Nehru Gram Bharati (Deemed to be University)

Prayagraj, Uttar Pradesh , INDIA

Syllabus

[As per NEP-2020 Regulations]

[NHEQF Level 4.5 to 6.0]

B.Sc./B.Sc. (Honours)/ (Honours with Research)

in

Physics

[Department of Physics]

[Effective From 2025-26 Onwards]

Board of Studies

Dated: 10-06-2025

1. Dr. Vikram Singh, Head, Department of Physics, NGB (DU), Chairman

2. Dr. Sanjay Kumar, Assistant Professor, Dept. of Physics, NGB (DU), Member

4. Dr. Archana Shukla, Assistant Professor, Dept. of Mathematics, NGB (DU), Member

4. Dr. Tarkeshwar Trivedi, Dept. of Physics, University of Allahabad, External Member (Subject Expert)

5. Prof. Devendra Kumar Mishra, Professor, Dept. of Physics, BHU External Member (Subject Expert)

6. Prof. Ram Kripal, (Retd.), Ex-Professor, Dept. of Physics, NGB(DU), Member

Attendance Sheet & Minutes

NEHRU GRAM BHARATI

(DEEMED TO BE UNIVERSITY)
KOTWA-JAMUNIPUR-DUBAWAL
PRAYAGRAJ- 221505

DEPARTMENT OF PHYSICS

Date: 12/06/2025

A meeting of the Board of Studies (BOS) of the Department of Physics was held on 12/06/2025 at 02:30PM in the Department of Physics. The following members were present.

1. Dr. Vikram Singh- Chairman
2. Dr. Sanjay Kumar- Member
3. Dr. Archana Shukla- Member
4. Prof. Devendra Kumar Mishra- External Expert - (ONLINE)
6. Dr. Tarkeshwar Trivedi- External Expert
7. Prof. Ram Kripal- Ex- Dean, Head, DoP, FoS, NGBU – (ONLINE)

Agenda:

A. Confirmation of the minutes of the previous meeting held on **04 April 2024**, along with the Action Taken Report (ATR).

B. Current Agenda:

1. To consider the inclusion of minor papers in the B.Sc. syllabus.
2. To revise the credit, marks distribution and correct minor errors in the syllabus.
3. To update the syllabus of M. Sc. & Ph. D.
4. Any other matter with the permission of the Chair.

Resolutions/Decisions Taken:

1. **Approval of Previous Minutes:**
   The minutes of the previous meeting dated **04 April 2024**, along with the Action Taken Report, were read and approved unanimously.
2. **Syllabus Modification and Credit Revision:**
   a. It was resolved to **add 7 minor papers** to the existing **B.Sc. NEP 2020 syllabus**.
   b. The **marks distribution** for internal and external assessments is revised from **20+80 to 40+60.**
   c. The **total credits per semester** have been revised:
      i. A reduction from **22 credits to 20 credits** per semester.
      ii. The **overall program credits** have been revised from **180 credits to 160 credits**.
   d. Minor typographical and formatting **errors in the syllabus** were reviewed and corrected.
3. No any modification to M. Sc. & Ph. D. Syllabus.
4. **Other Matters:**
   a. No additional matters were raised.
   b. No further resolutions were presented.

Conclusion:

The meeting concluded with a **vote of thanks** by the Chairperson to all members for their active participation and valuable contributions.

12/06/2025 12/06/2025 12/6/2025

Introduction of the Programme:

[a] Introduction:

The NEP-2020 offers an opportunity to effect a paradigm shift from a teacher-centric to a student- centric higher education system in India. It is based on Outcome Based Education, where the Graduate Attributes are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours/Honours with Research) in Physics is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills, as well as to develop scientific temper, spirit of enquiry, problem solving skills and human and professional values which foster rational and critical thinking in students.

[b] Graduate Attributes:

Type of learning outcomes	**The Learning Outcomes Descriptors**
Learning outcomes thatare specific to disciplinary/ interdisciplinaryareas of learning	Disciplinary/ interdisciplinary Knowledge & Skills
Generic learning outcomes	***Critical Thinking & problem-solving Capacity***
	Creativity
	Communication Skills: The graduates should be able to demonstrate the skills that enable them to: • listen carefully, read texts and research papers analytically, and present complex informationin a clear and concise manner to different groups/audiences, • express thoughts and ideas effectively in writing and orally and communicate with othersusing appropriate media, • confidently share views and express herself/himself, • construct logical arguments using correct technical language related to a field of learning,work/vocation, or an area of professional practice, • convey ideas, thoughts, and arguments using language that is respectful and sensitive togender and other minority groups.
	Analytical reasoning/thinking: The graduates should be able to demonstrate the capability to: • evaluate the reliability and relevance of evidence; • identify logical flaws in the arguments of others; • analyze and synthesize data from a variety of sources; • draw valid conclusions and support them with evidence and examples, and addressingopposing viewpoints.

	Research-related skills: The graduates should be able to demonstrate: • a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions, • the ability to problematize, synthesize and articulate issues and design research proposals, • the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships, • the capacity to develop appropriate methodology and tools of data collection, • the appropriate use of statistical and other analytical tools and techniques, • the ability to plan, execute and report the results of an experiment or investigation, • the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.
	Coordinating/collaborating with others: The graduates should be able to demonstrate the ability to: • work effectively and respectfully with diverse teams, • facilitate cooperative or coordinated effort on the part of a group, • act together as a group or a team in the interests of a common cause and workefficiently as a member of a team.
	Leadership readiness/qualities: The graduates should be able to demonstrate the capability for: • mapping out the tasks of a team or an organization and setting direction. • formulating an inspiring vision and building a team that can help achieve the vision,motivating and inspiring team members to engage with that vision. • using management skills to guide people to the right destination.
	'Learning how to learn' skills: The graduates should be able to demonstrate the ability to: • acquire new knowledge and skills, including 'learning how to learn' skills, that are necessary for pursuing learning activities throughout life, through self-paced and self- directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing tradesand demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution,through knowledge/ skill development/reskilling,
	• work independently, identify appropriate resources required for further learning, • acquire organizational skills and time management to set self-defined goals and targets withtimelines. • inculcate a healthy attitude to be a lifelong learner,
	Digital and technological skills: The graduates should be able to demonstrate the capability to: • use ICT in a variety of learning and work situations, • access, evaluate, and use a variety of relevant information sources, • use appropriate software for analysis of data.
	• ***National & International Perspective considering the current perspective of a Global Village.***

	Value inculcation: The graduates should be able to demonstrate the acquisition of knowledge and attitude that are required to: • embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values, • practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies, • formulate a position/argument about an ethical issue from multiple perspectives • identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights, • recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
	Autonomy, responsibility, and accountability: The graduates should be able to demonstratethe ability to: • apply knowledge, understanding, and/or skills with an appropriate degree of independence relevant to the level of the qualification, • work independently, identify appropriate resources required for a project, and manage a project through to completion,
	Environmental awareness and action: The graduates should be able to demonstrate the acquisition of and ability to apply the knowledge, skills, attitudes, and values required to take appropriate actions for: • mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainabledevelopment and living.
	Community engagement and service: The graduates should be able to demonstrate the capabilityto participate in community-engaged services/ activities for promoting the well-being of society.
	Empathy: The graduates should be able to demonstrate the ability to identify with or understand the perspective, experiences, or points of view of another individual or group, and to identify and understand other people's emotions.

[c] Flexibility:

The programmes are flexible enough to allow liberty to students in designing them according to their requirements. The Learner is given freedom of choice in selecting disciplines. Students may select his/her own stream. He/She may select three major disciplines from his her own stream or two major disciplines from his own stream and one major discipline from any other stream . Alongwith major disciplines, a student can select minor disciplines from other streams, languages, generic electives, ability enhancement courses, Vocational/Skill Enhancement Courses (SEC) and Value added Courses including Extra Curricular activities.

Multiple Entry & Exit Options:

ENTRY &EXIT OPTIONS	Credits Required
Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme**.** **+ 04 Credit Mandatory Internship in Case of Exit.**	**44**
Diploma upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme. **.** **+ 04 Credit Mandatory Internship in Case of Exit.** For Entry to NHEQF Level 5.0, must have completed the NHEQF 4.5 Level of Four Year Undergraduate Programme as per NEP-2020.	**84**
Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme. For Entry to NHEQF Level 5.5, must have completed the NHEQF 5.0 Level of Four Year Undergraduate Programme as per NEP-2020.	**120**
Bachelor Degree with Honours / Honours with Research in a Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme. For Entry to NHEQF Level 6.0, must have completed the NHEQF 5.5 Level of Four Year Undergraduate Programme as per NEP-2020.	**160**

Programme Educational Objectives (PEOs):

Programme outcomes (POs)	
Students having Degree in B.Sc. (with Physics) should have knowledge of different concepts and fundamentals of Physics and ability to apply this knowledge in various fields of academics and industry. They may pursue their future career in the field of academics, research and industry.	
PO 1	1. Competence in the methods and techniques of calculations using Mechanics. 2. Students are expected to have hands-on experience to apply the theoretical knowledge to solve practical problems.
PO2	1. Competence in the concepts of Thermodynamics and Statistical Mechanics. 2. Students are expected to have hands on experience in Thermal Physics Experiments.
PO 3	1. Knowledge of electrical instruments, circuits and basic semiconductors. 2. Student should be able to make basic electrical circuits and handle electrical instruments.
PO4	1. Knowledge of different concepts in Geometrical Optics. 2. Students are expected to have hands on experience of Experiments of GeometricalOptics
PO5	1. Students are expected to have deep understanding of electricity and magnetism andmodern physics. 2. Student should be able to make basic electrical circuits and handle electrical instruments.
PO 6	1. Comprehensive knowledge of Analog & Digital Principles and Applications. 2. Learn the integrated approach to analog electronic circuitry and digital electronics forR&D.
PO 7	1. Knowledge of basic concepts of quantum mechanics their applications in technology 2. Students are expected to have an insight in handling other optical instruments.
PO 8	1. Knowledge of basic concepts of advance electronics their applications in technology 2. Student should be able to make advance electrical circuits and handle some advanceelectrical instruments.
Programme specific outcomes (PSOs): ***UG I Year / Certificate course in Basic Physics***	

After completing this certificate course, the student should have

- Acquired the basic knowledge of Mechanics, waves- oscillation, Thermodynamics and statistical mechanics.
- Knowledge of different aspects of Thermal Physics which serves as a basis for many physical systems used in industrial applications and deals with the physics and technology of Engines andRefrigerators.
- Hands-on experience to apply the theoretical knowledge to solve practical problems of basic physical phenomena. He should be able to carry out experiments to understand the laws and concepts of Physics.
- An insight in understanding Mechanics, thermodynamics and in handling mechanical andthermodynamical instruments.

Programme specific outcomes (PSOs): UG
II Year/ (Diploma in Applied Physics)

After completing this diploma course, the student should have

- Knowledge of different concepts in Electrical circuits, Basic Semiconductor Physics and Geometrical Optics and laser.
- A deeper insight in Ray Optics to understand the Physics of many optical instruments which are widely used in research and Industry, Optoelectronics, IT and communication devices, and in industrial instrumentation.
- Knowledge of basic concepts of optical instruments with their applications in technology.
- With Hands- on training with electrical instruments and optical instruments widely used in different fields.

Programme specific outcomes (PSOs):
UG III Year and IV Year/ Bachelor of Science/ B. Sc. (Honors)/ B. Sc. (Honours with Research)

After completing this degree course, the student should have:

PSO 1: Knowledge of Mechanics and basic properties of matter. The course will empower him to apply his theoretical knowledge in various physical phenomena that occur in day to day life and he can use this scientific knowledge for the betterment of the society.

PSO2: Expertise in different aspects of Thermal Physics which serves as a basis for many physical systems used in industrial applications and deals with the physics and technology of Engines and Refrigerators.

PSO3: Understanding of basic concepts related to Electrical circuits and semiconductor physics. He should be proficient in designing and handling different electrical circuits.

PSO4: Proficient in the field of Optics which will increase his demand in research and industrial establishments engaged in activities involving optical instruments.

PSO5: Understanding of basic concepts related to Electricity and Magnetism, Basic knowledge in the field of Modern physics, which have utmost importance at both undergraduate and graduate level.

PSO6: Comprehensive knowledge of Analog & Digital Principles and Applications. Learn the integrated approach to analog electronic circuitry and digital electronics forR&D.

PSO7: Understanding of basic concepts related to quantum mechanics and its application in different fields. Proficient in the field of Optics which will increase his demand in research and industrial establishments engaged in activities involving optical instruments.

PSO8: Comprehensive knowledge of Analog & Digital Principles and Applications. Learn the integrated approach to analog electronic circuitry and digital electronics forR&D.

Department of Physics B.Sc.(Honours/Honours with Research) in Physics
SYLLABUS STRUCTURE OVER- All (Based on NEP – 2020)

B.Sc./B.Sc. (Honours/Honours with Research) in Physics										
Year	**Semester**	**Nomenclature of the Courses/Title**	**Com/Ele.**	**Credit**	Credit Distribution			Teaching Hours		
					L	T	P	L	T	P
First Year	I	Mechanics & Wave Oscillations (Major-I)	Compulsory	4	2	0	2	30	0	60
		Introduction to IKS (Major-I)	Compulsory	2	2	0	0	30	0	0
		Minor Course : Fundamentals of Physics and Its Applications- I [For Students of other Discipline/Subject]	Pool B Elective	3	3	0	0	45	0	0
		AEC: Communication Skills & Personality Development	Compulsory	2	2	0	0	30	0	0
		SEC-I : Paper-I	Pool C Elective	3	1	0	2	15	0	60
		VAC-I : Understanding India	Pool D Elective	2	2	0	0	30	0	0
		Other Major	Pool A Elective	4	2	0	2	30	0	60
		Total Semester Credits		**20**						
	II	Thermal Physics & Statistical Mechanics (Major-I)	Compulsory	5	3	0	2	45	0	60
		Minor Course: Fundamentals of Physics and Its Applications- II [For Students of Other Discipline/Subject]	Pool B Elective	3	3	0	0	45	0	0
		AEC : Critical Thinking & Problem Solving	Compulsory	2	2	0	0	30	0	0
		SEC-2: Paper-II (Same as Sem-I)	Pool C Elective	3	1	0	2	15	0	60
		VAC-2: Indian Constitution	Pool D Elective	2	2	0	0	30	0	0
		Other Major (Same as Sem-I)	Compulsory	5	3	0	2	45	0	60
		Total Semester Credits		**20**						
Exit Option : Certificate in Field of Learning/discipline										
Second Year	III	Electric Circuit & Basic Semiconductor Physics (Major-1)	Compulsory	4	2	0	2	30	0	60
		Applied IKS-I : Physics (Major-1)	Compulsory	2	2	0	0	30	0	0
		Minor Paper for Students of other discipline/Subject: Heat and Thermodynamics-I	Pool B Elective	3	3	0	0	45	0	0
		AEC: Soft Skills	Compulsory	2	2	0	0	30	0	0
		SEC-3 : Paper-I (Other than Sem-I)	Pool C Elective	3	1	0	2	15	0	60
		VAC-3: Indian Heritage and Culture/NSS/NCC	Pool D Elective	2	2	0	0	30	0	0

