DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

NAAC- 'A+' Grade

CIRCULAR NO.SU/ B.Sc./NEP-2020/91/2026

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Boards/Committees and recommended by the Faculty of Science & Technology, **Academic Council at its meeting held on 02nd June 2026 has accepted** the following **Revised syllabi of Bachelor of Science & Basket** under the Faculty of Science & Technology **as per Norms of National Education Policy-2020 and as per Government Letter dated 13 March 2024** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	**B.Sc.Botany**	**Vth and VIth semester**
2.	**B.Sc.Biotechnology**	**Vth and VIth semester**
3.	**B.Sc.Zoology**	**Vth and VIth semester**
4.	**B.Sc.Agrochemical and Fertilizer**	**Vth and VIth semester**
5.	**B.Sc.Geology**	**Vth and VIth semester**
6.	**B.Sc.Environmental Science**	**Vth and VIth semester**
7.	**B.Sc.Home Science**	**Vth and VIth semester**
8.	**B.Sc.Diary Science and Technology**	**Vth and VIth semester**
9.	**B.Sc.Automobile Technology**	**Vth and VIth semester**
10.	**B.Sc.Physics**	**Vth and VIth semester**
11.	**B.Sc.Chemistry**	**Vth and VIth semester**
12.	**B.Sc.Analytical Chemistry**	**Vth and VIth semester**
13.	**B.Sc.Polymer Chemistry**	**Vth and VIth semester**
14.	**B.Sc.Electronics**	**Vth and VIth semester**
15.	**B.Sc.Forensic Science & Cyber Security**	**Vth and VIth semester**
16.	**B.Sc.Microbiology**	**Vth and VIth semester**
17.	**B.Sc.Fisheries Science**	**Vth and VIth semester**
18.	**B.Sc.Mathematics**	**Vth and VIth semester**
19.	**B.Sc.Forensic Science**	**Vth and VIth semester**
20.	**B.Sc.Information Technology**	**Vth and VIth semester**
21.	**B.Sc.Horticulture**	**Vth and VIth semester**
22.	**B.Sc.Networking & Multimedia**	**Vth and VIth semester**
23.	**B.Sc.Biochemistry**	**Vth and VIth semester**
24.	**B.Sc.Industrial Chemistry**	**Vth and VIth semester**
25.	**B.Sc.Bioinformatics**	**Vth and VIth semester**

26.	**B.Sc.Instrumentation Practice**	**V^{th} and VI^{th} semester**
27.	**B.Sc.Non-Conventional and Conventional Energy**	**V^{th} and VI^{th} semester**
28.	**B.Sc.Statistics**	**V^{th} and VI^{th} semester**
29.	**B.Sc.Computer Science**	**V^{th} and VI^{th} semester**
30.	**Bachelor of Computer Application**	**V^{th} and VI^{th} semester**

This is effective from the Academic Year 2026-27 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus, ★
Aurangabad-431 004. ★
REF.NO.SU/AC.NO.06/4498-113 ★
Date:- 12.06.2026. ★
*****

Deputy Registrar,
Syllabus Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **The Director, University Network & Information Centre, UNIC, with a <u>request to upload this Circular on University Website.</u>**

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1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CHHATRAPATI SAMBHAJINAGAR (M.S.) - 431001

FACULTY OF SCIENCE AND TECHNOLOGY

B.Sc. Degree Programme

(Three Year / Four Years (Honors) /Four Years (Honors with Research)

Course Structure and Curriculum

(Revised)

(AS PER NEP-2020)

Subject (Major): PHYSICS

28.04.2026
(Kadam R.H.)

For

B.Sc. Third Year

(Semester – V and VI)

Professor Bhaskar Sathe,
Dean,
Faculty of Science & Technology,
Dr.Babasaheb Ambedkar
Marathwada University,
Chhatrapati Sambhajinagar

Effective from

Academic Year 2026-27

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PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Structure of B. Sc. (Three/Four Years Honours/Honours with Research Degree) Program with Multiple Entry and Exit Options

B. Sc. Third Year: 5th Semester **Subject: Physics**

Course Type	Course Code	Examination Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	PHY/DSC/T/300	SAC00063005T	**Classical Mechanics**	2		2		2+2+2+2 = 08
	PHY/DSC/T/301	SAC00063015T	**Solid State Physics**	2		2		
	PHY/DSC/P/326	SAC00063265P	**Practicals based on PHY/DSC/T/300**		4		2	
	PHY/DSC/P/327	SAC00063275P	**Practicals based on PHY/DSC/T/301**		4		2	
Discipline Specific Electives (DSE) (Choose any one from PHY/DSE/T/300 and PHY/DSE/T/301) and corresponding practical's	PHY/DSE/T/300	SBC00063005T	**Materials Characterization**	2		2		2+2=04
	PHY/DSE/T/301	SBC00063015T	**Atomic and Molecular Physics**	2		2		
	PHY/DSE/P/326	SBC00063265P	**Practicals based on PHY/DSE/T/300**		4		2	
	PHY/DSE/P/327	SBC00063275P	**Practicals based on PHY/DSE/T/301**		4		2	
Minor (Choose any two from pool of courses) **It is from different discipline of the same faculty.**	PHY/Mn/T/300	SCC00063005T	**It is from other discipline of the same faculty**	2		2		2+2 = 04
	PHY/Mn/T/301	SCC00063015T	**It is from other discipline of the same faculty**	2		2		
VSC (Vocational Skill Courses) (Choose any one from PHY/VSC/T/ 300 and PHY/VSC/T/ 301) and corresponding Practical's	PHY/VSC/T/300	SEC00063005T	**Solar Technology and Maintenance**	2		2		2+2 =04
	PHY/VSC/T/301	SEC00063015T	**Applied Electronics**	2		2		
	PHY/VSC/P/326	SEC00063265P	**Practicals based on PHY/VSC/T/ 300**		4		2	
	PHY/VSC/P/327	SEC00063275P	**Practicals based on PHY/VSC/T/ 301**		4		2	
OJT/ FP/CEP/CC/RP (Choose any one from pool of courses)	PHY/FP/CEP/P/326	SKC00063265P	**Field Project - II**		4		2	02
				12	**20**	**12**	**10**	**22**

Minor Courses Designed for other Discipline of the same Faculty

PHY/Mn/T/ 300: **Synthesis of Nanomaterials** (SCC00063005T)

PHY/Mn/T/ 301: **Environmental Physics** (SCC00063015T)

Structure of B. Sc. (Three/Four Years Honours/Honours with Research Degree) Program with Multiple Entry and Exit Options

B. Sc. Third Year: 6th Semester **Subject: Physics**

Course Type	Course Code	Examination Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	PHY/DSC/T/ 350	SAC00063506T	**Quantum Mechanics**	2		2		2+2+2+2+2 = 10
	PHY/DSC/T/ 351	SAC00063516T	**Mathematical Physics**	2		2		
	PHY/DSC/P/ 376	SAC00063766P	**Practicals based on PHY/DSC/T/350**		4		2	
	PHY/DSC/P/ 377	SAC00063776P	**Practicals based on PHY/DSC/T/351**		4		2	
	PHY/DSC/T/ 352	SIC00063526T	**Physics in Ancient India**	2		2		
Discipline Specific Electives (DSE) (Choose any one from PHY/DSE/T/350 and PHY/DSE/T/351) and corresponding practical's.	PHY/DSE/T/ 350	SBC00063506T	**Nuclear Physics**	2		2		2+2 = 04
	PHY/DSE/T/ 351	SBC00063516T	**Transistor Amplifiers and Oscillators**	2		2		
	PHY/DSE/P/ 376	SBC00063766P	**Practicals based on PHY/DSE/T/350**		4		2	
	PHY/DSE/P/ 377	SBC00063776P	**Practicals based on PHY/DSE/T/351**		4		2	
Minor (Choose any two from pool of courses)	PHY/Mn/T/ 350	SCC00063506T	**It is from Other discipline of the same faculty**	2		2		2+2 = 04
	PHY/Mn/T/ 351	SCC00063516T	**It is from Other discipline of the same faculty**	2		2		
OJT/ FP/CEP/CC/RP (Choose any one from pool of courses)	PHY/OJT/P/ 376	SJC00063766P	**On Job Training**		8		4	04
				12	**20**	**12**	**10**	**22**
Exit Option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor								

Minor Courses Designed for other Discipline of the same Faculty

PHY/Mn/T/ 350: **Sound** (SCC00063006T)

PHY/Mn/T/ 351: **Biophysics** (SCC00063516T)

Detailed Illustration of Courses included in 5thand 6thsemester:

1) **Major** (Core) subject is mandatory.

PHY/DSC/T/300: This is a 2-credit theory course corresponding to Major (core) subject

PHY/DSC/T/301: This is a 2-credit theory course corresponding to Major (core) subject

PHY/DSC/P/326: This is a 2-credit practical course based on PHY/DSC/T/300

PHY/DSC/P/327: This is a 2-credit practical course based on PHY/DSC/T/301

PHY/DSC/T/350: This is a 2-credit theory course corresponding to Major (core) subject

PHY/DSC/T/351: This is a 2-credit theory course corresponding to Major (core) subject

PHY/DSC/P/376: This is a 2-credit practical course based on PHY/DSC/T/350

PHY/DSC/P/377: This is a 2-credit practical course based on PHY/DSC/T/351

PHY/DSC/T/352: This is a 2-credit theory course corresponding to Indian Knowledge System Related to Major.

