm development, Flow charts-symbols and simple flowcharts.<br>▪ Introduction and Structure of C-program, 'C' Character set, key words, Constants and variables, Variable names, Data types, qualifiers and their declarations, Symbolic Constants.<br>▪ Input/output functions: scanf( ), printf( ), getchar(), putchar(), gets(), puts().<br>▪ Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Conditional Operator.<br>▪ Control statements: if, if else, while, do while, for loop, nested control structures (nested if, nested loops), break, continue, switch- case statement, goto statement.<br>▪ Use of Library functions: e.g. mathematical, trigonometric, graphics. | **09** |
| **Unit II** | **Arrays, Pointers and user defined function in C-Language :**<br>▪ Arrays: 1-D, 2-D: Arranging numbers in descending and ascending order, Sum of matrices, multiplication of matrices.<br>▪ Concept of pointers with suitable illustrative examples.<br>▪ User defined functions: Definitions and declaration of function, function prototype, passing arguments (Call by value, Call by reference).<br>▪ Simple illustrative examples. | **07** |
| **Unit III** | **Graphics in C-Language:**<br>▪ Concepts of graphics in C,<br>▪ Some simple graphic commands- Point,<br>▪ Line, Circle, Arc, Ellipse,<br>▪ Bar with suitable illustrative examples. | **04** |
| **Unit IV** | **Computational Physics: Numerical Methods to solve the Physics Problems**<br>▪ **Iterative methods:** Bisection method and Newton-Raphson Method– Algorithm, Flowchart and writing C- program for finding the roots of the equation, problems<br>▪ **Integration:** Trapezoidal rule, Simpson's 1/3rd rule – Algorithm, Flowchart and C-program, problems.<br>▪ **Numerical solution of ordinary differential equations:** Taylor series method Eulers method. Fourth order Range – Kutta methods. | **10** |

| | | |
|---|---|---|
| **Study Resources** | ▪ Programming in C- (Schaum's series), Gottfreid, TMH<br>▪ Programming in C- Balgurusami, Prentice Hall publications<br>▪ Let us C- Yashwant Kanetkar, BPB publications<br>▪ Programming with C- K.R. Venugopal, S. R. Prasad, TMH.<br>▪ Introductory methods of numerical analysis-S. Sastry, Prentice Hall<br>▪ Computer oriented numerical methods – V. Rajaraman. | |

**T.Y. B.Sc. PHYSICS (Vocational)**
**Semester-VI**
**PHY-VSC-362: Practical on Computational Physics & C**

**Total Hours: 60** **Credits: 2**

| | |
|---|---|
| **Course Objectives** | • Develop problem-solving skills through algorithm design and flowchart creation.<br>• Understand fundamental programming concepts, including variables, operators, loops, and conditional statements in C.<br>• Implement and analyze numerical methods such as matrix operations, sorting, factorial calculations, and prime number generation.<br>• Explore fundamental numerical techniques like least square fitting, Newton-Raphson method, and numerical integration. |
| **Course Outcomes** | After successful completion of this course, students are expected to:<br>• Develop algorithms and flowcharts for mathematical and logical operations and implement C programs using appropriate data types, operators, and control structures.<br>• Debug and handle compilation errors related to invalid variable names and expressions.<br>• Apply numerical methods like matrix multiplication, polynomial roots, and numerical integration in C programming.<br>• Demonstrate proficiency in sorting, recursion, and function calling techniques such as call by value and call by reference. |

| Sr. No. | Contents |
|---|---|
| **1** | Write an algorithm and draw a flowchart of any one of the following program: (a)Determine odd or even number (b) Determinant of a 3 x 3 matrix |
| **2** | Study of different errors in compiling the C program using valid or invalid variable names |
| **3** | Read, Store and Print the constant, integer, real and character variable data in C Program. |
| **4** | Write a program to learn operators and to make any of the operations a) addition b) subtraction c) multiplication d) division |
| **5** | Write a program to study Relational Operators, Logical Operators, Assignment Operators, Conditional Operator. |
| **6** | Write a program to find largest number out of three numbers using if, if-else statement. |
| **7** | Write a program to find Factorial of a number using for loop and while loop |
| **8** | To find out the first 100 prime numbers (using do-while loop) |
| **9** | Write a program to store the 10 numbers in an array and arrange them in ascending order using bubble sort method. |
| **10** | Matrix multiplication |
| **11** | Factorial of a number by recursive method to learn user defined function |
| **12** | Write user defined function and test the Call by value and Call by reference of passing arguments. |
| **13** | Write a program to find the constant using line fitting of a given data using least square fit method. |
| **14** | Roots of polynomial (Newton Raphson) |
| **15** | Numerical Integration by Trapezoidal rule/ Simpson's 1/3 rule |
| **Study Resources** | • Programming in C- (Schaum's Series): B. Gottfreid, Tata McGraw Hill Publishing<br>• Programming in C: E. Balgurusamy, Tata McGraw Hill Publishing<br>• Let us C: Yashwant Kanetkar, BPB publications<br>• Programming with C: K.R. Venugopal, S. R. Prasad, Tata McGraw Hill Publishing<br>• Introductory Methods of Numerical Analysis-S. Sastry, Prentice Hall Publishing |

| | |
|---|---|
| | • Computer Oriented Numerical Methods – V. Rajaraman, Prentice Hall of India |

*Students are required to perform any 12 practicals from the above list, covering a total of 60 hours of practical work.

## Skills acquired and Job prospects for the TYBSc Physics students:'

**After completion of T.Y.B.Sc. (Third Year Bachelor of Science) Physics** student, acquires a variety of skills that can help in different career paths.

- **Acquired Skills:**
  - Development in analytical & comphrehensive ability to solve complex problems.
  - Experimental & laboratory skills, hands-on experience with lab instruments & data collection.
  - Interdisciplinary knowledge of understanding the concepts of electronics, quantum mechanics, material science and many more.
  - Develop communication & presentation ability to convey scientific concepts.

While a B.Sc. in Physics provides a strong foundation & better paying jobs

- **Job Prospects:**
  - Laboratory Technician
  - Meterologist
  - Data analyst or Data Scientist with proficient programming skills
  - With additional training Quality control analyst, electronin or instrumentation engineer, Indian railway, Defense (via AFCAT, CDS)

  Similarly, he/she can enhanced carrier opportunities with higher education.

  There are numerous opportunities for the students who has completed his/her degree in B.Sc./B. Sc. Honors with Physics.