		Other Major (Same as Sem-I)	Compulsory	4	2	0	2	30	0	60
		Total Semester Credits		**20**						
	IV	Optics & Laser (Major-I)	Compulsory	5	3	0	2	45	0	60
		Minor Paper for Students of other discipline: Heat and Thermodynamics-II	Pool B Elective	3	3	0	0	45	0	0
		AEC: Content Writing & Editing	Compulsory	2	2	0	0	30	0	0
		SEC-4: Paper-II (Same as Sem-3)	Pool D Elective	3	1	0	2	15	0	60
		VAC-4: Food Nutrition & Hygiene or POOL D	Pool Elective	2	2	0	0	30	0	0
		Other Major	Pool Elective	5	3	0	2	45	0	60
		Total Semester Credits		**20**						
Exit Option : Diploma in Field of Learning/discipline										
Third Year		Electromagnetic Theory & Perspective of Modern Physics (Major-I)	Compulsory	4	2	0	2	30	0	60
		Applied IKS-II : Physics (Major-I)	Compulsory	2	2	0	0	30	0	0
		Minor Course : ELECTRICITY & MAGNETISM-I	Pool B Elective	3	3	0	0	45	0	0
	V	AEC: Team Building & Leadership	Compulsory	2	2	0	0	30	0	0
		Note: Choose any one Paper (Elective) 1. Mathematical Physics 2. Condensed Matter Physics	Elective	3	3	0	0	45	0	0
		VAC-5 Environmental Science and sustainability	Pool D Elective	2	2	0	0	30	0	0
		Other Major (Same as Sem-I)	(Compulsory)	4	2	0	2	30	0	60
		Total Semester Credits		**20**						
		Analog & Digital Electronics (Major-I)	Compulsory	5	3	0	2	45	0	60
		Note: Choose any one Paper (Major-I) 1. Atomic & Molecular Physics 2. Plasma Physics	Elective	3	3	0	0	45	0	0
	VI	Minor Course: ELECTRICITY & MAGNETISM-II [For Students of Other Discipline/Subject]	Pool B Elective	3	3	0	0	45	0	0
		Internship/Apprenticeship	Compulsory	4	0	0	4	0	0	120
		Other Major (Same as Sem-I)	(Compulsory)	5	3	0	2	45	0	60

		Total Semester Credits		**20**							
Exit Option : Basic UG degree in Field of Learning/discipline											
Fourth Year	VII	Quantum Mechanics (Major-I)	Compulsory	5	3	0	2	45	0	60	
		Research Methodology (Hons. with Research) /Biophysics (Honours)	Compulsory	4	4	0	0	60	0	0	
		Note: Choose any Two Paper (Dual Elective)[4+4] 1. Nanobiotechnology 2. Introduction to Nanoscience and Technology 3. Laser Fundamentals and Applications	Elective	8	4	0	0	60	0	0	
		Minor Paper From other discipline : Mathematical Methods	Pool Elective	3	3	0	0	45	0	0	
		Total Semester Credits		**20**							
	VIII	Advanced Electronics	Compulsory	5	3	0	2	45	0	60	
		Note: Choose any one Paper: 1. Astrophysics & Space Physics 2. Origin 3. High Energy Physics	Elective	3	2	0	1	30	0	30	
		Dissertation/Research Project & Viva Voce (Hons. with Research) or Field Visit/Tour based Viva Voce (Honours)	Compulsory	12	0	0	12	0	0	360	
		Total Semester Credits		**20**							
Completion : UG (Hons./Hons. with Research) degree in Field of Learning/discipline											
		Total Credits of All Semester		**160**							

*** AEC: Ability Enhancement Course SEC: Skill Enhancement Course;**
VAC: Value Added Course; IKS: Indian Knowledge System

Department of Physics
B.Sc. (Honours/Honours with Research) in Physics
SYLLABUS (Based on NEP – 2020)
Session 2025 – 26

YEAR	SEMESTER	PAPER TITLE	Course Code	MAJOR/ MINOR	COM/EL	(L)	(T)	(P)	TOTAL CREDIT	TEACHING HOURS
1ST	I ST	Mechanics & Wave Oscillations	PHY-23101	Major	COM	02	00	02	04	90 (30 + 60)
		Introduction to IKS: Physics	PHYIKS-2301	Major	COM	02	00	00	02	30
		Minor Paper for other discipline: Fundamentals of Physics and Its Applications- I	MPHY01	Minor	EL	03	00	00	03	45
	II ND	Thermal Physics & Statistical Mechanics	PHY-23102	Major	COM	03	00	02	05	105 (45 + 60)
		Minor Paper for other discipline Fundamentals of Physics and Its Applications- II	MPHY02	EL	03	00	00	03	45	EL
2ND	III RD	Electric Circuit & Basic Semi-Conductor Physics	PHY-23103	Major	COM	02	00	02	04	90 (30 + 60)
		Applied IKS-I: Physics	PHYIKS-2302	Major	COM	02	00	00	02	30
		Minor Paper for other discipline: Heat and Thermodynamics- I	MPHY03	Minor	EL	03	00	00	03	45
	IV TH	Optics & Laser	PHY-23104	Major	COM	03	00	02	05	105 (45 + 60)
		Minor Paper for other discipline: Heat and Thermodynamics- II	MPHY04	Minor	EL	03	00	00	03	45
3RD	V TH	Electromagnetic Theory & Perspective of Modern Physics	PHY- 23105	Major	COM	02	00	02	04	90 (30 + 60)

		Applied IKS-2: Physics	PHYIKS-2303	Major	COM	02	00	00	02	30
		Minor Course: Electricity and magnetism- I	MPHY05	Minor	ELE	03	00	00	03	45
		Note: Choose any one Paper i. Mathematical Physics ii. Condensed Matter Physics	PHY-23106A/ PHY-23106B	Major	EL	03	00	00	03	45
	VI[TH]	Analog & Digital Electronics	PHY-23107	Major	COM	03	00	02	05	105 (45 + 60)
		Note: Choose any one Paper i. Atomic & Molecular Physics ii. Plasma Physics	PHY-23108A/ PHY23108B	Major	EL	03	00	00	03	45
		Minor Course: Electricity and magnetism- II	MPHY06	Minor	EL	03	00	00	03	45
		Internship/Apprenticeship	PHY-23109	Major	COM	0	0	04	04	120
4[TH]	VII[TH]	Quantum Mechanics	PHY-23110	Major	COM	03	00	02	05	105 (45 + 60)
		Research Methodology (Honours with Research)/ Biophysics (Honours)	PHY-23111A/ PHY-23111B	Major	COM	04	00	00	04	60
		Note: Choose any Two Course (4+4) 1. Nanobiotechnology 2. Introduction to Nanoscience and Technology Laser Fundamentals and Applications	PHY-23112A/PHY-23112B/PHY-23112C	Major	EL	04	00	04	08	180 (60+120)
		Minor Paper for Other Discipline : Mathematical Methods	MPHY07	Minor	EL	03	00	00	03	45

	VIIIth	Advanced Electronics	PHY-23113	Major	COM	03	00	02	05	105 (45 + 60)
		Note: Choose any two Course: (4+4) 1. Astrophysics & Space Physics 2. Origin 3. High Energy Physics	PHY-23114A/ PHY- 23114B/ PHY-23114C	Major	EL	02	00	01	03	60 (30+30)
		Dissertation/Research Project Viva Voce (Hons. with Research)/Field Visit, Educational Tour based Viva Voce	PHY23115 A/PHY2311 5B	Major	COM	00	00	12	12	360

SEMESTER-I

B.Sc./B.Sc. (Honours/ Hounours with Research) in Physics

Programme: B.Sc./B. Sc. (Honours/ Honours with Research) in Physics	**Year:** B. Sc. First	**Semester:** I
Pedagogy:		
Course Code: PHY-23101	**Course/ Paper Title:** Mechanics, Waves and oscillation	

Course Outcomes- After completing this course, the students will be able to-

CO1: understand the background and concept of Vector Calculus which includes the concept of physical quantities like scalar and vectors, their differentiation and integration, line, Surface,Volume and their physical significance, vector operator and its application.

CO2: understand Frame of reference and Inertial and non-inertial frames, Galilean transformations, invariance, Principle of Equivalence, Michelson and Morley's Experiments and Postulates of Special Relativity which explains the concept of relative motions and their effect in different physical parameters.

CO3: aware of the concepts related to Relativistic dynamics and Mechanics of Rigid Bodies concept of Motion in an Inverse Square Field, Kepler's Laws and gravitation related concept.

CO4: aware of the concepts related to Simple Harmonic Motion, Damped Motion, Steady Forced Oscillations. Resonance. Fourier Series Decomposition. Simple cases of square, Saw-tooth and Rectified Sinusoidal Waves, Ultrasonic's: Generation and detection. Measurement of velocity in Liquids, Applications.

CO5: understand One- dimensional Wave-motion in non-dispersive media.

Credit (L+T+P): 2+0+2	**Paper:** Core Compulsory
Max. Marks: 40+ 60 (30T+30P)	**Min. Passing Marks:** 35

Total Number of Lectures: (Lecture- Tutorial- Practical): 30+0+60

Units	Topics	No. of Lectures
I	**Mathematical Background & Special Theory of Relativity** Background of Vector Calculus, Concept of line, surface and volume integral, Physical significance of Gradient, Divergence and Curl. Frame of Reference, Inertial and Non-inertial frames, Galilean transformation, Galilean invariance, Pseudo forces, Rotating reference frame, Centrifugal force, Coriolis Force. Inertial and Gravitational mass, Principle of Equivalence. Inference of Michelson-Morley Experiments. Postulates of special relativity, Lorentz transformations, Length contraction, Time dilation, Simultaneity in relativity theory, Addition of velocities, Relativistic dynamics, Variation of mass with velocity, mass- energy relation. Relativistic Doppler shift.	7
II	**Mechanics of Rigid Bodies and Non- Rigid Bodies** System of particles, Centre of Mass, Linear momentum, Centre of mass frame, Rotational motion in two and three dimensions, Angular momentum, Moment of inertia tensor, Central forces, Conservative forces, Potential energy, Gravitational potential and field due to a uniform spherical shell and solid sphere, Conservation Laws. Strain and stress in an isotropic homogeneous medium, Elastic moduli and relations between them, Torsion of cylinders, Bending of beams, Internal energy of a strained body.	7
III	**Motion Under A Central Force and fluid Mechanics** Two-particle central force problem reduced mass, lab and Center of mass co- ordinate systems, Motion in an inverse square field, Kepler's laws. Ideal fluids, Equation of continuity, Streamline flow, Rotational and irrotational flows, Euler's equations of motion, Bernoulli's theorem, Viscous fluids Poiseuillie's equation, Viscosity by rotating cylinder method, surface Tension.	5
IV	**Oscillations & Ultrasonic's** Simple Harmonic Motion, Damped Motion, Steady Forced Oscillations. Resonance. Fourier Series Decomposition. Simple cases of square, Saw-tooth and Rectified Sinusoidal Waves. Ultrasonic's: Generation and detection. Measurement of velocity in Liquids, Applications.	5
V	**One-dimensional Wave-motion in non-dispersive media** Wave Equation, Progressive Wave solution, Particle Velocity and Wave Velocity. Equations for Wave in fluids and on Strings. Specific Acoustic Impedance of fluids and Characteristic Impedance of strings. Energy density. Intensity of Energy Transfer. Reflection and transmission of plane waves at a discontinuity, Standing Wave Solutions. Modes of Natural Oscillations. EnergyConsiderations.	6
Suggested Readings		

1. *Berkeley Physics Course 2/e, Vol 1: Mechanics by C. Kittel, W. D. Knight, M. A.Ruderman, C. A. Helmholz, B. J. Moyer (McGraw-Hill).*
2. *The Feynman Lectures on Physics, Volume 1 by R. P. Feynman, R. B. Leighton and M. Sands (Narosa Publishing House)*
3. *Introduction to Special Relativity 1/e by R. Resnick (Wiley India Pvt Ltd)*
4. *Mechanics by J. C. Uppadhyaya (Ram Prasad & Sons)*
5. *Mechanics by D. S. Mathur* (*S. Chand & Company Ltd)*
6. *Physics of Vibration and Waves 6/e by H. J. Pain (Wiley India Pvt Ltd).*
7. *The Feynman Lectures on Physics, Volume 2 by R. P. Feynman, R. B. Leighton and M. Sands (Narosa Publishing House).*
8. *Physics of Oscillations and Waves by R. B. Singh (United Book Depot, Allahabad).*
9. *A Test Book Oscillations,Waves & Acoustics by M. M. Ghosh, D. Bhattacharya (S.ChandPublisher).*

[Practicals List]

Programme: B.Sc. (Honours/Honours with Research) in Physics		**Year: I**	**Semester-I**
Pedagogy:			
Course Code: PHY-23101	**Course/ Paper Title:** Practical (Mechanical Properties) [Practicals List]		
Course Outcomes			
After completing this course, the students will be able to- **CO:** Experimental physics has the most striking impact on the industry wherever the instrumentsare used to study and determine the mechanical properties. Measurement precision and perfection is achieved through Lab Experiments. Hands on experience of different equipments.			
Credit: 2		**Paper:** Core Compulsory	
Max. Marks: 40+ 60 (30T+30P)		**Min. Passing Marks:** 35	
Total Number of Lectures (Lecture- Practical- Tutorial): 30+0+60			

No.	**List of Practicals**	**Practical Hr.**
1	**Fly wheel:** To determine the moment of Inertia (I) of a fly-wheel about the axis of rotation.	**60**
2	**Compound Pendulum:** To determine the value of 'g' with the compound pendulum and the radius of gyration (k) of the pendulum about an axis passingthrough the centre of gravity and perpendicular to its length.	
3	**Rectangular Lamina:** To determine: (i) The value of 'g' with a rectangular lamina. (ii) The Moment of Inertia (I) and Radius of Gyration (k) of a rectangular lamina about an axis passing through the centre of gravity and perpendicular to the plane of the lamina.	
4	**Spiral Spring:** To determine the force per unit extension (K) and effective mass (me) of a spiral-spring (static and dynamic method).	
5	**Maxwell's Needle:** To determine the rigidity modulus of the material in the form of a wire by Maxwell's needle.	
6	**Surface Tension:** To determine the surface tension (T) of water by Jaeger's method.	
7	**Searle's Apparatus:** To determine Y, n and σ of the material of a given wire by Searle's apparatus.	
8	**Y by bending**: To determine the Young's modulus (Y) of the material of the beam.	
9	**Viscosity:** To determine the viscosity of a liquid by Poiseuille's method.	
10	**Torsion Table**: To determine the modulus of rigidity of the material of the given wire and moment of inertia of an irregular body with the help of a torsiontable.	
11	**Statistical Method:** To determine the modulus of rigidity of the given material in the form of a wire by statistical method.	