2) **Discipline Specific Electives (DSE):** (Needs to be chosen any one from pool of courses available at respective college). **These courses should be chosen related to Major**

PHY/DSE/T/300: This is a 2-credit discipline specific course (elective) related to Major

PHY/DSE/T/301: This is a 2-credit discipline specific course (elective) related to Major

PHY/DSE/P/326: This is a 2-credit practical course based on PHY/DSE/T/300

PHY/DSE/P/327: This is a 2-credit practical course based on PHY/DSE/T/301

PHY/DSE/T/350: This is a 2-credit discipline specific course (elective) related to Major

PHY/DSE/T/351: This is a 2-credit discipline specific course (elective) related to Major

PHY/DSE/P/376: This is a 2-credit practical course based on PHY/DSE/T/350

PHY/DSE/P/377: This is a 2-credit practical course based on PHY/DSE/T/351

3) **Minor: It is from different discipline of the same faculty**

PHY/Mn/T/300: This is a 2-credit theory from different discipline of the same faculty

PHY/Mn/T/301: This is a 2-credit theory from different discipline of the same faculty

PHY/Mn/T/350: This is a 2-credit theory from different discipline of the same faculty

PHY/Mn/T/351: This is a 2-credit theory from different discipline of the same faculty

4) **VSC** (Vocational Skill Courses): Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

   PHY/VSC/T/300: This is a 2-credit theory course-based Hands-on Training corresponding to Major (core) subject.

   PHY/VSC/T301: This is a 2-credit theory course-based Hands-on Training corresponding to Major (core) subject.

   PHY/VSC/P/326: This is a 2-credit practical course based on PHY/VSC/T/300

   PHY/VSC/P/327: This is a 2-credit practical course based on PHY/VSC/T/301

5) **PHY/FP/CEP/P/326:** Field project/Community Engagement and Service: This is a 2-credit practical course related to Field Project / Community engagement and service.

6) **PHY/OJT/P/376:** This is a 4-credit practical course related to On Job Training

SEMESTER- V

DSC-13: Classical Mechanics
Course Code: PHY/DSC/T/300
Examination Code: SAC00063005T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the mechanics of particles and systems of particles.
- Explain constraints, virtual work and D'Alembert's principle.
- Analyse central force motion and oscillatory systems.
- Apply Lagrange's equation to simple mechanical systems. Understand collisions, rotating frames, and rigid-body motion.

Course Outcomes: *After successful completion of this course, students will be able to*

- Analyse motion using Newton's laws and conservation principles.
- Apply Lagrangian formulation to obtain equations of motion.
- Solve problems on central forces, oscillations and collisions.
- Explain motion in rotating frames and Coriolis effects.
- Describe rigid body dynamics and angular momentum.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Mechanics of Particles:** Vector algebra: Mechanics of particles and systems of particles, conservation of momentum and energy, motion of systems with variable mass (basic idea), constraints and classification of constraints, principle of virtual work, D'Alembert's principle, Lagrange's equation of motion and simple applications: simple pendulum.	10
II	**Central Force Motion and Collisions:** Motion in a central force field, Inverse square law forces and potentials, equivalent one-body problem, equation of orbit and Kepler's laws, elastic and inelastic collisions, centre of mass and laboratory frames, Rutherford scattering and cross-section concept.	10
III	**Rotating Frames and Rigid Body Dynamics:** Non-inertial frames of reference, rotating coordinate systems, centrifugal and Coriolis forces and their applications, rigid body motion, moment of inertia and inertia tensor, angular momentum of rigid body, Euler's equations of rigid body motion, torque-free motion of rigid body, physical examples of rigid body rotation.	10

Learning Resources:

1) R. G. Takwale, P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill Publishing Company Ltd., Illustrated edition, 1979.
2) J. C. Upadhyaya, Classical Mechanics, Himalaya Publishing House, Mumbai,
3) P. V. Pant, Classical Mechanics, Narosa Publishing House Pvt. Ltd., New Delhi, First edition 2005
4) H. Goldstein, P. Charles, L. John, Classical Mechanics, Safko,3rd Edition, Addison-Wesley / Pearson Education
5) N. C. Rana, P. S. Jog, Classical Mechanics, Tata McGraw-Hill Publishing Company Ltd.
6) Gupta, Kumar, Sharma, Classical Mechanics, Pragati Prakashan

DSC-14: Solid State Physics

Course Code: PHY/DSC/T/301

Examination Code: SAC00063015T

Total Contact Hours: 30	**Credit 02**	**Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Establish a structural foundation by exploring the geometry of crystals, symmetry operations, and the 14 Bravais lattices.
- Develop mathematical proficiency in using Miller Indices to represent crystallographic planes and calculating the packing efficiency of various cubic structures.
- Trace the evolution of thermal theory from classical models to the quantum-mechanical insights of Einstein and Debye regarding lattice heat capacity.
- Analyze electronic transport mechanisms in metals, specifically focusing on the Drude-Lorentz model and the Free Electron Theory.
- Demonstrate experimental logic by introducing the Hall Effect as a primary tool for characterizing the electrical properties of materials.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Classify and Identify Structures: Categorize crystal systems and symmetry groups using unit cell parameters and Wigner-Seitz cell definitions.
- Derive Structural Constants: Mathematically calculate inter-planar distances and packing fractions (P.F.) for SC, BCC, FCC, and diamond lattices.
- Critique Thermal Models: Evaluate the success and physical limitations of the Debye model compared to classical theories in predicting heat capacity at low temperatures.
- Relate Physical Constants: Apply the Wiedemann-Franz Law to describe the relationship between thermal and electrical conductivities in metallic conductors.
- Analyze Carrier Dynamics: Interpret experimental data from Hall Effect measurements to determine charge carrier concentration, mobility, and type.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**The Crystal Structure: Unit Cells:** Primitive, non-primitive, and Wigner-Seitz primitive cell. **Symmetry:** Symmetry and symmetry operations, point groups, and space groups. **Lattices:** Bravais lattice in two dimensions, Bravais lattice in three dimensions. **Miller Indices:** Representation of planes and inter-planar distances. **Packing Fraction (P.F.):** Simple Cubic Structure (SC). Body-Centred Cubic Structure (BCC). Face-Centred Cubic Structure (FCC), Diamond Structure.	10
II	**Thermal Properties of Solids:** Classical theory of lattice heat capacity, Einstein's theory of lattice heat capacity, Density of modes, Debye's model of lattice heat capacity, and limitations of Debye's model	10
III	**Free Electron Theory of Metals:** Drude-Lorentz classical theory, Electrical and thermal conductivity, Wiedemann-Franz Law, **Hall Effect:** Hall voltage, Hall coefficient, experimental determination, and importance of the Hall effect.	10

Learning Resources:

1. C. L. Arora, P. S. Hemne, Physics for Degree Students, S. Chand Publication.
2. M. A. Wahab, Solid State Physics: Structure & Properties of Materials, Narosa Publishing House.
3. H. V. Keer, Principle of the Solid State, New Age International.
4. S. O. Pillai, Solid State Physics, VIIth Edition, New Age International.
5. Rajnikant, Applied Solid State Physics, Wiley India Pvt. Ltd.
6. R. K. Puri, V. K. Babbar, Solid State Physics, S. Chand Publications
7. Saxena, Gupta Saxena, Fundamentals of Solid-State Physics, Pragati Prakashan.
8. C. Kittle, Introduction to Solid State Physics, Wiley Publications.

DSC-15: Practicals Based on DSC-13
Course Code: PHY/DSC/P/326
Examination Code: SAC00063265P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand and apply concepts of elasticity, viscosity, surface tension, and oscillations through hands-on experiments.
- Develop skills in using laboratory instruments such as Searle's apparatus, viscometer, Melde's apparatus, and capillary tubes.
- Analyze experimental data to determine physical constants like Young's modulus, coefficient of viscosity, and surface tension.
- Study dynamic systems such as damped oscillations, elastic collisions, and vibrating strings.
- Estimate experimental errors and improve accuracy through proper measurement techniques and observations.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Determine Young's modulus (Y) using both Koeing's and Searle's methods with proper analysis.
- Evaluate the coefficient of viscosity (η) using Searle's viscometer and oscillating disc method.
- Measure surface tension using the capillary rise method and interpret intermolecular forces.
- Analyze physical phenomena such as elastic collisions, damped oscillations, and spring systems using theoretical and experimental approaches.
- Verify laws governing transverse vibrations and understand wave behavior using Melde's apparatus.