Suggested Readings
1. *Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot, Allahabad)* 2. *Practical Physics by Arora (S. Chand Publisher)* 3. Physics through experiments by B. Saraf (Vikas Publications), 2013. 4. An advanced course in practical physics by D. Chatopadhyay, PC Rakshit, B. Saha (New Central BookAgency Pvt Ltd.), 2002. 5. B.Sc. Practical Physics(Revised Edition) By C. L Arora (S.Chand & Co.), 2007.
This course can be opted as an Elective by the students of following subjects
Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology
Suggested Continuous Internal Evaluation (CIE) Methods
20 marks for Record File (depending upon the no. of experiments performed out of the total assignedexperiments) 10 marks for Viva Voce 10 marks for Class Interaction
Suggested Continuous Internal Evaluation (CIE) Methods
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

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Programme: B. Sc. (Honours/Honours with Research) in Physics		**Year: B.Sc. 1st Year**	**Semester: Ist**
Pedagogy:			
Course Code: PHYIKS-2301	Course/Paper Title:	**Introduction to Indian Knowledge System**	
Course Outcomes: After completing this course, the students will be able to -			
CO 1: explain the foundational Concepts & Principles of IKS.			
CO 2: explain the historical development and evolution of Indian Intellectual traditions.			
CO 3: explain the knowledge key texts, thinkers, and schools of thought within the IKS.			
CO 4: analyze the interdisciplinary nature of Indian knowledge, integrating philosophy, spirituality, science, arts, and literature though the study of IKS.			
CO 5: explain the holistic and multidimensional nature of Indian Thought.			
Credit: 03		Paper (Core Compulsory / Elective): Core Compulsory	
Max. Marks : 20 + 40			
Total Number of Lectures (Lecture – Tutorials – Practical): 45 + 0 + 0			

Units:	**Topics**	**No. of Lectures**
I	**Introduction to Indian Knowledge System** • Definition, Concepts and Scope of IKS. • IKS based approache on Indian Knowledge System & Role of Guru (teacher). • Understanding the concepts of dharma, karma, and the four purusharthas (goals of life).	09
II	**Vedic Knowledge and Philosophy** • Study of the Vedas, including the Rigveda, Yajurveda, Samaveda, and Atharvaveda. • Introduction to Upanishads and their metaphysical and philosophical teachings. • Analysis of the six orthodox (astika) schools of Indian philosophy (e.g., Nyaya, Vaisheshika, Yoga, Samkhya, Mimamsa, and Vedanta).	09

III	**Unit 3: Spiritual and Mystical Traditions** • Exploration of Hindu spiritual traditions, including Bhakti, Karma, Jnana, and Raja Yoga. • Study of Advaita Vedanta and its nondualistic philosophy.	09
	• Introduction to other spiritual paths like Tantra and Sufism in the Indian context.	
IV	**Scientific and Technological Advancements** • Examination of ancient Indian contributions to mathematics, astronomy, and medicine. • Study of scientific treatises such as Aryabhatiya, Sushruta Samhita, and Charaka Samhita. • Exploration of the Indian concept of time, measurement, and cosmology.	09
V	**Indian Arts, Literature, and Aesthetics** • Analysis of Indian classical music, dance, and theater traditions. • Study of classical Sanskrit literature, including the works of Kalidasa and Valmiki. • Understanding the concept of rasa (aesthetic experience) and its manifestations in Indian arts. • Modern Interpretation and Contemporary Relevance.	09

Suggested Readings:

- "Indian Philosophy: A Very Short Introduction" by Sue Hamilton
- "A History of Indian Philosophy" by Surendranath Dasgupta
- "Indian Philosophy: A Critical Survey" by Chandradhar Sharma
- "India: A History" by John Keay
- "The Wonder That Was India" by A.L. Basham
- "Ancient India" by R.S. Sharma
- "The Oxford History of India" edited by Percival Spear
- "A History of Indian Literature" (multiple volumes) by Sisir Kumar Das
- "Indian English Literature" by M. K. Naik
- "The Norton Anthology of World Literature: India, Pakistan, and Bangladesh" edited by Sarah Lawall
- "Indian Art" by Partha Mitter
- "The Art and Architecture of the Indian Subcontinent" by J.C. Harle
- "Indian Architecture: Buddhist and Hindu Period" by Percy Brown
- "The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph
- "Indian Science and Technology in the Eighteenth Century" by Dharampal
- "Raga Mala: The Autobiography of Ravi Shankar" by Ravi Shankar
- "The Ragas of North India" by Walter Kaufmann
- "The Complete Book of Ayurvedic Home Remedies" by Vasant Lad
- "Ayurveda: The Science of Self-Healing" by Vasant Lad
- "The Heart of Yoga: Developing a Personal Practice" by T.K.V. Desikachar
- "The Yoga Sutras of Patanjali" translated by Swami Satchidananda

Suggested continuous Evaluation Methods

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

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MINOR PAPER [for Students of Other Discipline/Subject]

Programme: B.Sc./B.Sc. (Honours/Honours with Research) in Physics	**Year: First**	**Semester: I**
Pedagogy:		
Course Code: MPHY01	**Course Title: : Fundamentals of Physics and Its Applications – I**	
Course Outcome: After completing this course, the students will be able to -		
CO1:To aware with simple motion and moment of inertia **CO2**: To aware with some properties of matter **CO3**: To aware students with **Oscillations and Waves** **CO4**: Understand basic electronics **CO5**: Experimental knowledge about SHM, Mechanics, Elasticity and Electrical Instruments.		
Credit: 3+0+0	**Paper: Elective (Miner)**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Units	Topics	No. of Lecture
I	**Mechanics** • Motion in one and two dimensions, Newton's laws of motion • Work, Energy, Power, Conservation laws • Rotational motion, Moment of inertia	9
II	**Properties of Matter** • Elasticity: Stress-strain, Hooke's Law, Modulus of elasticity • Surface tension and capillarity • Viscosity and Bernoulli's theorem	9
III	**Oscillations and Waves** • Simple harmonic motion (SHM) • Damped and forced oscillations, Resonance • Waves and their propagation	9
IV	**Basic Electronics** • Semiconductors: Diodes, Transistors • Rectifiers and amplifiers • Logic gates and Boolean algebra	9
V	**Laboratory Work** • Experiments on mechanics, elasticity, and SHM • Simple electrical circuits and semiconductor experiments.	9

Suggested Readings:

1. Mechanics by DS Mathur
2. Principle of electronics by V K Mehta
3. Basic electronics by Rakshit and Chattopadhyay

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses:

AEC: Ability Enhancement Course
Skill Enhancement Course (SEC): To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

SEMESTER-II

Programme: B.Sc./B.Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. I st Year**	**Semester: II**
Pedagogy:		
Course Code: Physics-23102	**Course Title: Thermal Physics & Statistical Mechanics**	

Course Outcome: After completing this course, the students will be able to -

CO1: will be aware of the basic concept of Thermodynamic systems, State, Zeroth law of thermodynamics and concept of Temperature, Heat and Work, their path dependence, Thermal Processes, concept and application of First Law, Second Law of Thermodynamics and Entropy,Kinetic theory of gases.
CO2: will be aware of the Thermodynamic potentials and Maxwell's equation, Applications of Maxwell's equations, Joule- Thomson effect, Inversion Temperature. Third Law of Thermodynamics, phase transitions, Ehrenfest's equation and Kinetic Theory of Gases.
CO3: will understand and able to apply the concept of Conduction of Heat & Fourier, concept of Kirchhoff's Law, Stefan Boltzmann law and Emission and absorption of Heat, able to apply the concept of Solar constant and radiation. Concept of Radiation Spectrum, black body radiation andPlanck's law.
CO4: will be acquainted with basic concepts of statistical Mechanics and their applications. Concept of Microscopic and Macroscopic systems which explains the different thermodynamicphenomena.
CO5: will be aware of ensembles, Postulates of quantum statistical mechanics, entropy and Maxwell's velocity distribution, Bose Einstein and Fermi-Dirac Distribution and its applications.

Credit: 3+0+2	**Paper: Core Compulsory**
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials +Practical): 45+0+60

Unit	Topics	No. of Lectures
I	**Basic Concept and Law's of Thermodynamics** Thermodynamic systems, Macroscopic and Microscopic variables, Thermodynamical State, Thermal Equilibrium, Zeroth Law of Thermodynamicsand Concept of Temperature. Heat and Work and their path-dependence, Thermal processes, First law of thermodynamics and internal energy, Joule's law, Applications of first law. Carnot cycle, Carnot Engine and Refrigerator, Reversible and irreversible processes, Carnot's Theorem. Thermodynamical scale of temperature, Clausius- Clapeyron's equation, Specific heat of saturated vapour, Clausius theorem, Clausius inequality, Entropy, Calculation of entropy in various processes, Entropy and unavailable energy, Physical significance of entropy, Second Law of thermodynamics.	9
II	Conditions for natural changes, Thermodynamic potentials and Maxwell's equation, Applications of Maxwell's equations, Joule- Thomson effect, Inversion Temperature. Third Law of Thermodynamics. Change of Phase, First and second order phase transitions, Ehrenfest's equations. Kinetic Theory of Gases: Maxwell Boltzman law of distribution of molecular velocities, Equation of r. m. s. velocity and average and most probable speeds, Mean free path, Transport phenomena.	9
III	**Conduction of Heat and Radiation:** Conduction of Heat: Fourier equation for one-dimensional flow of heat and its steady-state solution, Periodic flow of heat (only sinusoidal heat current). Radiation as electromagnetic waves, Emissive and Absorptive powers, Radiation in a hollow enclosure, Black-body radiation, Kirchoff's Law, Intensityand energy density, Pressure and energy density, Stefan Boltzmann law, Solar constant and temperature of sun, Temperature of Non-black bodies, Distribution of energy in the spectrum of black body radiation, Adiabatic expansion of black-body radiation, Wein's distribution law, Wein's displacement law, Wein's formula, Rayleigh-Jean's law, Planck's law.	9
IV	**Statistical Mechanics-I** Elementary concepts of Lagrangian and Hamiltonian, Hamilton equations of Motion, Microscopic and Macroscopic systems, Phase space representation, Division of phase space into cells, Liouville theorem and its consequences, Statistical ensembles, Equilibrium and fluctuations, Distribution probability, Equilibrium between two macroscopic systems in thermal diffusive and mechanical contacts.	9
	Statistical Mechanics-II Postulates of quantum statistical mechanics, Entropy and probability, Entropy ofa perfect gas using the concept of micro canonical ensemble, Gibbs Paradox, Partition functions, Thermodynamical	9

V	functions, Calculations of entropy ofperfect monoatomic gas using canonical and grand canonical ensemble. Principle of Equipartition of the energy, Maxwell's velocity distribution, Distribution function for two types of quantum statistics (Bose–Einstein and Fermi-Dirac): Simple applications (Black – body radiations, and Electronicspecific heat).	

Suggested Reading:

1. Thermal Physics 2/e by C. Kittel, H. Kroemer (W.h. Freeman & Company).
2. Fundamentals of Statistical and Thermal Physics by F. Reif (Waveland Pr Inc)
3. Heat and Thermodynamics (SIE) by M. W. Zemansky, Phillips, Dittman R. H. (Tata Mcgraw Hill Education Private Limited).
4. Thermal Physics by B. K. Agarwal (Lokbharati Prakashan).
5. Elementary Statistical Physics by C. Kittel (Dover).
6. Fundamentals of Statistical Mechanics by B. B. Laud (New Age International PublishersLtd.-New Delhi).
7. Statistical Physics by Hermann (Springer India).
8. Statistical Mechanics 2/e by B. K. Agarwal (New Age International (p) Limited).
9. Heat, Thermodynamics and Statistical Physics 12/e by Brij Lal, N. Subrahmanyam, P. S. Hemne (S. Chand Publisher).

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B. Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. I st Year**	**Semester: II**
Pedagogy:		
Course Code: PHY-23102	**Course Title: Lab work (**Thermal Properties of Matter) [Practicals List]	
Course Outcome: After completing this course, the students will be able to -		
After completing this course, the students will be able to- Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the thermal and electronic properties. Measurement precision and perfection is achieved through Lab Experiments.		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		

Practicals List	Practical Hrs.
1. Stefan-Boltzmann law: To verify the Stefan-Boltzmann law for radiation. **2.** K of Rubber: To determine the thermal conductivity (K) of a rubber given in the form of a tube. **3.** K of Copper: To determine the thermal conductivity (K) of the given material in the form of a rod by Searle's apparatus. **4.** K of Asbestos: To determine the thermal conductivity (K) of asbestos by Lees disc method. **5.** Variation of thermo- emf across two junctions of a thermocouple with temperature. **6.** Temperature coefficient of resistance by Platinum resistance thermometer. **7.** Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. **8.** Mechanical Equivalent of Heat by Callender and Barne's method.	60

Suggested Readings:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 20151e
3. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India PvtLtd., 2015, 11e
4. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e.

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

MINOR PAPER for Other Discipline

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: First**	**Semester: II**
Pedagogy:		
Course Code: MPHY02	**Course Title: : Fundamentals of Physics and Its Applications – II**	
Course Outcome: After completing this course, the students will be able to -		
CO1:To aware with basic phenomenon of light happening in daily life CO2: Students are able to get information about modern concept of physics CO3: To aware students with nuclear science and technologies including high energy concepts CO4: Useful to understands basic quantum concepts and their further implications CO5: To get expertise in Experimental handling of the instruments		
Credit: 3+0+0	**Paper: Elective (Miner)**	
Max. Marks: 40+60	**Min Passing Marks: 14+21**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Units	Topics	No. of Lecture
I	**Optics** • Reflection, refraction, and total internal reflection • Interference and diffraction • Polarization of light	9
II	**Modern Physics** • Photoelectric effect and Einstein's equation • X-rays and their applications • Bohr's atomic model and De Broglie hypothesis	9
III	**Nuclear Physics** • Radioactive decay and nuclear reactions • Fission and fusion • Particle accelerators	9
IV	**Relativity and Quantum concept** • Time dilation, Length contraction • Schrödinger equation and wave function • Uncertainty principle	9
V	**Laboratory Work** • Experiments on optics and modern physics • Simple nuclear physics demonstrations	9

Suggested Readings:

- Nuclear Physics by SN Ghosal
- Modern Physics by Beiser
- Optics by Brijlal

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses:
AEC : Ability Enhancement Course
Skill Enhancement Course (SEC) : To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

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EXIT OPTION: **Undergraduate Certificate (in the field of learning/discipline)** for those who exit after the first year (two semesters) of the undergraduate programme. (Programme duration: first yearor two semesters of the undergraduate programme) **[NHEQF Level 4.5]**

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SEMESTER-III

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. II nd Year	Semester: III
Pedagogy:		
Course Code: PHY-23103	**Course Title:** Electric Circuit & Basic Semiconductor Physics	

Course Outcome: After completing this course, the students will be able to -

CO1: aware of basic elements of Electrical Circuits, basic rules for preparing and analyzing theelectrical circuits, major laws and concepts and application,
CO2: acquainted with inductive circuit, Galvanometer and its application.
CO3: acquainted with A.C. Analysis, resonance and coil, A.C. bridges and their applications.
CO4: Will be aware of basic Semiconductor Electronics, concept of Conduction in Solids, NPN and PNP Transistors and their Characteristics and their applications in day to day life and aware of P.N. Junctions, Zener Diode, Photo-diode and Solar Cell.
CO5: Will be aware of Transistor, Hybrid parameter and the concept of Oscillators; alsounderstand the concept of Modulation and CRO.

Credit: 2+0+2	Paper: Core Compulsory
Max. Marks: 40+60 (30T+30P)	Min Passing Marks: 35

Total Number of Lectures (Lecture +Tutorials +Practical): 30+0+60

Unit	Topics	No. of Lecture
I	**Electrical Circuits-I** Circuit parameters, R, L & C. Kirchoffs Law for a loop and junction, Solutions by determinant and matrix methods. Applications to T, π and bridge circuits, Norton and Thevenin's theorems, Maximum power transfer theorem.	6
II	**Electrical Circuits-II** Difference between steady state & transients; Growth & decay of current in an inductive circuit, Charging and discharging of a capacitor through a resistor, CSand through an inductor and resistor in series. Ballistic Galvanometer, and QS, Measurement of a capacity and of a high resistance by leakage method.	6
III	**Electrical Circuits-III (A.C. Analysis & A.C. Bridges)** A.C. Analysis (Vector treatment only): Complex impedance and phasor notations. Impedance & Admittance & Admittance operators, vector diagrams for Voltage and Current in RL, CR and LCR in series & parallel, Powerconsumed in the circuit, Series and parallel resonance, Q of a coil, Transformer-its equivalent circuit and turn ratio. A.C. Bridges: Balance and sensitivity conditions for A.C. bridge, Measurement of L by Maxwell's Bridge, Measurement of C by Schering's bridge.	6
IV	**Basic Semiconductor Electronics-I** **Conduction in Solid:** Conductor, Insulator and Semiconductor, electrons and holes as charge carriers, Intrinsic and extrinsic semiconductors Conductivity and mobility, Conduction by diffusion and drift. **P.N. Junctions:** Built-in-voltage and charge depletion region, Statement of diode equation and diode characteristics, Forward and reverse resistances, Zener diode: its characteristics, Half wave, Full wave and Bridge rectifiers, Ripple factor, filtering by RC and LC circuit. Regulation: voltage regulation using Zener diode.	6
V	**Basic Semiconductor Electronics-II** BJT: NPN and PNP transistor action, Characteristics in CB, CE and CC configurations. Hybrid, alpha and beta parameters, their inter-relationship, Load line, small signal hybrid equivalent circuit, CE amplifier, Mid frequency response, Practical amplifier circuit Barkhausen criteria for sustained oscillations, Qualitative discussion of collector tuned oscillator, Circuits ofHartley and Colpitts oscillator, sweep oscillator. Modulation: Need for modulation, three types of modulation, Amplitude modulation, Frequency spectrum and power in A. M. wave typical A.M. circuit, Linear diode detector. CRO: Working of cathode ray tube, black diagram of CRO, typical applications of CRO.	6

Suggested Readings:

1. *Electronic Devices And Circuits (SIE) (Schaum's Outline Series) by J. J. Cathey (Tata Mcgraw Hill Education Private Limited).*
2. *Millman's Electronic Devices and Circuits by J. Millman (Tata Mgraw Hill)*
3. *Electronic Devices and Circuits Theory 10/e by R. L. Boylestad, L. Nashelsky (Pearson).*
4. *Eletrical Circuits and Introductory Electronics by Vinod Prakash (LokbharatiPrakashan).*
5. *Basic Electronics and Linear Circuits by N. Bhargava, D. Kulshreshtha, S. Gupta (Tata Mcgraw Hill Education Private Limited).*
6. *Introductory Circuit Analysis 12/e by R. L. Boylestad (Pearson)*
7. *Electronic Devices and Circuits 5/e by D. A. Bell (Oxford University Press).*
8. *Electricity & Magnetism 3/e by K. K. Tiwari (S. Chand Publisher).*

Course prerequisite: To study this course, the students must have had Science Subject in class 12th
Suggested continuous Evaluation methods-
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B. Sc. (Honours/Honours with Research) in Physics	**Year: Second Year**	**Semester: III**
Pedagogy:		
Course Code: PHY-23103	**Course Title: Lab work based** Basic Electronics Instrumentation	
Course Outcome: After completing this course, the students will be able to -		
CO1. Experimental physics has the most striking impact on the industry wherever the instrumentsare used to study and determine the mechanical properties. CO2. Measurement precision and perfectionis achieved through Lab Experiments. CO3. Hands on experience of different equipments.		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 0+0+60		

List of Practicals	**Practical Hours**
1. **Transistor- CE:** To draw the input, output and transfer (voltage and current) characteristics for a PNP transistor in the common emitter (CE) configuration and to evaluate the current gain (α). 2. **Transistor- CB:** To draw the input, output and transfer (voltage and current) characteristics for a PNP transistor in the common base (CB) configuration and to determine the current gain (α). 3. **Current Sensitivity:** To determine the current sensitivity and resistance of a moving coil galvanometer. 4. **PN- Junction Diode:** To draw the characteristic curves of a PN junction diode. 5. **Zener Diode:** To study the breakdown characteristic of a Zener diode. 6. **P. O. Box:** (i) To measure resistances of by a Ammeter P. O. Box. (ii) To measure resistances of voltmeter by a P. O. Box. (iii) To determine internal resistance of a cell by Mance's constant deflection method. (iv) To measure the galvanometer resistance by Thomson's constant deflection method. 7. **Energy Meter:** To calibrate an electrical energy meter with the help of a Joule's calorimeter.	60

Suggested Readings:

1. *Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot,Allahabad)*
2. *Practical Physics by Arora (S. Chand Publisher)*
3. Physics through experiments by B. Saraf (Vikas Publications), 2013.
4. An advanced course in practical physics by D. Chatopadhyay, PC Rakshit, B. Saha (New Central BookAgency Pvt Ltd.), 2002.
5. B.Sc. Practical Physics(Revised Edition) By C. L Arora (S.Chand & Co.), 2007.

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th
Suggested continuous Evaluation methods-
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

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Programme: B. Sc. (Honours/Honours with Research) in Physics	Year: Second Year	Semester: III
Pedagogy:		
Course Code: PHYIKS-2302	**Course Title: Applied IKS-1 : Physics**	
Course Outcome: After completing this course, the students will be able to -		
CO. 1 : aware with the IKS in the context of physical sciences. CO. 2 : develop concept of Vedic Physics and Philosophy. CO. 3 : aware with Classical Indian Physics. CO. 4 : aware with Indian Mathematics and Astronomy. CO. 5: aware with Indian Medicine and Ayurvedic Physics.		
Credit: 2+0+0	**Paper: Core Compulsory**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 30+0+0		

Unit 1: Introduction to Indian Knowledge System in Physics • Definition and scope of Indian knowledge systems in the context of physics. • Historical overview of ancient Indian contributions to science. • Key texts and scholars in Indian physics.	06
Unit 2: Vedic Physics and Philosophy • Study of the philosophical and metaphysical foundations of Indian physics. • Concepts like Prakriti (nature), Purusha (consciousness), and their relevance to physics. • Vedic cosmology and its connection to modern cosmological theories.	06
Unit 3: Classical Indian Physics • Detailed exploration of classical Indian physics principles. • Theory of five elements (Panchabhuta) and the concept of ether (Akasha). • Concepts like sound (Nada), light (Prakasha), and heat (Tejas) in Indian physics.	06
Unit 4: Indian Mathematics and Astronomy • Examination of Indian mathematical achievements, including the invention of zero, the decimal system, and contributions to trigonometry. • Study of ancient Indian astronomical knowledge, including the Siddhantas and planetary calculations.	06
Unit 5: Indian Medicine and Ayurvedic Physics • Introduction to Ayurveda and its principles. • Concepts of doshas (bio-energies) and their relation to health and physics. • How Ayurvedic physics can be applied to modern understanding of the human body.	06

Suggested Readings:

1. "Indian Physics: Outline of Early History" by David Pingree This book provides a comprehensive overview of the early history of Indian physics and its contributions to science. It covers topics such as astronomy, mathematics, and classical Indian physics.
2. "The Wisdom of the Vedas" by Jyotir Maya Nanda. This text explores the philosophical and metaphysical aspects of Indian knowledge systems, including those related to physics. It delves into Vedic concepts and their relevance to the understanding of the physical world.
3. "The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph. While not focused solely on physics, this book explores the contributions of Indian mathematicians and their impact on mathematical and scientific thought. It can provide valuable insights into the mathematical foundations of Indian physics.
4. "Ayurvedic Physics: Theory and Practice of Ayurveda" by Vasant D. Lad. This book delves into Ayurvedic physics, offering a detailed exploration of how Ayurvedic principles relate to the human body and the physical world. It discusses concepts like doshas and prana and their relevance to health and physics.
5. "Quantum Yoga: The Science of Inner Transformation" by Amit Goswami. This book bridges the gap between quantum physics and Indian philosophy, particularly yoga and consciousness. It explores how quantum principles align with the concepts of consciousness and self-realization, providing a unique perspective on modern physics.

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

MINOR PAPER [For Students of Other Discipline/Subject]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: Second**	**Semester: III**
Pedagogy:		
Course Code: MPHY03	**Course Title: : Heat and Thermodynamics – I**	

Course Outcome: After completing this course, the students will be able to -

CO1:To aware with basic phenomenon in gases
CO2: Students are able to get information about different laws of thermodynamics and their application in daily life
CO3: To aware students with thermal potentials and their significances
CO4: Useful to understands low temperature phenomena in thermal physics
CO5: To get expertise in Experimental handling of the instruments with thermodynamics.

Credit: 3+0+0	**Paper: Elective (Miner)**
Max. Marks: 40+60	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Units	Topics	No. of Lecture
I	**Kinetic Theory of Gases** • Molecular speeds and distribution functions • Transport phenomena • Degrees of freedom and energy distribution	9
II	**Laws of Thermodynamics** • Zeroth law and temperature scales • First and Second laws of thermodynamics • Carnot cycle and entropy	9
III	**Thermodynamic Potential** • Internal energy, Helmholtz and Gibbs free energies • Maxwell's relations • Clausius-Clapeyron equation	9
IV	**Low-Temperature Physics** • Liquefaction of gases • Superfluidity and superconductivity	9
V	**Laboratory Work** • Experiments on heat transfer and thermal expansion • Laws of thermodynamics verification	9

Suggested Readings:

- Heat and Thermodynamics by Zemansky
- Heat and Thermodynamics by Brijlal

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses to Opt:

AEC: Ability Enhancement Course
Skill Enhancement Course (SEC): To be Choosed from POOL C
Value Added Course: To be Choosed from POOL D

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SEMESTER-IV

Programme: B.Sc./B.Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. IInd Year	Semester: IV
Pedagogy:		
Course Code: PHY-23104	**Course Title:** Optics & Laser	

Course Outcome: After completing this course, the students will be able to -

CO1: will be aware of the basic concepts of Geometrical Optics and EM Waves.
CO2: will be aware of the basic concepts of Interference, Michelson interferometer, basic concepts of Newton's rings and Etalon.
CO3: will be aware of the basic concepts of Laser and its application.
CO4: Will understand and able to apply the Fresnel's Theory of Diffraction, Fraunhofer's diffraction by single and double slit, Grating and telescope.
CO5: Will understand and able to Polarization and aware with Analysis of polarized light.

Credit: 3+0+2	Paper: Core Compulsory
Max. Marks: 40+60 (30T +30P)	Min Passing Marks: 35

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60

Unit	Topics	No. of Lecture
I	**Geometrical Optics & Elementary Idea of EM Wave** Cardinal points of coaxial optical systems. Simple problem on combination of thin lenses, eyepieces, Aplantic points. Nature of light, elementary ideas of electromagnetic wave and photon theories of light. Complex representation of waves and its application (to be used in the theory of various phenomenon).	10
II	**Interference** Conditions for observing interference, Degree of coherence and visibility of fringes. Production of interference fringes and determination of wavelength, Michelson interferometer and its uses, Color of thin films, Newton's Rings. Theory of multiple reflections, F. P. Etalon.	8
III	**Laser** Temporal and Spatial Coherence. Michelson Stellar interferometer. Stimulated emission, Basic ideas about laser emission, Ruby and He-Ne lasers as examples, Semiconductor Laser.	8
IV	**Diffraction** Fresnel's theory of diffraction, Half-Period elements. Diffraction from circular obstacle and aperture (Elementary theory), Zone plate, Cornu's Spiral, Fresnel diffraction by straight edge and single slit. Fraunhofer's diffraction by single slit and double slit, Theory of plane grating, Width of principal maxima, Rayleigh's criterion of resolution, Resolving power of prism, grating and FP etalon. Limit of resolution for telescope. Concave grating (elementary theory) and its mountings.	10
V	**Polarization** Unpolarised, polarized and partially polarized lights. Polarisation by reflection, Double refraction by uni-axial crystals, Polaroids, Huygen's theory of double refraction. Half and quarter wave plates. Production of elliptically polarized light. Babinet compensator, Analysis of elliptically polarized light using a Nicol and a quarter wave plate, and by using Baninet compensator. Optical activity. Fresnel's theory of optical rotation, Specific rotation. Biquatz and Laurent's half shade polarimeters.	9

Suggested Readings:

1. Fundamentals of Optics 4/e by F. A. Jenkins and F. E. White (McGraw-HillInternational Editions).
2. Geometrical & Physical Optics by R. S. Longhurst (Prentic Hall Press).
3. Optics 4/e by A. Ghatak (Tata Mgraw Hill).
4. Geometrical and Physical Optics by B. K. Mathur and T. P. Pandya (New GopalPrinting Press).
5. Optics (Schaum's Outline Series) by E. Hhecht (Tata Mcgraw Hill Education PrivateLimited).
6. A Testbook of Optics 4/e by M. N Avadhanulu, N Subrahmanyam, Brij Lal (S. Chand& Company Ltd).

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. IInd Year**	**Semester: IV**
Pedagogy:		
Course Code: PHY-23104	**Course Title:** Demonstrative Aspects of Optics & Lasers	
Course Outcome: After completing this course, the students will be able to -		
Course Outcomes- After completing this course, the students will be able to- **CO:** Experimental physics has the most striking impact on the industry wherever the instrumentsare used to study and determine the mechanical properties. Measurement precision and perfectionis achieved through Lab Experiments. Hands on experience of different equipments.		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		

SN	List of Practicals	Practical (Hrs.)
1	**Nodal Slides:** To locate the cardinal points of an optical systems with the help of a nodal slide and hence to determine the focal length of the system.	60
2	**Sextant:** With the help of a sextant to determine the following (i) Variation of Zero-Error of the sextant with distance. (ii) Height of the tower. (iii) Horizontal distance between two objects or points	
3	**Dispersive Power of the Prism:** To determine the refractive index (μ) of the material of the prism for a given wave lengths and dispersive power (ω) of the materials of the prism with a spectrometer.	
4	**Newton's Rings:** To determine the wavelength (λ) of sodium light by Newton's ring method.	
5	**Fresnel's Bi-prism:** To determine the wavelength of sodium light with Fresnel's Bi- prism.	
6	**Single Slit Diffraction:** To determine the width of a narrow slit (d) by observing the diffraction bands.	
7	**Plane Transmission Grating:** To determine the wavelength (λ) of different spectral lines emitted by light source with a plane transmission grating.	
8	**Brewster's Law:** To measure the angle of polarization for glass and to measure the refractive index using Brewster's law.	
9	**Polarimeter:** To determine the specific rotation (α) of an optically active substance (cane sugar solution) with the help of a polarimeter.	
10	**Spectrometer: Refractive index of water and prism material by** **(i)** Total internal reflection. **(ii)** Grazing incidence methods	

Suggested Readings:

1. *Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot,Allahabad)*
2. *Practical Physics by Arora (S. Chand Publisher)*
3. Physics through experiments by B. Saraf (Vikas Publications), 2013.
4. An advanced course in practical physics by D. Chatopadhyay, PC Rakshit, B. Saha(New Central BookAgency Pvt Ltd.), 2002.
5. B.Sc. Practical Physics(Revised Edition) By C. L Arora (S.Chand & Co.), 2007.

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

MINOR PAPER [For Students of Other Discipline/Subject]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: Second**	**Semester: IV**
Pedagogy:		
Course Code: MPHY04	**Course Title: : Heat and Thermodynamics – II**	
Course Outcome: After completing this course, the students will be able to -		
CO1:To aware with basic phenomenon of mechanism of the heat transfer in different media CO2: Students are able to get information about basics of the statistical physics and applications CO3: To aware students with different kinds of equilibrium and significance of thermodynamic potentials CO4: Useful to understands basics of the thermo electric phenomena CO5: To get expertise in Experimental handling of thermal physics		
Credit: 3+0+0	**Paper: Elective (Minor)**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Units	Topics	No. of Lecture
I	**Heat Transfer** • Conduction, convection, radiation • Stefan-Boltzmann law, Kirchhoff's Law • Blackbody radiation and Wien's displacement law	9
II	**Statistical Mechanics** • Microstates and macrostates • Classical vs. quantum statistics • Bose-Einstein and Fermi-Dirac distributions	9
III	**Thermodynamic Equilibrium** • Gibbs free energy and phase transitions • Chemical potential and entropy production • Phase diagrams	9
IV	**Thermoelectric Effects** • Seebeck, Peltier, and Thomson effects • Applications in thermoelectric devices	9
V	**Laboratory Work** • Experiments on blackbody radiation and specific heat • Thermal conductivity measurements	9

Suggested Readings:

- Heat and Thermodynamics by Satya Prakash
- Heat and Thermodynamics by Brijlal
- Statistical Mechanics by Patharia

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses:
AEC : Ability Enhancement Course
Skill Enhancement Course (SEC) : To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

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Exit Option: **Undergraduate Diploma** (in the field of learning/discipline)for those who exit after two years (four semesters) of the undergraduate programme (Programme duration: First twoyears or four semesters of the undergraduate programme) **[NHEQF Level 5.5]**

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SEMESTER-V

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. III[rd] Year	Semester: V
Pedagogy:		
Course Code: PHY-23105	**Course Title**: Electromagnetic Theory & Perspective of Modern Physics	

Course Outcome: After completing this course, the students will be able to -

CO1: Better understanding of electrical and magnetic phenomenon in daily life.
CO2: Understand Amperes law, biot- savart law and its different applications.
CO3: To troubleshoot simple problems related to electromagnetic theory and waves.
CO4: Study the fundamental physics behind atoms about spectrum e.g. X- Ray. Magnetic behavior of materials.
CO5: Better understanding of nuclear physics and Elementary particles.