Expt. No	Name of Experiment
01	'Y' by Koeing's method
02	'Y' by Searls method
03	'η' by Searls method
04	Surface tension by capillary tube method
05	Viscosity of liquid using Searl's viscometer
06	Viscosity of liquid by using oscillating disc method
07	To study one-dimensional elastic collision using two hanging spheres
08	Study of Damped Oscillations using a Mass-Spring System
09	Determination of Spring Constant using Static and Dynamic Methods
10	Verification of Laws of Transverse Vibrations using Melde's Apparatus

Learning Resources:

1) H. T. Flint, Worsnop, Advanced Practical Physics for Students, Khosla Publishing House,
2) C. L. B. Sc. Practical Physics, S. Chand Publications
3) Khanna and Gulati, College Practical Physics, S. Chand Publication
4) Gupta and Kumar, Practical Physics, Pragati Prakashan, Meerut
5) Shrinivasan and Balsubramanyam, A textbook of Practical physics, S. Chand Publication

DSC-16: Practicals Based on DSC-14
Course Code: PHY/DSC/P/327
Examination Code: SAC00063275P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand wave optics phenomena such as interference, diffraction, and spectral analysis through experiments like Lissajous figures, iodine spectrum, and spectrometer-based measurements.
- Develop proficiency in precision instruments such as a spectrometer, a potentiometer, and a Hall effect setup.
- Apply concepts of electromagnetism and electronics to determine resistance, internal resistance, Hall coefficient, and thermoelectric emf.
- Analyse material properties, including Poisson's ratio and optical dispersion, using experimental methods.
- Interpret experimental observations, perform error analysis, and correlate theoretical concepts with practical results.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Analyze and interpret Lissajous figures to determine frequency relationships and phase differences.
- Determine fundamental constants such as Rydberg's constant and Cauchy's constants using spectrometer-based techniques.
- Evaluate physical parameters like Hall coefficient, Poisson's ratio, and temperature of flame using appropriate experimental methods.
- Measure electrical quantities such as low resistance, internal resistance, and thermocouple emf using potentiometer techniques.
- Study and interpret absorption spectra (e.g., iodine) and determine wavelengths using a diffraction grating.

Expt. No	Name of Experiment
01	To Study Lissajous figures.
02	To determine Rydberg's constant by using a spectrometer.
03	To estimate the temperature of a flame by the method of reversal of D lines of sodium.
04	Study of absorption spectra of iodine and determination of its wavelength using a grating.
05	To determine low resistance by potentiometer.
06	Hall coefficient of a semiconductor.
07	Cauchy's constant by spectrometer.
08	Determination of Poisson's ratio of rubber tube
09	Determination of internal resistance of a cell using potentiometer
10	Determination of emf of thermocouple using potentiometer

Learning Resources:

1) H. T. Flint, Worsnop, Advanced Practical Physics for Students, Khosla Publishing House,
2) C. L. Arora, B. Sc. Practical Physics, S. Chand Publications
3) Khanna and Gulati, College Practical Physics, S. Chand Publication
4) Gupta and Kumar, Practical Physics, Pragati Prakashan, Meerut
5) Shrinivasan and Balsubramanyam, A textbook of Practical physics, S. Chand Publication

DSE-1: Materials Characterization

Course Code: PHY/DSE/T/300

Examination Code: SBC00063005T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- To have an idea about the qualitative and quantitative phase analysis of materials
- To have an idea about the microstructural characterization of materials
- To gain knowledge on thermal characterization of materials
- To obtain knowledge about structure-property correlation

Course Outcomes: *After successful completion of this course, students will be able to:*

- To have an idea of X-Ray diffraction as a materials characterization technique
- To learn qualitative and quantitative phase analysis, crystal structure determination, grain size and strain calculation using XRD
- To learn about basic principles and applications of optical and electron microscopy
- To have an idea of elemental chemical composition analysis using EDS
- To learn various sample preparation techniques of SEM and TEM

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**X-ray diffraction and analysis:** Production and properties of X-rays, X-ray diffraction, Structure factor and intensity calculation, Determination of crystal structure, Calculation of crystal size and lattice strain using XRD peak broadening, Indexing of XRD spectra.	10
II	**Microscopy Techniques:** SEM and FESEM: Principle and applications, Modes of operation, Image formation - plane and fractured surfaces, Microanalysis (EDX, etc.) TEM: Principle and operation, bright field and dark field images, Sample preparation techniques, selected area diffraction, and indexing of selected area diffraction patterns.	10
III	**Spectroscopy Techniques:** Principle, Experimental arrangement, Analysis and Advantages of spectroscopic techniques- i) UV-Visible spectroscopy, ii) Raman spectroscopy, iii) Fourier Transform infrared (FTIR) spectroscopy, iv) X-ray photoelectron spectroscopy (XPS)	10

Learning Resources

1) B.D. Cullity, S.R. Stock, Elements of X-Ray Diffraction, Pearson Education India
2) P.J. Goodhew, J. Humphreys, R. Beanland, Electron Microscopy & Analysis
3) K. M. Krishnan, Principles of Materials Characterization and Metrology, Oxford
4) Y. Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley-VCH

DSE-2: Atomic and Molecular Physics

Course Code: PHY/DSE/T/301

Examination Code: SBC00063015T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEe:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand Atomic Models:
- Explore different atomic models, focusing on their historical context and limitations.
- Understand quantum numbers, and the principles behind the vector atomic model, including spin and coupling rules.
- Explore Spectroscopy Techniques.
- Learn about Raman spectroscopy, including its principles, applications, and related phenomena like NMR and ESR.

Course Outcomes: *After successful completion of this course students will be able to:*

- Students will be able to analyze the strengths and weaknesses of various atomic models, particularly the Bohr model and its successors.
- Students will apply quantum mechanical principles to explain atomic structure and behaviors, including the effects of spin and coupling.
- Raman and Magnetic Resonance Techniques:
- Students will demonstrate proficiency in Raman spectroscopy and related techniques, identifying their characteristics and practical applications in scientific research.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**The Atomic Model:** Introduction, Thomson atomic model, the Rutherford Nuclear atomic model, drawbacks of Rutherford Atomic model, The Bohr's atomic model, Bohr's Quantum Theory and Origin of Spectral Lines, Energy Level Diagram and Series Spectrum of Hydrogen Atom Based on Bohr's Model	10
II	**Vector Atomic Model:** Introduction-vector atomic model, quantum numbers associated with the vector atomic model, L-S coupling, J-J coupling, Lande's factor, the Pauli's exclusion principle, selection rules, intensity rules, interval rule, normal Zeeman effect, stark effect, and its experimental study.	10
III	**Raman Spectroscopy:** Raman effect, characteristics properties of Raman lines, classical theory of Raman effect, electron spin resonance (ESR), Nuclear magnetic resonance (NMR), Effect of nuclear spin on intensities of rotational Raman spectra.	10

Learning Resources

1) J. B. Rajam, Atomic physics, S. Chand & Company Ltd.
2) C. L. Arora, P. S. Hemme, Physics for degree students, S. Chand Publication
3) R. Murugeshan, Er. Kiruthiga Sivaprasath, Modern physics, Sivaprasath, S.Chand Publication
4) C. N. Banwell, E. M. McCash, Fundamentals of molecular spectroscopy, Mc Graw Hill International Edition.

DSE-3: Practicals Based on DSE-1
Course Code: PHY/DSE/P/326
Examination Code: SBC00063265P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand and apply X-ray diffraction (XRD) techniques to determine crystal structure, lattice parameters, and crystallite size using the Scherrer formula.
- Analyse surface morphology and microstructure of materials using SEM and TEM images.
- Use spectroscopic techniques (UV-Visible, FTIR, Raman) to study optical properties and identify molecular vibrations and functional groups.
- Perform elemental analysis using EDX to identify the composition of materials.
- Interpret experimental data and correlate structure–property relationships in materials.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Analyse XRD patterns to identify crystal structure and calculate crystallite size and lattice strain.
- Interpret SEM and TEM images to understand surface morphology and internal structure of materials.
- Apply UV-Vis, FTIR, and Raman spectroscopy to analyze optical and vibrational properties of materials.
- Determine elemental composition and oxidation states using EDX and related techniques.
- Integrate results from multiple characterization techniques to establish structure–property relationships.

Expt. No	Name of Experiment
01	Identification of Crystal Structure using XRD Pattern.
02	Determination of Crystallite Size using Scherrer Formula.
03	Determination of Lattice Strain and Indexing of Peaks.
04	Study of Surface Morphology using SEM Images.
05	Study of TEM Images and Diffraction Patterns.
06	To identify elements, present in a sample using EDX.
07	Determine the absorption spectrum of a sample using UV-Visible Spectroscopy.
08	Identify functional groups using the FTIR spectrum.
09	Study molecular vibrations using Raman spectroscopy.
10	determine elemental composition and oxidation states.

Learning Resources:

1) B. D. Cullity, S.R. Stock, Elements of X-Ray Diffraction, Pearson Education India
2) P. J. Goodhew, J. Humphreys, R. Beanland, Electron Microscopy & Analysis
3) K. M. Krishnan, Principles of Materials Characterization and Metrology, Oxford
4) Y. Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley-VCH

DSE-4: Practicals Based on DSE-2

Course Code: PHY/DSE/P/327

Examination Code: SBC00063275P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand principles of wave optics, including interference, diffraction, and dispersion through biprism, Edser's A pattern, and Hartmann formula.
- Explain the working and characteristics of optical fibres, including numerical aperture, transmission, and bending losses.
- Study the behavior of photoconductive and photoelectric devices such as LDR, photocell, and LED.
- Apply concepts of quantum physics to determine fundamental constants like Planck's constant.
- Develop experimental skills in handling optical instruments like goniometer, fibre setups, and interferometric arrangements.

Course Outcomes: *After successful completion of this course students will be able to:*

- Analyze and interpret interference patterns (biprism, Edser's A pattern) to determine the wavelength of light.
- Evaluate optical fibre parameters such as numerical aperture and bending loss, and understand signal transmission.
- Determine dispersion constants using Hartmann formula and study cardinal points using goniometer.
- Measure and analyze spectral response of the photoconductor (LDR) and verify the characteristics of photoelectric devices.
- Determine fundamental constants such as h/eusing photocell and Planck's constant (h) using LED through graphical methods.

Expt. No	Name of Experiment
01	Spectral response of photoconductor (LDR).
02	Interference of light using optical fibre.
03	To measure numerical aperture of optical fibre.
04	To study the variation in bending loss in multimode fibre.
05	Determination of wavelength of light using Biprism.
06	Study of cardinal points using Goniometer.
07	Edser's A pattern.
08	Hartmann dispersion formula.
09	Determination of h/e by using photocell.
10	Determination of 'h' by using LED.

Learning Resources:

1) H. T. Flint, Worsnop, Advanced Practical Physics for Students, Khosla Publishing House,
2) C. L. Arora, B. Sc. Practical Physics, S. Chand Publications
3) Khanna and Gulati, College Practical Physics, S. Chand Publication
4) Gupta and Kumar, Practical Physics, Pragati Prakashan, Meerut
5) Shrinivasan and Balsubramanyam, A textbook of Practical physics, S. Chand Publication

Minor - 5: Synthesis of Nanomaterials

Course Code: PHY/Mn/T/ 300

Examination Code: SCC00063005T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- To provide an overview of nanomaterials, their unique properties, and synthesis strategies suitable for undergraduate learners.
- To classify nanomaterials and discuss basic synthesis methods with real-world examples.
- To highlight characterization basics and applications, fostering interdisciplinary awareness.
- To address safety and environmental aspects in nanomaterial handling.

Course Outcomes: *After successful completion of this course, students will be able to*

- Explain the unique properties of nanomaterials and their differences from bulk materials.
- Classify nanomaterials based on dimensionality and describe synthesis techniques.
- Discuss top-down and bottom-up approaches for nanomaterial preparation.
- Outline basic characterization methods and applications in technology.
- Identify risks and sustainable practices in nanomaterial synthesis.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Fundamentals of Nanomaterials and Synthesis Approaches:** Introduction to nanoscience and nanomaterials. Size-dependent properties and surface-to-volume ratio. Classification of nanomaterials (0D, 1D, 2D, 3D). Top-down and bottom-up approaches for nanomaterial synthesis. Mechanisms of nucleation and growth of nanoparticles. Thermodynamics and kinetics in nanomaterial formation.	10
II	**Synthesis Methods:** ***a) Chemical Methods:*** Sol–gel method, co-precipitation method, hydrothermal and solvothermal synthesis, microemulsion method. Advantages and limitations of chemical synthesis routes, ***b) Physical Methods:*** Mechanical milling (high energy ball milling), physical vapour deposition (PVD), thermal evaporation, sputtering technique, pulsed laser deposition (PLD). Chemical vapour deposition (CVD) and plasma-assisted synthesis.	10
III	**Nanomaterials Applications:** Applications of nanomaterials in electronics, catalysis, photocatalysis, biomedical field (cancer, hyperthermia), sensors, energy storage and environmental remediation, microwave absorption.	10

Learning Resources:

1) C. N. R. Rao, A. Müller and A. K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH.
2) Thomas Varghese, K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis Properties and Applications of Nanomaterials, Atlantic Publishers & Distributors (P) Ltd.
3) S. K. Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing Company
4) B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, Textbook of Nanoscience and Nanotechnology, Springer

Minor-6: Environmental Physics
Course Code: PHY/Mn/T/ 301
Examination Code: SCC00063015T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- To introduce students to the basic concepts of environmental physics.
- To understand the structure of an atmosphere and solar radiation.
- To study the sources, effects, and control methods of air and noise pollution.
- To create awareness about renewable energy resources and their conservation techniques.
- To understand the role of physics in environmental science.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Explain the basic components of the environment and their physical interactions.
- Describe the energy flow in ecosystems and the Earth's energy balance, including greenhouse effects and climate change.
- Analyze the causes and impacts of air and noise pollution and understand measurement methods.
- Explain different renewable energy sources such as solar, wind, and hydropower

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Basics of Environmental Physics:** Introduction to Environmental Physics and its importance, Components of environment, Structure and composition of the atmosphere, Solar radiation, Heat transfer in the atmosphere, Greenhouse effect, Global warming, Climate change and environmental challenges.	10
II	**Pollution:** Introduction to pollution, Air pollution, Effects of air pollution on health and environment. Measurement of air pollution, Control and prevention of air pollution. Noise pollution- Introduction and sources, Effects of noise pollution on humans and wildlife. Measurement of noise, Methods of noise control and prevention	10
III	**Energy and Environment:** Introduction to energy sources, Solar energy, Applications of solar energy, Wind energy-principles and applications, Hydro-power generation and advantages, Biomass energy, Geothermal and tidal energy, Energy Conservation, Applications of Physics in Environmental Science	10

Learning Resources:

1) Anubha Kaushik and C. P. Kaushik, Environmental Studies, New Age International Publishers.
2) V. K. Mehta and Rohit Mehta, Environmental Science and Engineering, S. Chand Publications
3) D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning Pvt. Ltd.
4) S. C. Santra, Environmental Science, New Central Book Agency
5) Erach Bharucha, Text book of Environmental Studies, UGC recommended book
6) D. S. Energy Resources and Environment, New Age International
7) Peter Hughes and Nigel Mason, Introduction to Environmental Physics, CRC Press

VSC-1: Solar Technology and Maintenance

Course Code: PHY/VSC/T/300

Examination Code: SEC00063005T

Total Contact Hours: 30 | **Credit 02** | **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the importance of renewable energy sources and the role of solar energy in sustainable development.
- Explain solar radiation, solar spectrum, and the photovoltaic effect used in solar energy conversion.
- Identify different types of solar cells such as monocrystalline, polycrystalline, and thin-film solar cells.
- Describe the construction, working principle, and characteristics of solar cells, panels, modules, and arrays.
- Analyse the efficiency and basic electrical parameters of solar photovoltaic systems.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Understand the fundamentals of solar energy and photovoltaic systems.
- Learn the construction, working, and characteristics of solar cells and modules.
- Develop knowledge of solar power system components and installations.
- Acquire skills in operation, testing, troubleshooting, and maintenance of solar systems.
- Understand safety practices and performance evaluation of solar energy systems.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Fundamentals of Solar Energy and Photovoltaic Technology:** Introduction to renewable energy sources, Need and importance of solar energy, Solar radiation and solar spectrum, Principles of photovoltaic effect, Types of solar cells: Monocrystalline, Polycrystalline, Thin film solar cells, Construction and working of solar cell, Characteristics of solar cell and solar panel, Solar photovoltaic modules and arrays, Efficiency of solar PV systems, Basic electrical concepts related to solar systems.	10
II	**Solar Power Systems and Installation Techniques:** Components of solar PV systems: Solar panels, Batteries, Charge controllers, Inverters. Standalone and grid-connected solar systems, Solar Street lighting system, Solar water pumping system, Solar water heating system, Mounting structures and panel orientation, Site selection and shadow analysis, Wiring and electrical protection devices, Earthing and lightning protection, Installation procedures and safety precautions.	10
III	**Solar System Maintenance and Troubleshooting:** Preventive and corrective maintenance, Cleaning and maintenance of solar panels, Battery maintenance techniques, Testing instruments used in solar systems, Measurement of voltage, current, and power, Fault diagnosis in solar PV systems, Troubleshooting of inverter and charge controller, Performance analysis of solar systems, Energy auditing and efficiency improvement, Safety practices during maintenance.	10

Learning Resources:

1) G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers.
2) S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw Hill Education.
3) Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning.
4) H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill.
5) Ashok Kumar and Sunita Suman, Renewable Energy Technologies, Wiley India.

VSC-3: Practical's based on VSC-1

Course Code: PHY/VSC/P/326

Examination Code: SEC00063265P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the construction and working of solar cells, solar panels, and solar PV systems.
- Measure electrical parameters and study the V-I characteristics of solar PV modules.
- Develop practical skills in installation, wiring, testing, and operation of solar systems.
- Learn battery maintenance, fault identification, and troubleshooting techniques in solar PV systems.
- Understand preventive maintenance, cleaning procedures, and safety practices for solar energy systems.

Course Outcomes: *After successful completion of this course students will be able to:*

- Identify different types of solar cells and solar panels and explain their working.
- Perform measurements and analyse the performance characteristics of solar PV modules.
- Install and operate basic solar home lighting and battery charging systems.
- Test solar charge controllers and inverters and troubleshoot common faults in solar PV systems.
- Apply maintenance and safety procedures for efficient operation of solar energy systems.

Expt. No	Name of Experiment
01	Study of different types of solar cells and solar panels
02	Measurement of open circuit voltage and short circuit current of a solar panel
03	Plotting V-I characteristics of a solar PV module
04	Study and testing of solar charge controller
05	Study of solar inverter and its operation
06	Installation and wiring of a small solar home lighting system
07	Battery charging and maintenance using solar PV system
08	Measurement of solar panel efficiency under different conditions
09	Fault identification and troubleshooting in solar PV systems
10	Preventive maintenance and cleaning procedure for solar panels

VSC-4: Practical's based on VSC-2

Course Code: PHY/VSC/P/327

Examination Code: SEC00063275P

Total Contact Hours: 60	**Credit 02**	**Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Demonstrate hands-on proficiency in assembling electronic circuits on breadboards or experimental kits.
- Validate fundamental network theorems through empirical measurement of current and voltage.
- Observe the practical conversion of AC to DC using various rectification and filtration techniques.
- Evaluate the performance of voltage regulation circuits under varying load conditions.
- Experiment with timing circuits to understand the generation of pulses and waveforms using the IC-555 timer.
- Develop skills in using laboratory tools such as Multimeters, Cathode Ray Oscilloscopes (CRO), and regulated power supplies.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Experimentally verify Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems and compare results with theoretical calculations.
- Analyze the effect of RC, RL, and RLC filters on the ripple factor and efficiency of different rectifier configurations.
- Construct and characterize voltage regulators using Zener diodes and transistors, measuring their percentage regulation.
- Implement fixed voltage regulation using 78XX and 79XX ICs and understand their practical applications in dual power supplies.
- Design an IC-555 based Monostable and Astable multivibrator for a specific time delay and frequency, verifying the output on an oscilloscope.
- Generate and analyze a linear ramp signal using the IC-555 timer for sweep circuit applications.
- Accurately record observations, perform error analysis, and derive logical conclusions from experimental data.