Credit: 2+0+2	**Paper : Core Compulsory**
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 30+0+60

Unit	Topics	No. of Lecture
I	**Electrostatics** Electrostatics in Free Space: Coulomb Law, Electric Field. Simple case of charge distributions. Gauss Flux Law (Integral and Differential forms). Electric Dipole in Electrostatic Field. Irrotational Nature of Electric Field. Simple Cases of Charge Distributions. Electrostatics in Dielectrics: Polarization, Polarization Charges. Displacement Vector D. Gauss Flux Law (Integral and Differential forms) and simple Applications. Energy of Charge Distribution. Energy as an integral over the Field. Simple Problems (Parallel Plate Condenser, Uniformly chargedspherical surface and volume).	12
II	**Magneto statics** Ampere's Law, Biot- Savart's Law, Law of force in Magnetic Field on Currents and charged particles. Magnetic Filed due to a straight infinite wire. Magnetic Field due to circular loop and solenoid at axial points. Vector potential and its evaluation for uniform Magnetic Field due to a Loop of Current. Magnetic Moment. Magnetic Materials and Magnetization. Magnetization Current density J, Magnetic Field H, Curl of H and Calculation of H.	8
III	**Time Varying Fields & Electromagnetic Waves in Free-Space** Time Varying Fields: Displacement Current, Curl H Faraday's Law (Integral and Differentia forms). Self and Mutual Inductances. Energy of Coupled Circuits and current distribution. M ⍰⍰L_1 L_2 . Energy as an integral over the Magnetic Field. Energy of Solenoid. Electromagnetic Waves in Free-Space: Maxwell Equations, Plane polarized Plane Wave solution. Characteristics of these Electromagnetic waves.	7
IV	**Atomic Physics** Bohr-Summerfield Model (Historical developments), Bohr model and the spectra of hydrogenic atoms, critical resonance and the ionization potential. Frank- Hertz experiment. Characteristic and continuous X-rays. Moseley's law,Bragg's Law. Space Quantization, Magnetic moment of the electrons and magnetron, Larmor Precession, Electron Spin, Stern- Gerlach experiment, Quantative concept of various quantum numbers of an electron, Pauli's exclusion principle and electronic configurations of atoms. Magnetic Properties of Materials Diamagnetism, Larmor's theory and diamagnetic susceptibility. Paramagentism, Langvin's theory and Curie Weiss Law. Qualitative discussion of Ferromagnetism and anti-ferromagnetism.	8
V	**Nuclear physics** Natural radioactivity, Laws of radioactive disintegration, radioactive series, Detection of radiation, GM Counter and Bubble Chamber, Scintillation Counter. Kinematics of nuclear reactions, artificial nuclear transmutation, discovery of neutron, radioactive tracers, transuranic elements. Cyclotron. Constitution of nucleus, Binding energy, liquid drop model and the semi-empirical mass formula, Elementary theory of α-decay, β-decay and discovery of neutrino Magic numbers and the shell model, exchange forces in nuclei and Yukawa theory qualitative), Fission and fusion, Nuclear reactors (qualitative), Thermonuclear energy. Elementary Particles, Classification of Elementary Particles, Leptons, Mesons and Baryons and their quantum numbers, Conservation Laws.	10

Suggested Readings:

1. Introduction to Electrodynamics 3/e by D. J. Griffiths (Phi Learning).
2. Berkeley Physics Course, Vol 2: Electricity and Magnetism by E. M. Purcell(McGraw-Hill).
3. Electromagnetic by B. B. Laud (New Age International Pvt. Ltd. New Delhi).
4. Modern Physics by author Beiser.
5. Modern Physics by R. Murugation.
6. Introduction to Electromagnetictheory by Prof. Ram Kripal

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. IIIrd Year**	**Semester: V**
Pedagogy:		
Course Code: PHY-23105	**Course Title:** Lab work based on theory (Demonstrative Aspects of Electricity & Magnetism)	

Course Outcome: After completing this course, the students will be able to -

Course Outcomes- After completing this course, the students will be able to-
CO: Experimental physics has the most striking impact on the industry wherever the instrumentsare used to study and determine the mechanical properties. Measurement precision and perfectionis achieved through Lab Experiments. Hands on experience of different equipments.

Credit: 0+0+2	**Paper: Core Compulsory**
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**
Total Number of Lectures (Lecture+ Tutorials+ Practical): 0+0+60	

SN	**Practicals List**	**Practical (Hrs.)**
1	**Self-Inductance (by BG):** To determine the self –inductance of a given coil by Rayleigh's method using post-office box.	60
2	**Mutual Inductance (by BG):** To determine the mutual inductance of a given pair of coils using a ballistic galvanometer.	
3	**High Resistance by leakage method (by BG):** To determine the high resistance by the method of leakage of condenser.	
4	**Search Coil (by BG):** To determine field of an electromagnet with a search coil.	
5	**Earth Inductor (by BG):** To determine the value of horizontal (H) and vertical (V) components of the earth's magnetic field and the angle of dip (ϕ) by an earth inductor.	

Suggested Readings:

1. *Practical Physics by S. K. Kore, R. P. Khare & S. K. Jain (United Book Depot,Allahabad)*
2. *Practical Physics by Arora (S. Chand Publisher)*
3. Physics through experiments by B. Saraf (Vikas Publications), 2013.
4. An advanced course inpractical physics by D. Chatopadhyay, PCRakshit, B. Saha(New Central BookAgency Pvt Ltd.), 2002.
5. B.Sc. Practical Physics(Revised Edition) By C. L Arora (S.Chand & Co.), 2007.

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

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Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: Third Year	Semester: V
Pedagogy:		
Course Code: PHYIKS-2303	**Course Title: Applied IKS-2 : Physics**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Aware with Indian Perspectives on Matter and Energy. CO. 2 Aware with Yoga and Consciousness. CO. 3 Aware with Indian Environmental Science. CO. 4 Aware with Modern Physics and Indian Knowledge Integration CO. 5. Aware with Applications and Future Directions.		
Credit: 2+0+0	**Paper: Core Compulsory**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 30+0+0		

Unit/ Topics	Lectures (Hrs.)
Unit 1: Indian Perspectives on Matter and Energy • Exploration of Indian views on matter (Padartha) and energy (Shakti). • Concepts of Prana (life force) and its relevance to physics. • Comparison with Western scientific concepts.	6
Unit 2: Yoga and Consciousness • Study of Yoga philosophy and its relationship to the mind-body connection. • Exploration of the concept of Chakras and their potential scientific implications. • Meditation and its impact on mental and physical well-being.	6
Unit-3: Indian Environmental Science • Understanding Indian perspectives on environmental conservation and sustainability. • Concepts like Prithvi (Earth) and its ecological significance. • Ancient Indian practices for ecological balance.	6
Unit 4: Modern Physics and Indian Knowledge Integration • Discussion of contemporary physics and its relationship with Indian knowledge systems. • Quantum physics and its philosophical implications in the context of Indian thought. • Case studies of research that integrates Indian concepts into modern physics.	6
Unit 5: Applications and Future Directions • Exploration of practical applications of Indian knowledge systems in modern physics and science. • Research trends and potential future developments. • Student presentations on specific research topics related to Indian knowledge systems in physics.	6

Suggested Readings:

1. "Indian Physics: Outline of Early History" by David Pingree. This book provides a comprehensive overview of the early history of Indian physics and its contributions to science. It covers topics such as astronomy, mathematics, and classical Indian physics.
2. "The Wisdom of the Vedas" by Jyotir Maya Nanda. This text explores the philosophical and metaphysical aspects of Indian knowledge systems, including those related to physics. It delves into Vedic concepts and their relevance to the understanding of the physical world.
3. "The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph. While not focused solely on physics, this book explores the contributions of Indian mathematicians and their impact on mathematical and scientific thought. It can provide valuable insights into the mathematical foundations of Indian physics.
4. "Ayurvedic Physics: Theory and Practice of Ayurveda" by Vasant D. Lad. This book delves into Ayurvedic physics, offering a detailed exploration of how Ayurvedic principles relate to the human body and the physical world. It discusses concepts like doshas and prana and their relevance to health and physics.
5. "Quantum Yoga: The Science of Inner Transformation" by Amit Goswami. This book bridges the gap between quantum physics and Indian philosophy, particularly yoga and consciousness. It explores how quantum principles align with the concepts of consciousness and self-realization, providing a unique perspective on modern physics.

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Major (Elective): Choose Any One Course

Programme: B. Sc. (Honours/ Honours with Research) in Physics	Year: Third Year	Semester: V
Pedagogy:		
Course Code: PHY-23106A	**Course/ Paper Title: MATHEMATICAL PHYSICS**	

Course Outcomes- After completing this course, the students will be able to-

CO1: apply the concept of Complex Analysis and related functions, equations, theorems wherever it is needed in calculations, simulations and explanation of theoretical concepts.

CO2: understand Linear Differential Equations.

CO3: understand Special Functions such as Bessel, Legendre, Hermite and Laguerre differential equations with properties of their solutions

CO4: aware of very important Integral transforms such as Laplace transform, Fourier theorem, Fouriertransforms.

CO5: aware of Dirac delta function and Green's function and applications.

Credit: 3+0+0	**Paper:** Major Elective
Max. Marks: 40+ 60	**Min. Passing Marks:** 35

Total Number of Lectures: (Lecture- Tutorial- Practical): 45+0+0

Units	Topics	No. of Lectures
I	Complex Analysis: Analytic functions, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's Integral formula, Laurent series, Poles, Residue theorem, Evaluation of integrals.	9
II	Linear Differential Equations: Second order linear differential equations; Regular, regular singular and singular points; series expansion method.	9
III	Special Functions: Bessel, Legendre, Hermite and Laguerre differential equations with properties of their solutions.	9
IV	Integral transforms: Laplace transform, Fourier theorem, Fourier transform.	8
V	Dirac delta function and Green's function: Green's function for Laplace operator, Solution of Poisson's equation, Inhomogeneous Wave equation and applications.	10

Suggested Readings:

1. Mathematical Physics byP. K. Chattopadhyay (New Age International Publishers Ltd.)
2. Mathematical Physics byB.S. Rajpoot (Pragati Prakashan).
3. Advanced Engineering Mathematics, 19/e by H.K. Dass (S. Chand)
4. Mathematical Methods for Physicists, 7/e byG.B. Arfken,H. Weber, F. Harris (Elesvier Publisher).
5. Mathematics for Physicistsby P. Dennery and A. Krzywicki (Dover Publications).
6. Matrices and Tensors in Physics, 3/e by A.W. Joshi (New Age International).
7. Complex Variables and Applications, 8/eby J.W. Brown and R.V. Churchill (McGraw-Hill HigherEducation).
8. Schaum's Outline of Complex Variables 2/e by J. Schiller, M. R. Spiegel, Seymour Lipschutz(Tata McGraw- Hill Education).
9. Schaum's Outline of Vector Analysis, 2/e by M.R. Spiegel and S. Lipschutz (Tata McGraw - Hill Education).Group Theory in Physics by Wu Ki Tung (World Scientific)

This course can be opted as an elective by the students of the same discipline-

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

Programme: B.Sc. (Honours/ Honours with Research) in Physics	YEAR- Third	SEMESTER: V
Pedagogy:		
Course code : PHY-23106B	**Course Title: Condensed Matter Physics**	

Course Outcomes

CO1: will be able to understand the concepts related to Electron band theory, Superconductivity, Lattice Defects, and Diamagnetism.

CO2: will be able to understand superconductivity, an elementary idea about high T_c superconductors.

CO3: will be able to understand ionic lattice in presence of the infrared field, conducting polymers.

CO4: will be able to understand lattice defects.

CO5: will be able to understand temperature-dependent of saturate demagnetization.

Credits: 3+0+0	**Paper:** Major Elective
Max. Marks: 40+60	**Min. Passing Marks: 35**

Total No. of Lectures-Tutorials-Practical (in hours per week): 45+0+0

UNIT	Topic	No. of Lectures
I	Crystal Structure Interaction of radiation with matter (for elastic and en elastic scatterings of x-ray). Concept of reciprocal lattice point, calculation of reciprocal lattice point of SC, BCC and FCC lattices, Application of reciprocal lattice point in diffraction technique.	10
II	Bonding in Solids Different types of bonding in solids, covalent, metallic, Vander Waal, hydrogen bonding & ionic bonding, Madelung constant of ionic crystals, cohesive energy, Thermal expansion and thermal conductivity, anharmonicity interaction of electrons and phonons with photons (direct and indirect transitions).	10
III	Lattice Vibrations Concept of dispersion relation, quantization of lattice vibrations (Phonons), normal modes & normal coordinates, longitudinal and transverse modes of vibration, modes of vibration of monatomic and diatomic lattices. Density of states (Phonons). Theory of specific heat of solids: classical theory , Einstein theory and Debye theory. Theory of metals: Classical theory, free electron theory and F-D distribution function, Hall effect.	10
IV	Crystal Defects, Superconductivity and Magnetism Point defects (Schottky & Frankel Defects) Imperfections, Line defects (Edge& Screw dislocations), Burger vector & Burger Circuit, Role of dislocation in plastic deformation and crystal growth.	7
V	Introduction of superconductivity, phenomenological, semi phenomenological and microscopic theories of superconductors, Meissner effect, Type-I and type- II superconductors.	8

Suggested Readings

1. J. Dekker: Solid State Physics
2. S.O. Pillai: Solid State Physics
3. Kittle: Introduction to Solid State Physics
4. Verma & Srivastava : Crystallography for Solid State Physics

This course can be opted as elective paper by the students of the same discipline

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

MINOR PAPER [For Students of Other Discipline/Subject]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: Third**	**Semester: V**
Pedagogy:		
Course Code: MPHY05	**Course Title: :** Electricity and Magnetism – **I**	

Course Outcome: After completing this course, the students will be able to -

CO1:To aware with basic phenomenon and laws associated with the electrostatics CO2:
Students are able to get information about basics of electrical instrument
CO3: To aware students with different kinds of magneto statics phenomena and magnetic properties of the materials
CO4: Useful to understands basics of the electromagnetic theory
CO5: To get expertise in Experimental handling of electricity and magnetism

Credit: 3+0+0	**Paper: Elective (Miner)**
Max. Marks: 40+60	**Min Passing Marks: 14+21**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Units	Topics	No. of Lecture
I	**Electrostatics** • Coulomb's Law, Electric field and potential • Gauss's theorem and its applications • Capacitors and dielectrics	9

II	**Current Electricity** • Ohm's law, Kirchhoff's laws • Network theorems (Thevenin's, Norton's) • Electrical instruments: Galvanometer, Voltmeter	9
III	**Magnetostatics** • Biot-Savart law and Ampere's law • Magnetic fields due to conductors • Magnetic properties of materials	9
IV	**Electromagnetic Induction** • Faraday's laws, Lenz's Law • Self and mutual inductance • Transformers and applications	9
V	**Laboratory Work** • Verification of Ohm's and Kirchhoff's laws • Electromagnetic induction and capacitor experiments	9
Suggested Readings: • Electricity and magnetism by KK Tiwari • Electrostatics and Magnetostatic by RM Dreizler		
Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th		
Suggested continuous Evaluation methods-		
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks		

Other Courses To Opt:

AEC: Ability Enhancement Course

Value Added Course: To be Choosed from POOL D

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SEMESTER-VI

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: B. Sc. Third	Semester: VI
Pedagogy:		
Course Code: PHY-23107	**Course Title:** Analog- Digital Electronics	

Course Outcomes (COs)

After completing this course, the students will be able to-
CO1: will be able to review the characteristics of a semiconductor diode and BJT.
CO2: will be able to review Principle of Operation of FET and MOSFET.
CO3: will be aware of logic families i.e. RTL, DTL and TTL their I/O Characteristics.
CO4: will be aware of Basic Logic Gates and their representations, Boolean Algebra and Venn- diagrams. Karnaugh Mapping and combination of Logic Circuits.
CO5: will be able to review Integrated Circuits (ICs) and Photonic devices.