Expt. No	Name of Experiment
01	Verification of Thevenin's Theorem
02	Verification of Norton's Theorem
03	Verification of the Maximum Power Transfer Theorem
04	Study of Full-Wave Rectifiers with RC filters.
05	Study of Bridge Rectifier with RL filters.
06	Study of Zener Diode as a Shunt Voltage Regulator.
07	Study of Transistor Series Voltage Regulator.
08	Study of Fixed Voltage Regulators using IC 78XX and 79XX series.
09	Design and Analysis of IC 555 as a Monostable Multivibrator.
10	Design and Analysis of IC 555 as an Astable Multivibrator.

FP-II: Field Project
Course Code: PHY/FP/CEP/P/326
Examination Code: SKC00063265P

Total Contact Hours: 60	Credit 02	Marks 50 (CIA:20, SEE:30)

Learning Objectives: *By the end of this course, students will be able to:*

- Apply theoretical knowledge of Physics to investigate and solve real-world scientific or societal problems.
- Develop skills in field investigation, data collection, documentation, and analysis using appropriate scientific methods.
- Enhance critical thinking, problem-solving, teamwork, and project management skills through field-based activities.
- Communicate project findings effectively through technical report writing, oral presentation, and scientific discussion.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Identify and define a real-world problem related to Physics and formulate suitable objectives and methodology for field investigation.
- Collect, organize, analyze, and interpret field data using appropriate scientific techniques and ICT tools.
- Prepare a comprehensive field project report following scientific writing standards and ethical research practices.
- Present the project findings effectively through oral presentation and viva-voce, demonstrating critical thinking, communication skills, and professional competence.

Short Guidelines for Field Project

1. Project Type: Field Survey / Community-based Study / Industry-based Study / Environmental Study / Case Study / Problem-solving Project.
2. Group Size: 1–3 students per project.
3. Duration: One semester (60 hours of work).
4. Selection of Topic: The project should address a real-life problem related to Physics or its applications and should be approved by the guide/department.
5. Report Format: (Use as applicable)
   - Title, Abstract
   - Introduction & Background
   - Statement of the Problem
   - Review of Literature, Aim and Objectives
   - Methodology
   - Field Observations/Data Collection
   - Results & Discussion
   - Conclusion & Recommendations
   - References
6. Evaluation Scheme and Assessment Method: Continuous Internal Assessment (CIA) based on project proposal, progress, presentation, and viva-voce, followed by Semester End Evaluation (SEE) through project report, presentation, and viva-voce conducted jointly by internal and external examiners as per university norms.

NOTE (For Field Project – FP):

For the Field Project (FP), the guidelines prescribed in Circular No. Acad-SU/UG/NEP-2020/Scheme of Exam. /77/2024 dated 26.04.2024 shall be followed. The detailed provisions regarding Continuous Internal Assessment (CIA) and Semester End Evaluation (SEE) are specified in the said circular (Page Nos. 22 to 26). However, as the evaluation scheme in the above circular is based on a 60:40 marks distribution, the same shall be suitably modified to a 30:20 marks distribution for Semester End Evaluation (SEE) and Continuous Internal Assessment (CIA), respectively. Accordingly, all evaluation sheets shall be revised proportionately to reflect this modification.

SEMESTER- VI

DSC-17: Quantum Mechanics

Course Code: PHY/DSC/T/350

Examination Code: SAC00063506T

Total Contact Hours: 30 | **Credit 02** | **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the basic need for quantum mechanics
- Interpret the physical meaning of the wave function
- Apply Schrödinger equation to simple systems
- Understand operator formalism and observables
- Explain atomic structure using quantum theory

Course Outcomes: *After successful completion of this course, students will be able to:*

- Explain fundamental concepts of quantum mechanics
- Solve basic Schrödinger equation problems
- Interpret operators and expectation values
- Understand the hydrogen atom and angular momentum
- Distinguish classical and quantum behaviour

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Fundamentals of Quantum Mechanics:** Introduction, failure of classical physics, blackbody radiation and photoelectric effect, De-Broglie matter waves, physical meaning of wave function, probability density and normalization, expectation values, Heisenberg uncertainty principle and its physical significance, wave packets, phase and group velocity.	10
II	**Schrödinger Equation and One-Dimensional Systems:** Time - dependent Schrödinger equation (concept), time-independent Schrödinger equation, stationary states, particle in an infinite potential well, finite potential well (qualitative idea), free particle, boundary conditions on wave functions, normalization of eigenfunctions.	10
III	**Quantum Formalism, Atomic Structure and Introduction to Quantum Computing:** Operators in quantum mechanics, eigenvalues and eigenfunctions, commutation relations, expectation values, angular momentum operators, quantum numbers, hydrogen atom energy levels, physical meaning of orbitals, Pauli exclusion principle, fermions and bosons, degeneracy of energy levels, spin quantum number, basic concept of quantum computing, qubits and superposition principle	10

Learning Resources:

1) David J. Griffiths, Introduction to Quantum Mechanics, Cambridge University Press
2) Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Kluwer Academic Pub
3) R. Shankar, Principles of Quantum Mechanics, 2nd Edn, Springer
4) H. A. Mavromatis, Exercises in Quantum Mechanics: A Collection of Illustrative Problems and Their Solutions, Springer Verlag
5) Chuck Easttom, Pearson Quantum Computing Fundamentals, 1e, Pearson Education

DSC-18: Mathematical Physics

Course Code: PHY/DSC/T/351

Examination Code: SAC00063516T

Total Contact Hours: 30	**Credit 02**	**Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- To understand vector algebra and vector calculus relevant to physical applications.
- To apply vector integration and integral theorems in solving field-related problems.
- To solve first- and second-order ordinary differential equations arising in physics.
- To introduce the fundamental principles of statistical physics and phase space.
- To understand Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics and their comparative significance.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Apply vector products and vector calculus operations in physical problems.
- Evaluate line, surface, & volume integrals and use Gauss, Green's, and Stokes theorems.
- Solve first-order and second-order linear homogeneous differential equations.
- Explain the concepts of probability, Microstates and macrostates, and phase space.
- Describe and compare Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics.
- Use mathematical tools and statistical methods in advanced physical applications.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Vector Analysis:** Product of vectors, Scalar triple product, vector triple product. Gradient of a scalar field, divergence and curl of vector function: Physical interpretation. Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems.	10
II	**Vector Differentiation:** ***Differentiation:*** Partial differentiation, successive differentiation, total differentiation, and exact differentiation. ***Ordinary Differential Equations (ODE):*** Order and degree of differential equations.**1)** Solution of a first-order differential equation. **2)** Solution of second-order linear differential equations with constant coefficients (Homogeneous Equations).	10
III	**Statistical Physics:** Introduction, probability, permutations, and combinations, Microstates and macrostates, phase space. Distribution Laws (Maxwell-Boltzmann distribution law. Fermi-Dirac distribution law. Bose-Einstein distribution law) Detailed comparison of M-B, F-D, and B-E statistics.	10

Learning Resources:

1) D. Biswas, Mathematical Methods in Physics, New Cen. Book Agency, 2009 Edition.
2) B. D. Gupta, Mathematical Physics, S. Chand Publications
3) B.S. Rajput, Mathematical Physics, Pragati Edition.
4) F. Reif, Fundamentals of Statistical and Thermal Physics, Mc-Graw Hill Publications.
5) Brijlal, N. Subrahmanyam, P. S. Hemne, Heat, Thermodynamics & Statistical Physics, S. Chand Publications.
6) H. K Das, Mathematical Physics, S. Chand and Comp. Pvt. Ltd.

DSC-19: Practicals based on DSC-17

Course Code: PHY/DSC/P/376

Examination Code: SAC00063766P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand statistical distributions and represent data using Gaussian (normal) distribution and histograms.
- Explain concepts of solid state and thermal physics, including Debye's theory and blackbody radiation.
- Apply fundamental principles of quantum mechanics, such as wave-particle duality, quantum states, and energy quantization.
- Explore computational and simulation-based approaches for studying quantum systems like the harmonic oscillator, the particle in a box, and the quantum Fourier transform.
- Understand the working principles of photoelectric effect and quantum devices, and relate them to fundamental constants.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Analyze and plot Gaussian distributions and interpret statistical behavior of physical systems.
- Determine Debye temperature and study blackbody radiation, relating experimental results with theoretical models.
- Simulate and interpret quantum systems such as a harmonic oscillator, a particle in a 1D box, and quantum random processes.
- Apply concepts of quantum computing basics, including qubits, superposition, and quantum Fourier transform.
- Verify photoelectric effect laws and calculate de-Broglie wavelength, demonstrating wave-particle duality and quantum nature of matter.

Expt. No	Name of Experiment
01	To draw the histogram of the theoretical Gaussian Curve
02	Determination of Debye's temperature
03	Simulation of Quantum Harmonic Oscillator
04	Simulation of Quantum Random Numbers
05	Simulation of the Quantum Fourier transform
06	Verification of Photoelectric Effect Laws using Photocell
07	Simulation of a Particle in a One-Dimensional Infinite Potential Well (Energy levels and eigenfunctions).
08	Simulation of Qubits and Superposition Principle (Basic Quantum Computing)
09	Calculation of De-Broglie Wavelength of Moving Particles
10	Study of Blackbody Radiation using Optical Pyrometer / Radiation Source

Learning Resources:

1) H. T. Flint, Worsnop, Advanced Practical Physics for Students, Khosla Publishing House,
2) C. L.Arora, B. Sc Practical Physics, S. Chand Publications
3) Khanna and Gulati, College Practical Physics, S. Chand Publication
4) Gupta and Kumar, Practical Physics, Pragati Prakashan, Meerut
5) Experiments in Modern Physics, by Adrian C. Melissinos, Jim Napolitano, Academic Press
6) Introduction to Classical and Quantum Computing, Published by Rooted Grove, Omaha, Nebraska
7) Quantum Computing - Ket Zero And Ket One A Beginner's Guide, by Mostafizur Rahaman L, Richa Goel, Goyal Publishers

DSC-20: Practicals based on DSC-18

Course Code: PHY/DSC/P/377

Examination Code: SAC00063776P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Develop skills in vector operations, vector identities, and triple products with applications.
- Compute and interpret gradient, divergence, and curl, and verify Gauss', Green's, and Stokes' theorems.
- Apply differentiation techniques (partial, total, exact) and solve first- and second-order differential equations.
- Understand concepts of probability, microstates, and phase space, and compare Maxwell–Boltzmann distribution, Fermi–Dirac distribution, and Bose–Einstein distribution.
- Apply mathematical methods to experimental (CRO, sound) and simulation-based problems.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Perform and verify vector operations, identities, and triple products in practical problems.
- Determine and interpret gradient, divergence, curl, and evaluate line and surface integrals.
- Verify Gauss', Green's, and Stokes' theorems using suitable vector fields.
- Solve differential equations and apply partial and total differentiation in physical contexts.
- Analyse statistical distributions (M–B, F–D, B–E) and apply mathematical methods in experiments and simulations.

Expt. No	Name of Experiment
01	Study and verification of basic vector operations and vector identities.
02	Evaluation of scalar triple product and vector triple product.
03	Study of partial derivatives, total derivatives and exact differentials.
04	Solution of first order and second-order ordinary differential equations.
05	Study of probability, microstates and graphical comparison of M-B, F-D and B-E distributions.
06	Study of Sound by Quincke's Method (Mathematical Determination)
07	Study of CRO (Mathematical Analysis of Signals)
08	To measure the phase difference between current and voltage for the C-R circuit using a CRO
09	Velocity of Sound using Helmholtz Resonator (Mathematical Determination)
10	Calculation and physical interpretation of divergence and curl

Learning Resources:

1) B. D. Gupta, Mathematical Physics, Vikas Publishing House Pvt. Ltd., New Delhi.
2) H. K. Dass and Rama Verma, Mathematical Physics, S. Chand Publishing, New Delhi.
3) B. S. Rajput, Mathematical Physics, 22nd Edition, Pragati Prakashan, Meerut.
4) P. K. Chattopadhyay, Mathematical Physics, 2nd Edition, New Age International (P) Ltd., New Delhi.
5) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
6) Shanti Narayan, Differential Calculus and Differential Equations, S. Chand Publishing, New Delhi.
7) B. B. Laud, Statistical Mechanics, 3rd Edition, New Age International (P) Ltd., New Delhi.

DSC-21: Physics in Ancient India

Course Code: PHY/DSC/T/ 352

Examination Code: SIC00063526T

Total Contact Hours: 30	**Credit 02**	**Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- To introduce students to the scientific and philosophical dimensions of IKS relevant to physics.
- To develop appreciation for ancient and modern Indian contributions to astronomy, mathematics, and physical sciences.
- To connect traditional knowledge with contemporary scientific concepts.
- To encourage critical thinking and interdisciplinary exploration.

Course Outcomes: *After successful completion of this course students will be able to*

- Compare ancient Indian concepts of matter and motion with classical physics.
- Identify scientific ideas embedded in Vedic and post-Vedic texts.
- Discuss India's role in high-energy physics and space research.
- Demonstrate how ancient Indian geometry and number systems influenced global mathematics.
- Analyze case studies of IKS in metallurgy and architecture.
- Formulate small research questions bridging IKS and physics.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Ancient Indian Physics and Cosmology:** Nyāya–Vaiśeṣika philosophy (Concept of *paramanu (atom), dravya, guna and karma*), Classification of padarthas (categories) and states of matter, Vaiśeṣika views on gravitation (*gurutva*) and motion (vega), Vedic concepts of electricity (*vidyut*), sound (*śabda*), and acoustics, cosmology (*Bhuta, akāśa, kāla, diś*), Speed of light in Puranic and Vedic texts (e.g., Sayana's commentary), Overview of *Vedāṅga Jyotiṣa* and astronomical models of Varāhamihira and Āryabhata.	**10**
II	**Interdisciplinary Relevance:** Mathematics: (*Zero, infinity, decimal system, Pi, Pythagoras theorem in Śulvasūtras, algebra and trigonometry in Bhāskara and Brahmagupta*) Metallurgy and Materials Iron pillar of Delhi, wootz steel, zinc extraction, nanotechnology in ancient India, Health and Physics (*Tridoṣa theory, Pañcamahābhūta, and their physical analogues*) IKS Research Methodologies (*Interpreting ancient texts through scientific lens*) Ethics and Philosophy (*Sadvidyā, Yoga and consciousness studies in physics*)	**10**
III	**Modern Indian Physicist and Their Contribution:** J.C. Bose (*Millimeter waves, wireless communication, plant physiology*) C.V. Raman (Raman effect, spectroscopy, Nobel Prize work) Meghnad Saha (*Saha ionization equation and stellar astrophysics*) S.N. Bose (*Bose–Einstein statistics, photon gas, collaboration with Einstein*) Homi J. Bhabha (*Cosmic rays, cascade theory, nuclear program*) Vikram Sarabhai, A.P.J. Abdul Kalam, Raja Ramanna (*Space and nuclear science*) Indian contributions to CERN and Higgs boson research, LIGO.	**10**

Learning Resources:

1) D. Chhatopadhyaya, History of Science and Technology in Ancient India, South Asia Books.
2) B. C. Chauhan, The Knowledge System of Bharata, Garuda Prakashan
3) N. G. Dongre, Physics in Ancient India, National Book Trust
4) M. B. Bhat, V. Rajat, R. N. Nagendra Pavna, Introduction to Indian Knowledge System, PHI Learning Pvt. Ltd.
5) N. R. Kumar, P. Kolhe, R. M. Pujari, Pride of India, Samskrita Bharati Publications
6) K. D. Verma, Vedic Physics, Motilal Banarsidass
7) G. Venkatraman, BHABHA AND HIS MAGNIFICIENT OBSESSIONS, Universities Press
8) S. Soni, Indias Glorious Scientific Tradition, Prabhat Prakashan
9) Online Platform: SWAYAM, NPTEL, INSA, Ancient Indian Science Portal, IIT Gandhinagar.

DSE-5: Nuclear Physics

Course Code: PHY/DSE/T/350

Examination Code: SBC00063506T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the fundamental concepts of nuclear forces and their role in atomic stability.
- Define radioactivity and describe its various forms and properties, Explore applications of radioactivity in fields such as medicine and industry.
- Identify different types of nuclear detectors and their operational principles
- Compare and contrast various particle accelerators and their applications in research.

Course Outcomes: *After successful completion of this course students will be able to:*

- Students will be able to articulate the significance of nuclear forces in maintaining atomic structure.
- Students will successfully describe the decay processes and types of radiation emitted by radioactive materials.
- Students will evaluate the practical applications of radioactivity in various fields.
- Students will be proficient in classifying and explaining the function of different types of nuclear detectors.
- Students will be able to differentiate between various particle accelerators and summarize their uses in scientific research.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Nuclear Forces and Atom Model:** Introduction, Binding Energy, Nuclear Stability, Nuclear Forces, Meson Theory of Nuclear forces, liquid drop model, shell model, energy released in fission, chain reaction, atom bomb, nuclear reactors, nuclear fusion, sources of stellar energy	10
II	**Radioactivity:** Law of radioactive decay, half-life, mean life, specific activity, partial radioactive decay, successive disintegration, Applications of radioactivity (Agricultural, Biological, Medical and industrial), Problems	10
III	**Nuclear Detectors and Accelerators:** Types of detectors, Geiger-Mueller counter, Scintillation counter, Ionization Chamber, Proportional counter. Classification of accelerators: linear accelerator, Cyclotron, Betatron, and Synchrocyclotron.	10

Learning Resources:

1) D. C. Tayal, Nuclear Physics, Himalaya Publishing House, Bombay
2) I. Kaplan, Nuclear Physics, Narosa Publishing House, New Delhi.
3) B. B. Srivastava, Nuclear Physics, Rastogi Publications
4) R. C. Sharma, Nuclear Physics, Meerut Publishing House.