Credits: 3+0+2	**Paper:** Core Compulsory
Max. Marks: 40+60 (30T+30P)	**Min. Passing Marks:** 35

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 45+0+60

Unit	Topics	No. of Lectures
I	**Diode & BJT:** Review of characteristics of a semiconductor diode: cut in voltage, explanation of storage and transition capacitances. BJT as a switch, Analytic expression using Ebers- Moll model, saturation properties for normal, inverse and emitter follower mode and their comparisons. Switching speed of diode, storage and transition time, switching speed of a BJT. Metal-semiconductor junction, Schottky diode and transistor.	9
II	**FET:** Field effect transistor, principle of operation, a practical FET structure, MOSFET, enhancement and depletion modes, their representations. The MOS switch.	8
III	**RTL, DTL & TTL Gates:** The diode-transistor gate, fan out, I/O characteristics. The transistor-transistor logic, caparison between TTL and DTL. The active pull- up, I/O characteristics. The Resistance-transistor logic, RTL- OR gates, pull-up resistors, fan- out. I/O characteristics, noise margin, rise time, RTL, Ex.- OR gate.	8
IV	**Basic Logic Gates & Combinational logic circuits:** AND, OR, NOR, NOT, NAND and Ex-OR operation. Truth tables, their representations, Venn diagrams. Binary Notation, Boolean algebra, Karnaugh mapping. Combinational logic circuits: Half-Adder, Full-Adder, Parallel and Series addition. Half and full subtractor. BCD adder.	8
V	**IC & Photonic Devices:** Integrated Circuits: Various techniques of fabrication, LSI and MSI, metal semi-conductor contact. Photonic Devices: Photoelectric effect in semiconductors, photoresisters and photoconductor, light emitting diodes (LED) and displays, Photodiode, Phototransistor, solar cell and its characteristics.	12
	Suggested Readings	
	1. *Digital Integrated Electronics by H. Taub and D. Schilling (McGraw-Hill InternationalEditions).*	
	2. *Millman's Integrated Electronics: Analog & Digital Circuits & Systems 2/e by J.Millman, C. Halkias, C. D. Parikh (Tata Mcgraw Hill Education Private Limited).* 3. *Digital Logic And Computer Design by M. M. Mano (Prentice-Hall of India Pvt.Ltd.).* 4. *Electronic Fundamentals and Applications: Integrated and Discrete Systems 5/e by J. D. Ryder (Phi Learning).* 5. *Electronic Devices and Circuits Theory 10/e by R. L. Boylestad, L. Nashelsky(Pearson).* 6. *Physics of Photonic Devices 2/e by S. L. Chuang (John Wiley & Sons).* 7. *Modern Digital Electronics 4/e by R. P. Jain (Tata Mcgraw Hill Education PrivateLimited).*	

Suggested Continuous Internal Evaluation (CIE) Methods
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B.Sc. (Honours/ Honours with Research) in Physics	**Year: B. Sc. Third**	**Semester: VI**
Pedagogy:		
Course Code: PHY-23107	**Course/ Paper Title:** Practical (Digital Electronics)	
Course Outcomes:		
After completing this course, the students will be able to Analog & digital circuits have the moststriking impact on the industry wherever the electronics instruments are used to study and determine the electronic properties. Measurement precision and perfection is achieved through Lab Experiments.		
Credit: 0+0+2	**Paper:** Core Compulsory	
Max. Marks: 40+ 60	**Min. Passing Marks: 14**+21	
Total Number of Lectures (Lecture- Tutorial- Practical): 0+0+60		

S.No.	**Practicals List**	Practical Hrs.
1	**e/m:** To determine e/m of electron and also check from graph and calculation (plot B vs l/i , I vs l, B vs i).	**60**
2	**CE Amplifier :** To (1) trace the circuit and write the value of resistances by colour code, (2) Note D.C. Voltages and currents, (3) Study input-output characteristics at 1 KHz, (4) Study frequency response & obtain mid frequency gain and cut off frequencies.	
3	**FET:** To (1) trace the circuit for amplifier with value of resistance by colour codeand note D.C. voltages and currents, (2) find the voltage amplification 'A' given 0.2V A.C. voltage of 1khz, (3) Find Q point, (4) Draw characteristic curves at differentgate voltages taking care that curves near Q point is also plotted, (5) Draw A.C. & D.C. load lines (6) Find 'A' from A.C. load line also (7) Calculate saturation current for different Vgs, Plot a graph & obtain out of voltages, (8) Calculate g(m), R(on) & R (9) verify $I_D = I_{DSS}[1 - \frac{V_{GS}}{V_P}]^2$.	
4	**RTL gate :** to verify (1) Truth table for NOR- NOT gates, (2) switching action of transistor & draw VL – V0, IB – Ic, □ Vs V, Rswitch Vs VCE curves, (3) To find out the fanout using driver driven condition in (a) single input RTL gate (b) doubleinput RTL gate.	
5	**DTL:** (1) To verify truth table for DTL gates, (2) To draw input-output characteristic & voltages at different points for DTL gates, (3) To find fan out.	
6	**TTL:** (1) To verify truth table for TTL gates, (2) To draw input-output characteristic& voltages at different points for TTL gates, (3) To find fan out.	
7	**Hysteresis:** To draw hysteresis loop for the material of given anchor ring and tofind: (i) Hysteresis loss (ii) Retentivity (iii) Coercivity (iv) B_{max} (v) H_{max}	
8	**Bias Stabilization:** (i) To Calculate the band gap by plotting IB Vs (IB+IC) forcollector biasing case at two temperatures: (1) at room temperature (2) at 55 0C (ii) To calculate stability factor for fixed biasing, collector biasing, emitter biasingand potential divider biasing. (iii) To study the variation of IB, IC, VCC and VBE with temperature for differentbiasing. (iv) Plot temperature Vs VCE , VBE, IB, IC (at room temperature).	
9	**Photo transistor and photo diode:** (1) Calibration of OPAM (2) To draw characteristic of photo diode/transistor for at least three different distances (3)Verification of inverse squre law.	
	Suggested Readings	

1. Advanced Practical Physics by H. B. Lal, U. S. Pandey & R. B. Singh (United Book Depot, Allahabad).
2. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India PrivateLimited, 1975, 5e
3. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016,43e
4. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGrawHill, 2010, 7e
5. William H. Gothmann, "Digital Electronics: An Introduction to Theory andPractice", Prentice-Hall of IndiaPrivate Limited, 1982, 2e
6. R.P. Jain, "Modern Digital Electronics", McGraw Hill, 2009, 4e.

Suggested Continuous Internal Evaluation (CIE) Methods

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Major (Elective): Choose Any One Course

Programme: B. Sc. (Honours/Honours with Research) in Physics	**Year: Third Year**	**Semester: VI**
Pedagogy:		
Course Code: PHY-23108A	**Course Title: Atomic & Molecular Physics**	
Course Outcome: After completing this course, the students will be able to -		
CO1: will be aware of concepts related to Atomic Spectroscopy. CO2: will understand the Atomic Spectroscopy width of spectral lines. CO3: will be aware of Microwave Spectroscopy of Diatomic Molecules Rotational Spectra. CO4: will be aware of infra-red Spectroscopy of Diatomic Molecules Vibrational Spectra (Harmonicand Anharmonic models). CO5: will be aware of Raman and Electronic Spectroscopy of Diatomic molecules.		
Credit: 3+0+0	**Paper: Elective (Major)**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	Topics	No. of Lecture
I	**Atomic Spectroscopy-I** Review of He atom, ground state and first excited state, Quantum states of an electron in an atom, Spectrum of Hydrogen and Helium atom, fine structure, Spectra of Alkali atoms; energy level diagrams. Sharp, Principal, Diffuse and fundamental series.	9
II	**Atomic Spectroscopy-II** Width of spectral lines, Spectroscopic terms; LS & JJ couplings, Hyperfine structure, Zeeman, Paschen Back & Stark effect, X-ray Spectroscopy (Characteristic and continuous).	8
III	**Microwave Spectroscopy of Diatomic Molecules** Rotational Spectra (Rigid rotator and Non-Rigid Rotator Models), Isotopic Effect in Rotational Spectra, Symmetric and Asymmetric Top Molecules, Microwave Spectrometer), Chemical Analysis by Microwave Spectroscopy, The Microwave Oven.	9
IV	**Infra-red Spectroscopy of Diatomic Molecules** Vibrational Spectra (Harmonic and Anharmonic models), Selection rules, TermSchemes, Molecular Symmetric Top, Vibrating Rotator, Isotopic Shift, Infra-red (IR) Spectrophotometer, Fourier Transform Infra-red (FTIR) Spectroscopy andApplications.	9
V	**Raman and Electronic Spectroscopy of Diatomic Molecules** Raman Spectra (Quantum Mechanical and Classical Approach), Structure Determination from Raman and IR Spectroscopy, Techniques and Instrumentation (Raman Spectrometer), Near Infra-red FT-Raman Spectroscopy. Electronic Spectra-Vibrational Structure of Band System, Fine Structure of the Band Systems, Intensity Distribution in Band Systems: Frank Condon principle, Techniques and Instrumentation (Photoelectron Spectrometer).	10

Suggested Readings:

1. Atomic and Molecular Spectra by Raj Kumar (Kedar Nath Ram Nath).
2. Molecular Structure and Spectroscopy by G. Aruldhas (PHI Learning).
3. Introduction to Atomic Spectra by H. E. White (McGraw-Hill).
4. Molecular Spectra and Molecular Structure, Vol I: Spectra of Diatomic Molecules by G.Herzberg (Krieger Publishing Company).
5. Fundamental of Molecular Spectroscopy,4/e by C. N. Banwell (McGraw-Hill)
6. Atoms and Molecules: An Introduction for Students of Physical Chemistry by M. Karplus and
7. R.N. Porter (Benjamin–Cummings Publishing Company).

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: Third Year**	**Semester: VI**
Pedagogy:		
Course Code: PHY-23108B	**Course Title:** Plasma Physics	

Course Outcome: After completing this course, the students will be able to -

CO1: Concept of plasma physics and its generation
CO2: application of plasma physics in upper atmosphere, diagnosis of atmosphere
CO3: Experimental tool to study the magnetosphere using VLF waves.
CO4: aware with Fundamental equations, Hydromagnetic Waves
CO5: Polarization, Phase Velocity, Group Velocity, Cut-offs, Resonance for ElectromagneticWave Propagating Parallel and Perpendicular to the Magnetic.

Credit: 3+0+0	**Paper: Elective (Major)**
Max. Marks: 40+60	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Unit	Topics	No. of Lecture
I	**Acceleration of Charged Particles:** Electric and Magnetic fields due to a Uniformly Moving charge and An Accelerated Charge, Linear and Circular Acceleration and Angular Distribution of Power Radiated, Bremsstrahlung, Synchrotron Radiation and Cerenkov Radiation, Electromagnetic Mass of the Electron.	12
II	**Dynamics of Charged Particles in E and B Fields:** Motion of Charged Particles in electromagnetic Field: Uniform E and BFields, Non-uniform Fields Diffusion across Magnetic Fields, Time Varying E and B Fields, concept of ring current.	**08**
III	**Plasma Physics:** Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, First, Second, and Third Adiabatic Invariants (Pinch Effect, Magnetic Mirrors), Formation of Van Allen radiation belt.	**8**
IV	**Hydrodynamical Description of Plasma:** Fundamental equations, Hydro magnetic Waves: Magneto sonic and Alfven Waves, Magneto convection and Sun Spots, Bipolar magnetic Regions and Magnetic Buoyancy, Magnetised Winds (Solar Wind).	**7**
V	**Wave Phenomena in Magneto plasma:** Polarization, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and Perpendicular to theMagnetic.	**10**

Suggested Readings:

1. Classical Electricity and Magnetism: W.K.H. Panofsky and M. Phillips.
2. Plasma Physics: A Bittencourt.
3. Plasma Physics and Controlled Fusion: F.F. Chen.

4. Classical Electrodynamics: J.D. Jackson.

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

MINOR PAPER [For Students of **Other Discipline**/Subject]

Programme: B.Sc. (Honours/ Honours with Research) in Physics	**Year: Third**	**Semester: VI**
Pedagogy:		
Course Code: MPHY06	**Course Title: :** Electricity and Magnetism – **II**	

Course Outcome: After completing this course, the students will be able to -

CO1:To aware with basic phenomenon of the alternating current
CO2: Students are able to get information about magnetic properties of material CO3: To aware students with transmission lines as well as radio wave propagations
CO4: Useful to understands basics of the applied electromagnetism and their application CO5: To get expertise in Experimental handling of AC and resonances

Credit: 3+0+0	**Paper: Elective (Miner)**
Max. Marks: 40+60	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Units	**Topics**	**No. of Lecture**
I	**Alternating Current and EM Waves** • AC circuits, LCR resonance • Power in AC circuits • Maxwell's equations and electromagnetic waves	9
II	**Magnetic Properties of Matter** • Diamagnetism, Paramagnetism, Ferromagnetism • Hysteresis loop and its applications	9
III	**Electromagnetic Theory** • Displacement current and Maxwell's equations • Poynting vector and wave propagation	9
IV	**Applied Electromagnetism** • Transmission lines and antennas • Basics of radio wave propagation	9
V	**Laboratory Work** • AC circuits and LCR resonance experiments • Electromagnetic wave propagation demonstrations	9

Suggested Readings:

- Electricity and magnetism by KK Tiwari
- Thermal Physics and Semi conductor devices by JP Agarwal

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses to Opt:

Internship/Apprenticeship (Compulsory)

Value Added Course : To be Choosed from POOL D

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Exit Option: Bachelor' Degree (Programme duration: Three years or six semesters) .

[NHEQF Level 5.5]

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SEMESTER-VII

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. IVth Year**	**Semester: VII**
Pedagogy:		
Course Code: PHY-23110	**Course Title:** Quantum Mechanics	

Course Outcome: After completing this course, the students will be able to -

CO1: aware of the Quantum Theory & Schrodinger's wave Mechanics and Interpretation of the wave function. Method to solve so many problems which can't be resolved by Classical or Newtonian Mechanics. acquainted with Operators and measurement in Quantum Mechanics and Uncertainty Principle.

CO2: understand Time-Dependent Schrodinger Equation and its application and understand Harmonic Oscillators Problem.

CO3: aware of the concept of Angular Momentum, H-atom Problem, Time-Independent Perturbation Theory, Elementary concept of Spin and Identical Particles and H- atom problem.

CO4: Will be aware of the Time independent perturbation theory.

CO5: Will be aware of the Spin and total angular momentum and aware of the Identical Particles.