DSE-6: Transistor Amplifiers and Oscillators
Course Code: PHY/DSE/T/351
Examination Code: SBC00063516T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the physical construction, working and operational characteristics of BJT and FET.
- Analyze the necessity of transistor biasing and the significance of maintaining a stable operating point (Q-point) for faithful amplification.
- Comprehend the theory of multi-stage amplification, specifically the RC-coupled amplifier's frequency response.
- Explore the design and working of various LC and RC oscillators used in signal generation

Course Outcomes: *After successful completion of this course, students will be able to:*

- Differentiate between BJT and FET based on their IV characteristics and current gain parameters (alpha and beta).
- Perform DC load line analysis to determine the stability of the operating point in various biasing circuits.
- Design and analyze a Voltage Divider Bias circuit and calculate its stability factor for thermal runaway prevention.
- Demonstrate the graphical and mathematical process of signal amplification in the CE amplifier.
- Illustrate the working mechanism and frequency limitations of RC-coupled transistor amplifiers.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**BJT and FET:** Construction, working and characteristics of Bipolar Junction Transistor (BJT), Transistors IV characteristics (CE, CB and CC configuration). Transistor current gains α and β and *relation between* α *and* β FET: Construction, Working and IV Characteristics of FET.	10
II	**Transistor biasing and Amplifiers:** Faithful amplification, Essentials of Transistor biasing. Transistor load line analysis and operating point, bias stability, transistor biasing circuits [only circuit diagram, advantages and disadvantages for fixed bias (base bias), collector feedback bias and emitter feedback bias (self-bias)]. Voltage divider bias (circuit diagram, Circuit analysis, stability factor), Single stage transistor amplifier, RC coupled transistor amplifier	10
III	**Transistor Oscillators:** Oscillator principle and tank circuit, Positive feedback Amplifier (Oscillator). Essentials of Transistor Oscillator, Explanation of Barkhausen Criterion, Hartley Oscillator (LC), Phase Shift Oscillator (RC), Wien Bridge oscillator (LC)	10

Learning Resources:

1) S. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, McGraw Hill Education
2) B. L. Theraja, Basic Electronics: Solid State, S. Chand Publications
3) J.B. Gupta, Electronic Devices and Circuits, S.K. Kataria & Sons
4) I.J. Nagrath, Electronic Devices and Circuits, PHI Learning Pvt. Ltd.
5) R. S. Sedha, A Textbook of Applied Electronics, S. Chand Publications
6) D. Roy Choudhary, S. B. Jain, Linear Integrated Circuits, New Age International Publishers
7) G.S.N. Raju, Electronic Devices and Circuits, TechSar Pvt. Ltd
8) V. K. Mehta, Rohit Mehta, Basic principle of electronics, S. Chand Publications
9) N. N. Bhargava, D. C. Kulshrstha, S. C. Gupta, Basic Electronics & Linear circuits, Mc-Graw Hill
10) A.P. Malvino, An introduction to Electronics edition-II or III.
11) M. L. Gupta, Electronics and Radio engineering, Mc-Graw Hill.
12) Kjm Rao, An introduction of Electronics, India Book House Limited

DSE-7: Practicals based on DSE-5
Course Code: PHY/DSE/P/376
Examination Code: SBC00063766P

Total Contact Hours: 60	**Credit 02**	**Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand fundamental concepts of thermal physics, including temperature measurement and mechanical equivalent of heat.
- Explain key principles of modern physics, such as charge quantization (Millikan's oil drop method) and radiation phenomena.
- Study optical interference techniques (air wedge method) for precise measurement of small dimensions.
- Analyze the interaction of gamma radiation with matter, including attenuation and inverse square law.
- Develop skills in handling radiation detection instruments such as Geiger-Müller (GM) counter and evaluate their characteristics.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Determine the temperature of the sodium flame and evaluate the mechanical equivalent of heat using experimental methods.
- Calculate the electronic charge (e) using Millikan's oil drop experiment and understand charge quantization.
- Measure the thickness of a thin wire using the air wedge method based on interference phenomena.
- Analyze gamma ray interactions, including verification of inverse square law and determination of linear and mass attenuation coefficients.
- Evaluate the performance of GM counter by plotting plateau curve and determining its dead time and counting characteristics.

Expt. No	Name of Experiment
1	Temperature of sodium flame.
2	'e' by Millican's oil drop method.
3	To determine the mechanical equivalent of heat.
4	Figure of merit.
5	Determination of the thickness of a thin wire by the air wedge method.
6	To investigate the relation between the count rate and the thickness of the material for a gamma ray source demonstrating exponential attenuation.
7	To determine the linear and mass attenuation coefficients of aluminium foil.
8	To verify the inverse square law for gamma rays.
9	To draw the plateau curve for the GM counter
10	To find the dead time of the GM counter

Learning Resources:

1) H. T. Flint, Worsnop, Advanced Practical Physics for Students, Khosla Publishing House,
2) C. L. Arora, B. Sc. Practical Physics, S. Chand Publications
3) Khanna and Gulati, College Practical Physics, S. Chand Publication
4) Gupta and Kumar, Practical Physics, Pragati Prakashan, Meerut
5) Shrinivasan and Balsubramanyam, A textbook of Practical physics, S. Chand Publication

DSE-8: Practicals based on DSE-6

Course Code: PHY/DSE/P/377

Examination Code: SBC00063776P

Total Contact Hours: 60 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Determine the operational parameters of Bipolar Junction Transistors (BJT) and Junction Field Effect Transistors (JFET) through experimental data.
- Analyze the dependency of transistor behavior on different configurations (CE, CB, CC) and bias arrangements.
- Investigate the concept of the "Q-point" and its stability in various biasing circuits to ensure linear amplification.
- Examine the frequency response of multi-stage amplifiers to identify bandwidth and gain-bandwidth products.
- Demonstrate the conversion of DC power to AC signals using positive feedback in LC and RC oscillator circuits.

Course Outcomes: *After successful completion of this course students will be able to:*

- Plot and interpret the input/output characteristics of BJTs and calculate current gains (α, β, γ) for different configurations.
- Extract JFET parameters, including dynamic drain resistance (r_d), trans-conductance (g_m), and amplification factor (μ), from transfer and drain curves.
- Locate the Operating Point (Q-point) on the DC Load Line and evaluate the thermal stability of different biasing schemes.
- Design a Voltage Divider Bias circuit to provide a stable operating point for a common-emitter amplifier.
- Construct an RC-coupled amplifier and determine its lower and upper cut-off frequencies from the frequency response curve.
- Build and troubleshoot Hartley and Wien Bridge oscillators, verifying that the output frequency matches theoretical predictions based on component values.
- Validate the Barkhausen Criterion by observing the onset of sustained oscillations in RC and LC feedback circuits.

Expt. No	Name of Experiment
1	Study of Input and Output Characteristics of BJT in CE Configuration and Measurement of Current Gain β
2	Study of Input and Output Characteristics of BJT in CB Configuration and Measurement of Current Gain α
3	To plot the Drain Characteristics and Transfer Characteristics of an n-channel JFET and to determine its parameters Dynamic Drain Resistance, Trans-conductance, Amplification Factor
4	Study of Transistor Collector Feedback Bias Circuits
5	Study of Transistor Emitter Feedback Bias (Self-Bias) Circuits
6	Design and Analysis of Voltage Divider Bias Circuit
7	Frequency Response of an RC Coupled Transistor Amplifier
8	Design and Analysis of a Transistor Hartley Oscillator (LC)
9	Study of Transistor RC Phase Shift Oscillator
10	Study of Transistor Wien Bridge Oscillator (RC)

Minor - 7: Sound

Course Code: PHY/Mn/T/350

Examination Code: SCC00063506T

Total Contact Hours: 30 | **Credit 02** | **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- To understand the basic concepts of sound waves, their nature, propagation, and characteristics.
- To study the velocity of sound in air, including Newton's formula and Laplace's correction.
- To explain the principles of architectural acoustics and factors affecting sound quality.
- To understand the production and properties of ultrasonic waves using piezoelectric and magnetostriction methods.
- To explore the applications of ultrasonic waves in medical, industrial, and scientific fields.

Course Outcomes: *After successful completion of this course students will be able to:*

- Explain the fundamentals of sound waves and calculate parameters.
- Apply Newton's formula and Laplace's correction to determine the velocity of sound in air and solve numerical problems.
- Analyse the acoustical properties of buildings and evaluate reverberation time.
- Describe the generation of ultrasonic waves using piezoelectric and magnetostriction oscillators.
- Identify and explain various applications of ultrasonics.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Sound waves:** Introduction, Sound as a longitudinal wave, Propagation of sound, Velocity of sound, Newtons formula for velocity of sound in air, Laplace's correction, Factors affecting the velocity of sound, Characteristics of sound, Numerical.	10
II	**Acoustics:** Introduction, the acoustics of building, Factors affecting acoustics of building, Reverberation, Control of reverberation, Reverberation time, Sabine's formula reverberation time (Derivation), Absorption of sound, Absorption co-efficient and its measurements, Seating arrangement, Design of auditoriums and hall/room, Conditions of good acoustical designs of room, Numerical.	10
III	**Ultrasonic:** Ultrasonic-Piezo-electric effect, Piezo-electric Generator, Magneto-striction effect, Magnetostriction oscillator, Applications of ultrasonic: SONAR, Non-Destructive Testing (NDT), medical and industrial applications, chemical effects, and other applications	10

Learning Resources:

1) Halliday, Resnick and Walker, Fundamentals of Physics, Wiley India.
2) N. Subrahmanyam and Brij Lal, A Textbook of Sound, S. Chand Publications
3) N. Subrahmanyam and Brij Lal, Waves and Oscillations, S. Chand
4) D. R. Khanna, R. S. Bedi, Text book of sound, Atma Ram and Sons
5) A. B. Wood, A Textbook of Sound, HarperCollins Distribution Services
6) L. E. Kinsler, A. R. Frey, A. B. Coppens, and J. V. Sanders, Fundamentals of Acoustics, Wiley
7) B. Brown and J. E. Goodman, Ultrasonics

Minor - 8: Biophysics

Course Code: PHY/Mn/T/351

Examination Code: SCC00063516T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Explain the laws of thermodynamics, free energy, and entropy transformations in living systems.
- Describe the physical principles of membrane potential, ion transport, and nerve impulse conduction.
- Identify the structural and functional significance of amino acids, proteins, nucleic acids, and high-energy bonds.
- Understand the fundamental physics behind spectroscopy, X-ray diffraction, and microscopy.

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

- Evaluate biological phenomena like diffusion, osmosis, and surface tension using chemical kinetics and Fick's laws.
- Apply the Nernst equation and capacitor models to explain electrical signals in biological membranes.
- Correlate the molecular structure of DNA, RNA, and mitochondria with their roles in bioenergetics.
- Utilize principles of UV-Visible, FTIR, XRD, and Electron Microscopy to characterize biological samples.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Thermodynamics and Transport in Biological System:** Laws of Thermodynamics, concept of Free energy, entropy and transformations, Bioenergetics: energy flow in living system, chemical kinetics: Rate and order of reaction, activation energy, Diffusion: Ficks law (basic idea) osmosis and dialysis, surface tension and its biological application.	10
II	**Bioelectricity and electrochemical processes:** Oxidation and reduction (basic concepts), Redox potential and biological significance, Nernst equation and applications, Electrochemical processes in living systems, Cell membrane as capacitor (basic model), Membrane potential and ion transport, Nerve impulse (electrical signal concept)	10
III	**Molecular biophysics and techniques:** Biomolecules: amino acids, proteins, Nucleic acids (DNA, RNA structure), High energy bonds (ATP concept), Structure and function of mitochondria, Spectroscopy: UV-Visible, FTIR (basic principle), X-ray diffraction (Bragg's law concept), Microscopy: optical and electron microscope (basic physics)	10

Learning Resources:

1) V. Pattabhi, N. Gautham, Biophysics, Alpha Science Int. Ltd.
2) C. P. Kothandaraman, Fundamentals of Heat and Mass transfer, New age internationals Publisher, New Delhi.
3) P. K. Srivastava, Elementary Biophysics, Alpha Science Int. Ltd.
4) R. N. Roy, A textbook of Bio Physics, New Central Book Agency Ltd.
5) M. V. Volkenstein, Molecular Biophysics, Academic Press New York
6) P. K. Banerjee, Introduction to Biophysics, S. Chand and Company Pvt. Ltd.
7) M. Subramanian, Biophysics: Principles and Techniques, MJP, Publisher
8) G. R. Ghatwal, Biophysics, Himalaya, Publishing House Pvt. Ltd.

OJT: On Job Training
Course Code: PHY/OJT/P/376
Examination Code: SJC00063766P

Total Contact Hours: 120	**Credit 04**	**Marks 100 (CIA:40, SEE:60)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the working environment of industry/research laboratories related to Physics.
- Apply theoretical knowledge to real-life practical situations in industry or field settings.
- Develop technical and problem-solving skills relevant to instrumentation, measurement, and analysis.
- Gain experience in handling equipment, safety practices, and professional ethics.
- Enhance communication, teamwork, and professional behavior in a workplace environment.

Course Outcomes: *After successful completion of this course students will be able to:*

- Demonstrate practical understanding of industrial/research processes related to Physics.
- Apply experimental and analytical skills in real-world applications.
- Prepare a training report documenting observations, work carried out, and learning outcomes.
- Exhibit professional skills, including teamwork, time management, and workplace ethics.
- Present and explain their training experience effectively through presentation/viva voce.

Short Guidelines for On Job Training:

1. **Nature of Training:** Industry / Research Laboratory / Technical संस्था / Field-based organization
2. **Duration:** As prescribed by the university (typically 4–6 weeks or equivalent hours)
3. **Placement:** Arranged by department or student (with prior approval of the institution)
4. **Supervision:** Internal guide (faculty) + External supervisor (industry/organization)
5. **Assessment Components:**
   - Training Performance (by external supervisor)
   - Report Submission
   - Presentation & Viva Voce
6. **Report Format:**
   - Organization Profile
   - Objectives of Training
   - Work Done / Observations
   - Skills Acquired
   - Conclusion

NOTE (For On-Job Training - OJT):

For the On Job Training (OJT), the guidelines prescribed in Circular No. Acad-SU/UG/NEP-2020/Scheme of Exam./77/2024 dated 26.04.2024 shall be followed. The detailed provisions regarding Continuous Internal Assessment (CIA) and Semester End Evaluation (SEE) are specified in the said circular (Page Nos. 13 to 17).

Structure / Pattern of 30 Marks Theory Course

- The SEE of the theory course shall have two parts (10 + 20 = 30 Marks).
- **Part A** shall consist of 5 questions having 2 marks each (multiple choice questions / fill in the blanks / answer in sentence) as compulsory questions, and it should cover the entire course curriculum (10 Marks).
- **Part B** shall consist of 6 questions (5 marks for each question) (02 questions from each of 03 units / covering the entire syllabus), and students shall have to attempt any 04 questions out of 06 (20 Marks).
- Wherever possible, 20 to 30% weightage can be given to problems/numerical, wherein the use of a non-programmable scientific calculator may be allowed.
- The number of sub-questions (with the allotment of marks) in a question may be decided by the examiner.

28.04.2026
(Kadam R.H.)

Dr. S.T. Alone.

Mr. M. L. Dhaye

28/4/26
(Prof. Sayyad S.B.)

28/4/26
(Deshmukh S.B)

28/04/2026
Prof P. T Sonwane

28/4/2026

(Dr. V.K Barote)

28.4.26
(Prof. R.J. Topare)

Badhe
28/04/26
Dr. BADHE S.G.

28/04/26
Prof. P.S. Ugile (Pawar)

28.04.2026
Dr. Sagar E. Shirsath

VSC-2: Applied Electronics

Course Code: PHY/VSC/T/301

Examination Code: SEC00063015T

Total Contact Hours: 30 **Credit 02** **Marks 50 (CIA:20, SEE:30)**

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the fundamental principles of circuit analysis using various network theorems.
- Analyze the design and working of different types of power supply circuits, including rectification and filtration.
- Explain the internal architecture and functional blocks of the IC-555 timer.
- Explore the practical applications of IC-555 in generating various waveforms and timing pulses.
- Develop the ability to calculate parameters like efficiency, ripple factor, and frequency for electronic circuits.

Course Outcomes: *After successful completion of this course, students will be able to:*

- Apply Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems to simplify and solve complex DC networks.
- Compare and contrast the performance of Half-wave, Full-wave, and Bridge rectifiers in terms of efficiency and output characteristics.
- Design and evaluate voltage regulator circuits using Zener diodes, transistors, and Three-terminal ICs (78XX/79XX).
- Analyze the frequency response of different filter circuits (RC, RL, and RLC) and their roles in smoothing DC output.
- Construct and troubleshoot timing circuits using IC-555 in Monostable and Astable modes for real-world applications.
- Derive mathematical expressions for time delay and frequency for IC-555-based multivibrators.

Module No.	Topic/Actual content of the syllabus	Contact Hours
I	**Network Theorems:** Electronic passive and active components, Concept of Voltage and Current Divider Theorem, Ideal Constant Voltage Sources, Ideal Constant Current Sources, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem.	10
II	**Power Supplies:** Block diagram of Regulated Power supply, half wave and Full wave rectifiers, and their efficiency, bridge rectifier, and its efficiency, Zener diode as voltage regulator, transistor series voltage regulator, IC 78XX & 79XX regulator **Filter Circuits:** Reactance, Capacitor, Inductor, RC, RL, RLC and their types	10
III	**The 555 Timer:** Introduction, Basic block of IC-555 timer and function of each block, IC-555 as Monostable multivibrator and its applications, IC-555 as an Astable multivibrator, and its applications, IC-555 Free running ramp generator.	10

Learning Resources:

1) V. K. Mehta, Rohit Mehta, Principles of Electronics, S. Chand Publications
2) S. Salivahanan, N. Suresh Kumar, Electronic Devices and Circuits, Tata McGraw-Hill
3) Abhijit Chakrabarti, Circuit Theory: Analysis and Synthesis, Dhanpat Rai and Co. Ltd.
4) D. Roy Choudhury, Networks and Systems, New Age Publications
5) R. S. Sedha, A Textbook of Applied Electronics, S. Chand Publications
6) D. Roy Choudhury and Shail B. Jain, Linear Integrated Circuits, New Age Publications
7) B.L. Theraja , A Textbook of Electrical Technology, S. Chand Publications
8) S.L. Gupta and V. Kumar, Handbook of Electronics, Pragati Prakashan
9) Albert Malvino and David Bates, Electronic Principles, MacGraw - Hill