Credit: 3+0+2	**Paper (Code compulsory/Elective): Core**
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60

Unit	**Topics**	**No. of Lecture**
I	**Quantum Theory & Schrödinger's Wave Mechanics:** Origin of Quantum Mechanics, Particle nature of radiation, Photoelectric effect and Compton effect. Wave nature of particles. De-Broglie Waves, Davisson- Germer experiment, Wave Packets, Phase velocity and group velocity, Heisenberg's Uncertainty Principle and applications, Observables and Operators, Hermitian, operator, Parity operator, commutation relations. Eigen values and eigen functions orthonormality and completeness. Dirac Delta function. Measurement in quantum mechanics, Non-Commutability, uncertainly, Expectation values, Ehrenfest's Theorem. Schrödinger Equation, interpretation of wave function and concept of probabilities, amplitude, application to one-dimensional potential step and barrier, Quantum Mechanical Tunneling.	9
II	Time-Dependent Schrödinger equation & Harmonic Oscillator Problem Separation of variables in Time-Dependent Schrödinger equation. Density of states, One-dimensional Potential Barrier problems. Tunneling through square wellpotential. One-dimensional Harmonic Oscillator, Hermite Polynomials, Zero-point energy, Correspondence with Classical theory.	9
III	**Angular Momentum & H-Atom Problem** Angular Momentum, Commutation Relations. Eigen Values and Eigen functions of L^2, L_z and ladder (L_+ L_-) operators. Spherically symmetric potentials, Complete solutions of the Hydrogen-Atom Problem, Hydrogen Spectrum.	9
IV	**Time-Independent Perturbation Theory** Time-independent, non-degenerate, first-order Perturbation Theory, Spin Orbit coupling. Ground and excited states of helium atom and exchange degeneracy. Qualitative and elementary idea about Lamb shift.	9
V	**Spin & Identical Particles** Elementary concept of spin, Pauli Matrices and spin wave functions. Total angular momentum. Identical Particles, Symmetric and Anti-symmetric wave function, Pauli's ExclusionPrinciple.	9

Suggested Readings:

1. *Introduction to Quantum Mechanics 2/e by D. J. Griffiths (Pearson).*
2. *Quantum Mechanics: Concepts and Applications 2/e by N. Zettili (John Wiley &Sons).*
3. *Quantum Mechanics by J. L. Powell, B. Crasemann (Narosa Publishing House).*
4. *Quantum Mechanics 3/e by L. Schiff (Tata Mcgraw Hill Education Private Limited).*
5. *Introduction to Quantum Mechanics by A. Ghatak (Macmillan Publishers India).*
6. *Quantum Mechanics by H. Prakash and B. K. Agarwal (Phi Learning).*
7. *Modern Quantum Mechanics, 2/e by J.J. Sakurai (Pearson Education India).*

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. IVth Year**	**Semester: VII**
Pedagogy:		
Course Code: Physics-23110	**Course Title: Lab work based on theory** (Optoelectronics)	
Course Outcome: After completing this course, the students will be able to -		
Course Outcomes- After completing this course, the students will be able to- **CO:** Experimental physics has the most striking impact on the industry wherever the instrumentsare used to study and determine the mechanical properties. Measurement precision and perfection is achieved through Lab Experiments. Hands on experience of different equipments.		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		

Sl. No.	**List of Practicals**	**Practical (Hrs.)**
1	**Michelson Interferometer:** Determination of wavelength and separation of wavelength of sodium light by Michelson Interferometer.	60
2	**Ultrasonic:** Determination of velocity of ultrasonic in kerosene oil by diffraction method.	
3	**Babinet Compensator:** To determine (1) phase difference in two orthogonal plane polarized components, (2) Orientation and ratio of axis of elliptically polarized light by (a)□, □ method (b) direct method.	
4	**Carnues fringe:** To determine the Young's modulus of a rectangular glass-plate by Carnues fringe method.	
5	**Thickness of mica sheet:** To determine the thickness of mica sheet using Fresnel's Bi-Prism.	
6	**Plane Reflection Grating:** To determine wavelength of laser light using plane reflection grating (inch scale & cm scale).	
7	**Refractive Index Gradient:** Gradient of refractive index in a mixture of twoliquids, to find, 1. Difference Between refractive indeces of two liquids 2. variation of refractive index and refractive index gradient with height. 3. maximum (dN/dy) and width of transition region at half maximum.	
8	**Fraunhoffer Diffraction:** Fraunhoffer Diffraction at double slit. 1. Plotting the intensity variation in diffraction pattern. 2. To determine the wavelength of He-Ne/Diode laser. Finding the ratio of maximum intensity and observation of missingorder.	
9	**Photoelectric Effect:** To understand the phenomenon photoelectric effect as a whole.	

Suggested Readings:

1. *Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot, Allahabad)*
2. *Practical Physics by Arora (S. Chand Publisher)*
3. Physics through experiments by B. Saraf (Vikas Publications), 2013.
4. An advanced course inpractical physics by D. Chatopadhyay, PCRakshit, B. Saha (New Central BookAgency Pvt Ltd.), 2002.
5. B.Sc. Practical Physics(Revised Edition) By C. L Arora (S.Chand & Co.), 2007.

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

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[For Students Pursuing Hons. With Research]

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. IVth Year	Semester: VII
Pedagogy:		
Course Code: PHY-23111A	**Course Title: Research Methodology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 The student should be well versed to take a research problem for his/her master's or doctoral research. They will understand the nuances of scientific writing and IPR. CO2. Students will learn data collection and data preparation. CO3. Students will learn data classification, Thesis writing. CO4. Students will learn to interpret data. CO5.To know about ethic in research field.		
Credit: 4+0+0	**Paper: Core Compulsory**	
Max. Marks: 40+60	**Min Passing Marks: 14+21**	
Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0		

Unit	Topics	No. of Lecture
I	**Research Methodology :** Meaning of research, Objectives of research, Types of research, Research approaches, Significances of research, Research methods versus methodology, Research and scientific methods, Research processes, Criteria for good research, Research problem, Selecting the problem, Necessity of defining the problem.	10
II	**Research Design and sample Surveys :** Meaning and need for research design, features of a good design. Important concepts relating to research design: Dependent and independent variables, Extraneous variables, Control, Research hypothesis, Experimental and non-experimental hypothesis – Testing research, Experimental and control group, Different research designs: Research design in case of exploratory research studies, Research design in case of hypothesis- testing research studies.	10
III	**Data Collection and Data Preparation:** Experiments and surveys, Collection of primary data: Difference between questionnaire and schedule, Guidelines for constructing questionnaire/schedule, Collection of secondary data, Selection of appropriate methods for data collection, Case study method. Data preparation process: Questionnaire checking, Editing, Coding, Classification, Tabulation, Graphical representation, Data cleaning, Data adjustment, Types of analysis, Statistics in research.	15
IV	Interpretation and Report Writing Meaning of Interpretation, Technique of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of Research Report, Types of Reports, oral Presentation, Mechanics of Writing Research Report, Precautions for writing Research reports.	15
V	Ethical Issues, Intellectual Property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.	10

Suggested Readings:

- The Craft of Scientific Writing (3rd Edition), Reference Books by Michael Alley, Springer,New York, 1996.
- Science and Technical Writing – A Manual of Style (2nd Edition) by Philip Reubens (Generaleditor), Routledge, New York, 2001.

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

[For Students Pursuing Honours Only]

Programme: B..Sc. (Honours/Honours with Research) in Physics	Year: IV	Semester: VII
Pedagogy:		
Course Code:PHY-23111B	**Course/ Paper Title:** Bio- Physics	

Course Outcomes-

Biophysics is the field that applies the theories and methods of physics to understand how biological systems work. The students' knowledge can be used in the sector relater to health and Medical.

Credit: 4+0+0	**Paper:** Core Compulsory
Max. Marks: 40+ 60	**Min. Passing Marks:** 14+21

Total Number of Lectures: (Lecture- Tutorial- Practical): 60+0+0

Units	Topics	No. of Lectures
I	**Basic Concepts in Biophysics** Elementary ideas about the DNA structure, Forces stabilizing DNA and protein structure, sugar-phosphate backbone, nucleosides and nucleotides, three dimensional DNA structure, RNA. Proteins: primary, secondary, tertiary and quaternary structures, enzymes and their catalytic activity, DNA and protein folding, DNA denaturation, replication, mutation, intercalation, neurotransmitters, membranes.	**15**
II	**Technique For The Study of Biological Structure and Function** Application of experimental techniques of light scattering (tomography), FTIR and Raman spectroscopy, absorption and fluorescence spectroscopy/ microscopy, anisotropy, optical activity, circular dichroism, electrophoresis.	**15**
III	**Photobiology** interaction of light with cell and tissues, Photosynthesis, human eye and vision optical biopsy, optical biosensors, Laser tweezers and Laser scissors Photo-dimerization, Photodynamic therapy.	**10**
IV	**Radiation Effects on Biological Systems- I** High doses received in a short time, Low-level doses limits, direct ionization of DNA, radiation damage to DNA,	**10**
V	**Radiation Effects on Biological Systems- II** Biological effects (Genetic, Somatic, Cancer and sterility). Bio-imaging: Ultrasound, MRI imaging, confocal fluorescence imaging and X-ray.	**10**

Suggested Readings

1. *Essentials of Biophysics: P. Narayanan.*
2. *Basic Molecular Biology: Price.*
3. *Quantum Mechanics of Molecular Conformations: Pullman (Ed.).*
4. *Non-linear Physics of DNA: Yakushevich.*
5. *Biological Physics: Nelson. Spectroscopy of biological systems*
6. *Modern Spectroscopy: J.M. Hollas.*
7. *Transmission Electron Microscopy of Metals: Gareth Thomas*
8. *Elements of X-ray Diffraction: Bernard Dennis Cullity.*

This course can be opted by Student pursuing Honours in the Discipline.

Suggested Continuous Internal Evaluation (CIE) Methods

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

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Major (Elective): Choose Any Two Courses

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. IVth Year	Semester: VII
Pedagogy:		
Course Code: PHY-23112A	**Course Title:** Nano- biotechnology	
Course Outcome: After completing this course, the students will be able to -		
CO1: will be able to understand the concepts of Biological Nano-Objects and the Structural and Functional Regulation of DNA. CO2: will be aware of the methods of Nano- biotechnology and their applications. CO3: will be aware of Optical tools, and concepts applied to the life sciences. CO4: will be aware of real-time PCR-Biosensors And the pharmaceutical application of nanoparticle carriers. CO5: will be aware of major physiologic systems.		
Credit: 4+0+0	**Paper: Core Elective**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0		

Unit	Topics	No. of Lecture
I	**Biological Nano-Objects** Structural and Functional Regulation of DNA: Geometry, Topology and Methylation : Geometry of the DNA Double Helix - The Z Conformation of DNA.- Supercoiled DNA - Methylation of DNA - Protein–Lipid Assembly and Biomimetic Nanostructures : Introduction: Biological Membranes - Lipid Membranes: Structure and Properties - Models and Methods for Characterizing Membranes - Protein–Lipid Assembly - Applications of Biomimetic Membranes	**15**
II	**Functionalized Inorganic Nanoparticles FOR Biomedical Applications and Living Machines** Synthesis and Chemical Surface Modification of Inorganic Nanoparticles – Biological Tagging in Vitro and in Animals - *In-Vivo* Applications - Living Nanomachines: Introduction - Force and Motion by Directed Assembly of Actin Filaments - Molecular Motors: Myosins and Kinesins - ATP Synthase.	**12**
III	**Methods of Nano- biotechnology** Optical tools – Nanoforce and imaging – Surface methods – Mass spectrometry – Electrical Characterization and Dynamics of Transport – Micro fludics : Concepts and Applications to the Life Sciences.	**13**
IV	**Applications of Nano- biotechnology** Real Time PCR – Biosensors : From the Glucose electrode to the Biochip – DNA Microarrays – Protein Microarrays – Cell Biochips – Lab on a chip – Polyelectrolyte multilayers – Bio- integrating materials – Pharmaceutical applications of nanoparticles carriers.	**10**
V	**Major Physiologic Systems of Current Interest to Biomedical Engineers** Cardiovascular, endocrine, nervous, visual, auditory, gastrointestinal, and respiratory. Useful definitions. The status of tissue engineering of specific organs, including bone marrow, skeletal muscle, and cartilage. Cell biologicalfundamentals of tissue engineering. Nanoparticle-biomaterial hybrid systems Biomaterial based metallic nanowires, networks.	**10**

Suggested Readings:

1. Nanoscience : Nanobiotechnology and Nanobiology, P. Boisseau, P. Houdy and M. Lahmani, Springer, 2007.
2. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology, Hari Singh Nalwa, American Scintific Publishers, 2005.
3. Nanobiotechnology, C.M.Niemeyer, C.A. Mirkin, Wiley VCH, 2004.
4. Nanocomposite Science & Technology, Ajayan, Schadler & Braun, Wiley VCH, 2005.
5. Nanoelectronics and Nanosystems: From Transistors to Molecular Devices, K.Goser, P. Glosekotter, J. Dienstuhl, Springe, 2004.

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

OR

Programme: B..Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. IVth Year	Semester: VII
Pedagogy:		
Course Code: PHY-23112B	**Course Title: Introduction to Nanoscience and Technology**	

Course Outcome: After completing this course, the students will be able to -

CO1: will acquire in-depth knowledge about Generic Methodologies for Nanotechnology andclassification.
CO2: will be able to understand Carbon Nanostructures Introduction.
CO3: will be able to understand Nanostructured Molecular Materials Introduction
CO4: will be able to understand inorganic nanostructures.
CO5: will be able to understand Evolving Interfaces of Nano biology and their applications.

Credit: 4+0+0	Paper: Core Elective
Max. Marks: 40+60	Min Passing Marks: 35

Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0

Unit	Topics	Practical (Hrs.)
I	**Generic Methodologies for Nanotechnology** Introduction and classification - What is nanotechnology?, Milestone and History of nanotechnology - Classification of nanostructures - Nanoscale architecture; Summary of the electronic properties of atoms and solids - The isolated atom - Bonding between atoms - Giant molecular solids - The free electron model and energy bands - Crystalline solids - Periodicity of crystal lattices - Electronic conduction; Effects of the nanometre length scale - Changes to the system total energy - Changes to the system structure - How nanoscale dimensions affect properties.	**15**
II	**Carbon Nanostructures** Introduction; carbon molecules – nature of the carbon bond – new carbon structures; cabon clusters – small carbon clusters discovery of C60 – structure of C60 and its crystal – alkali doped C60 – superconductivity in C60 – large and electrical properties – vibrational properties – mechanical properties; applications of carbon nanotubes – field emission and shielding – computers – fuel cells – chemical sensors – catalysis – mechanical reinforcement. smaller fullerenes – other buckyballs; carbon nanotubes – fabrication – structure .	**12**
III	**Inorganic Nanostructures** Metal Nanostructures (Au, Ag, Cu, Al)-Surface Plasmon Resonance, Properties and Application of metal Nanostructures. Overview of relevant semiconductor physics - Quantum confinement in semiconductor nanostructures - The electronic density of states - Fabrication techniques - Physical processes in semiconductor nanostructures (e.g, ZnO etc) - The characterization of semiconductor nanostructures - Applications of semiconductor nanostructures.	**13**
IV	**Nanostructured Molecular Materials** Introduction; Building blocks - Principles of self-assembly - Self-assembly methods to prepare and pattern nanoparticles - Templated nanostructures - Liquid crystal mesophases - Macromolecules at interfaces - The principles of interface science - The analysis of wet interfaces - Modifying interfaces - Making thin organic films - Surface effects on phase separation - Nanopatterning surfaces by self-assembly - Practical nanoscale devices exploiting macromolecules at interfaces.	**10**
V	**Evolving Interfaces of Nano** Nanobiology - Introduction - Bio-inspired nanomaterials - Interaction Between Biomolecules and Nanoparticle Surfaces - Different Types of Inorganic Materials Used for the Synthesis of Hybrid Nano-bio Assemblies - Applications of Nano in Biology - Nanoprobes for Analytical Applications - Current Status of Nano- biotechnology - Future Perspectives of Nanobiology; Nanosensors - Introduction - What is a Sensor? - Nanosensors - Order from Chaos - Characterization - Perception - Nanosensors Based on Quantum Size Effects - Electrochemical Sensors - Sensors Based on Physical Properties – Nanobiosensors - Smart Dust; Nanomedicines - Introduction - Approach to Developing Nanomedicines - Various Kinds of Nanosystems in Use - Protocols for Nanodrug Administration - Nanotechnology in Diagnostic Applications - Materials for Use in Diagnostic and Therapeutic Applications - Future Directions.	**10**

Suggested Readings:

1. *Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.*
2. *Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.*
3. *Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.*
4. *Nano:The Essentials: Understanding Nanoscience and Nanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.*

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

OR

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: B.Sc. IVth Year**	**Semester: VII**
Pedagogy:		
Course Code: PHY-23112C	**Course Title: Laser Fundamentals and Applications**	

Course Outcome: After completing this course, the students will be able to -

CO1: will be acquainted with Properties of Lasers & Einstein Coefficients and Light Amplification Laser Beam Characteristics, Laser Rate Equation & Optical Resonators, Two, Three and Four Level Laser Systems.

CO2: will have knowledge about Laser Systems, Application of Laser in Light Wave Communications,Carrier Wave Communication, Analog Modulation, Digital Modulation, Optical Fibers in Communication.

CO3: will be aware of Application of Laser in Science &Technology for daily life and Industrial use.

CO4: will be aware of the Application of Laser in LightWave Communications Carrier Wave Communication, Analog Modulation, Digital Modulation, Optical Fibers in Communication, The Optical Fiber.

CO5: will be aware of the Application of Laser in Science & Industry.

Credit: 4+0+0	**Paper: Core Elective**
Max. Marks: 40+60	**Min Passing Marks: 14+21**

Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0

Unit	**Topics**	**Practical (Hrs.)**
I	**Properties of Lasers & Einstein Coefficients and Light Amplification** Laser Beam Characteristics, Coherence Properties of Laser Light, Temporal, Spatial Coherence. The Einstein Coefficients: Absorption and Emission Cross Sections, Light Amplification, The Threshold Condition, Line Broadening Mechanisms (Natural, Collision, Doppler Broadening), Saturation Behavior of Homogeneously and Inhomogeneously Broadened Transitions, Quantum Theory for the Evaluation of the Transition Rates and Einstein Coefficients, More Accurate Solution for the Two-Level System.	**15**
II	**Laser Rate Equation & Optical Resonators** *Laser Rate equation, Two-Level System, Three-Level Lase*r System, The Four-Level Laser System, Variation of Laser Power around Threshold, Optimum Output. Optical Resonators: Modes of a Rectangular Cavity and the Open Planar Resonator, Spherical Mirror Resonators, The Quality Factor, The Ultimate Line width of a Laser, Mode Selection (Transverse and Longitudinal Mode Selection), Pulsed Operation of Lasers, Q-Switching, Techniques for Q- Mode Locking, Modes of Confocal Resonator System, Modes of a General Spherical Resonator.	**12**
III	**Some Laser Systems** Ruby Lasers, Neodymium-Based Lasers, Nd:YAG Laser, Nd:Glass, Titanium Sapphire Laser, The He–Ne Laser, The Argon Ion Laser, The CO2 Laser, Dye Lasers, Semiconductor Lasers. Optical Parametric Oscillators: Introduction, Optical Non-linearity, Parametric Amplification, Singly Resonant Oscillator, Doubly Resonant Oscillator, Frequency Tuning, Phase Matching.	**13**
IV	**Application of Laser in Light Wave Communications** Carrier Wave Communication, Analog Modulation, Digital Modulation, Optical Fibers	**10**

	in Communication, The Optical Fiber, Why Glass Fibers?, Attenuation of Optical Fibers, Aperture of the Fiber, Multimode and Single-Mode Fibers, Single- Mode Fiber, Spot Size of the Fundamental Mode, Pulse Dispersion in Optical Fibers.	
V	**Application of Laser in Science & Industry** Second-Harmonic Generation Stimulated Raman Emission, Intensity-Dependent Refractive, Lasers in Chemistry, Lasers and Ether Drift, Lasers and Gravitational Waves, Rotation of the, Photon Statistics, Lasers in Isotope Separation. Applications in Material Processing: Laser Welding, Hole Drilling, Laser Cutting. Other Applications: Laser Tracking, Lidar. Lasers in Medicine. Precision Length Measurement Laser Interferometry and Speckle. Speckle Metrology. Velocity Measurement: Lasers in Information Storage, Bar Code Scanner.	**10**

Suggested Readings:

1. Lasers:Fundamentals and Applications by K. Thyagarajan and Ajoy Ghatak (Springer US)
2. Basics of Laser Physics by Karl F. Renk (Springer-Verlag Berlin Heidelberg)
3. Principles of Lasers by Orazio Svelto(Springer US)
4. Principle of Lasers and Optics by Willium S.C. Chang (Cambridge University Press)
5. Handbook of Lasers by Marvin J. Weber (CRC Press LLC).
6. Fundamentals of Light Sources and Lasers byMark Csele (Published by John Wiley & Sons, Inc., Hoboken, New Jersey).

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

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MINOR PAPER [For Students of Other Discipline/Subject]

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: Fourth**	**Semester: VII**
Pedagogy:		
Course Code: MPHY07	**Course Title: : MS EXCEL**	
Course Outcome: After completing this course, the students will be able to -		
CO: Aim to aware with skill development in computer software which is uses in Physics and other fields.		
Credit: 3+0+0	**Paper: Elective (Minor)**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Units	Topics	No. of Lecture
I	Mathematical calculation: Basic understanding, Addition Subtraction, Multiplication Division.	9
II	Single x single y data Graph plotting, Single x multiple y date graph plotting, Double x vs y data graph plotting	9
III	Labelling of x and y exes, labelling of data point in graph.	9
IV	Graph plotting for given equation such as linear, polynomial, quadratic, Parabola, Circle or any given function.	9
V	Curve fitting and analysis of linear, polynomial, exponential or any given function.	9

Suggested Readings:

1. Excel 2021 for Dummies" by Greg Harvey.
2. Mastering Microsoft Excel 2021" by J. Carlton Collins.
3. Excel Formulas and Functions for Dummies" by Ken Bluttman:

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

SEMESTER-VIII

Programme: B. Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. IVth Year	Semester: VIII
Pedagogy:		
Course Code: PHY-23113	**Course Title:** Advanced Electronics	

Course Outcome: After completing this course, the students will be able to -

CO1: understand about transistor, field effect transistor and its application.
CO2: aware with Feedback Amplifiers and Oscillators
CO3: aware with power and RF Amplifier and multi- vibrator.
CO4: aware with Modulation and De-Modulation:
CO5: aware with operational amplifier and its applications.

Credit: 3+0+2	**Paper: Core Compulsory**
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60

Unit	Topics	No. of Lecture
I	**Field Effect Transistors & Multistage Amplifier** Small signal model and dynamic parameters, CS and CD amplifiers. Multistage Amplifiers: BJT at high frequencies, frequency response of gain and phase shift, and frequency response of RC coupled amplifier.	9
II	**Feedback Amplifiers and Oscillators** Classification, Different Negative Feedback Amplifiers, Stability and Nyquist Criteria Sinusoidal Oscillators, Phase Shift and Wien's Bridge Oscillators, Crystal Oscillators, Astable Multivibrator, Uni junction Transistor (UJT).	9
III	**Power and RF Amplifier** Large Signal Amplifier and Distortions, Transformer Coupled Audio Power Amplifiers, Push-Pull amplifier, Single and Double Tuned Amplifiers.	9
IV	**Modulation and De- Modulation:** Frequency Spectrum and Power in Amplitude Modulation (AM) wave, Amplitude Modulating Circuits, Frequency and Phase Modulations, Frequency Modulator, Frequency Changing and Tracking; Automatic Gain Control (AGC), Automatic Frequency Control (AFC), FM Detection, Amplitude Limiter, Phase Discriminator, Ratio Detector.	9
V	**Op-Amp (IC-741) and their Application:** Operational amplifier (block diagram), characteristics parameters, inverting and non-inverting amplifier. Application as a voltage follower, summer, differentiator, integrator Digital Techniques and Applications: Register, counter, comparators	9

Suggested Readings:

1. *Hand Book of Electronics, 38/e by S. L. Gupta & V. Kumar (Pragati Prakashan).*
2. *Electronic Device& Circuits, 3/e by J. Milliman& C. C. Halkias (McGraw-Hill).*
3. *Modern Digital Electronics 4/e by R. P. Jain (Tata McGraw- Hill Education).*
4. *Principles of Communication Systems, 2/e by H. Taub& D. Schilling (McGraw- Hill).*
5. *Electronic Fundamentals and Applications, 5/e by J. D. Ryder (PHI Learning).*
6. *Digital Integrated Electronics by H. Taub& D. Schilling(McGraw- Hill).*
7. *Digital Principles and Applications by A. P. Malvino& D. P. Leach(McGraw-Hill).*
8. *Digital Logic and Computer Design by M. Morris Mano (PHILearning).*
9. *MicroelectronicsbyJ.MillmanandA.Grabel(McGraw-Hill).*

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

[Practicals List]

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: B.Sc. IVth Year	Semester:VIII
Pedagogy:		
Course Code: PHY-23113	**Course Title: Lab work based on theory**	
Course Outcome:		
CO: Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the mechanical properties. Measurement precision and perfectionis achieved through Lab Experiments. Hands on experience of different equipments.		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60	**Min Passing Marks: 14+21**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		

SN	List of Practicals	Practical (Hrs.)
1	Astable Multivibrator	60
2	Boltzmann constant	
3	Capacity and permittivity	
4	Curie Temperature	
5	Modulation and Demodulation	
6	Energy Band Gap of Si & Ge Diodes	
7	Double Stage Amplifier	
8	Design of CE Amplifier	
9	Design of regulated Power supply	
10	Operational amplifier	
11	Uni- Junction Transistor	

Suggested Readings:

1. *Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot, Allahabad)*
2. *Practical Physics by Arora (S. Chand Publisher)*
3. Physics through experiments by B. Saraf (Vikas Publications), 2013.
4. An advanced course inpractical physics by D. Chatopadhyay, PCRakshit, B. Saha (NewCentral Book Agency Pvt Ltd.), 2002.
5. B.Sc. Practical Physics(Revised Edition) By C. L Arora (S.Chand & Co.), 2007.

Course prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

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MAJOR (ELECTIVE): CHOOSE ANY ONE COURSE

Programme: B.Sc. (Honours/Honours with Research) in Physics	Year: Fourth Year	Semester: VII-VIII
Pedagogy:		
Course Code: PHY-23114A	**Course Title: Astrophysics & Space Physics**	
Course Outcome: After completing this course, the students will be able to -		
CO1: Structure of the Sun, and different phenomenon originated from it, solar activity. **CO2:** Geomagnetic activity and its impacts on communication/navigations systems. **CO3:** Hazards radiations from the sun and influence of Human's life and technologicalsystem, climate change. **CO4:** aware with Sun-Earth interaction & Magnetosphere and Microstructure of agnetopause; Shape of magnetospheric cavity. **CO5:** aware with Structure & formation of ionosphere; equatorial ionospheric anomaly(EIA), Ionospheric irregularities: Sporadic E and Spread-F irregularities and theirdistribution		
Credit: 3+0+0	**Paper (Code compulsory/Elective): Core**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	Topics	No. of Lecture

I	**Acceleration of Charged Particles:** **Sun & Solar Phenomena**: Structure of the Sun: Solar interior, solar atmosphere, photosphere, chromosphere, corona; Small & large scale Solar structures, Sun spots and their properties, Prominences, Solar Flare: classifications, phases & flaretheory; Solar cycle, Solar magnetic field.	9
II	**Solar Wind**: Observed and derived properties of solar wind, Solar wind formation: Fluid theory for static as well as expanding isothermal solar atmosphere, Spatial configuration of magnetic field frozen into solar wind, Termination of solar wind, Heliosphere.	**9**
III	**Astrophysical Processes**: Simple orbits, Kepler's laws, Flat rotation curve of galaxies and implications for dark matter, Role of gravity in different astrophysical systems; Radiative Process: Radiation theory and Larmor formula, Different radiative processes.	**9**
IV	**Sun-Earth interaction & Magnetosphere**: Its structure, Bow shock, Magnetopause, Magnetopause current, Stand-off distance of stagnation point, Microstructure of magnetopause; Shape of magnetospheric cavity, Magnetotail; Planetary magnetospheres. VLF waves, Whistlers & its applications.	**9**
V	**Ionosphere:** Structure & formation of ionosphere; equatorial ionospheric anomaly (EIA), Ionospheric irregularities: Sporadic E and Spread-F irregularities and their distribution; Ionospheric Scintillations, Geomagnetic storms, its classification, TYPE 1& TYPE 2 geomagnetic storms & consequences.	**9**

Suggested Readings:

1. Astrophysics of the Sun: Harold Zirin, Cambridge University Press, Cambridge, U.K.
2. Solar System Astrophysics: J.C. Brandt & P.W. Hadge
3. Guide to the Sun: Kenneth J. H. Philips, Cambridge University Press, U.K.
4. An Introduction to Modern Astrophysics: W. Carroll & D. A. Ostlie, Addison Wesley
5. The Physics of Astrophysics Vol I & II: Frank H. Shu, University Science Books, USA
6. Astrophysical Concepts: M. Harwitt, Springer-Verlag, New York

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

OR

Programme: B. Sc. (Honours/Honours with Research) in Physics	**Year: Fourth Year**	**Semester: VIII**
Pedagogy:		
Course Code: PHY-23114B	**Course Title: Origin**	
Course Outcome: After completing this course, the students will be able to -		
CO1: Mathematical calculation: Basic understanding, Addition Subtraction, Multiplication Division. **CO2:** Single x single y data Graph plotting, Single x multiple y date graph plotting, Double x vs y data graph plotting Double x vs y data graph plotting **CO3:** Labelling of x and y exes, labelling of data point in graph. **CO4:** Graph plotting for given equation such as linear, polynomial, quadratic, Parabola, Circle or any given function **CO5:** aware with Curve fitting and analysis of linear, polynomial, exponential or any given function.		
Credit: 3+0+0	**Paper (Code compulsory/Elective): Core Elective**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	**Topics**	**No. of Lecture**
I	Mathematical calculation: Basic understanding, Addition, Subtraction, Multiplication Division.	9
	Single x single y data Graph plotting, Single x multiple y date graph plotting, Double x vs y	**9**

II	data graph plotting.	
III	Labeling of x and y exes, labeling of data point in graph.	**9**
IV	Graph plotting for given equation such as linear, polynomial, quadratic, Parabola, Circle or any given function.	**9**
V	Curve fitting and analysis of linear, polynomial, exponential or any given function.	**9**

Suggested Readings:

1. Origin Software Complete Usage Instruction and Graph Representation: A complete Guide fornew users by Muhammad Arsalan (Author), Azka Awais (Author).

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

OR

Programme: B.Sc. (Honours/Honours with Research) in Physics	**Year: Fourth Year**	**Semester: VIII**
Pedagogy:		
Course Code: PHY-23114C	**Course Title: High Energy Physics**	
Course Outcome: After completing this course, the students will be able to -		
Students would be able understand the complex properties and behaviour of high energy particles at the microscopic level. This course would encourage students to peruse higher study and research in particle and high energy Physics.		
Credit: 3+0+0	**Paper (Code compulsory/Elective): Core Elective**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	**Topics**	**No. of Lecture**
I	Quantization of Scalar Fields Lagrangian Formulation, Hamiltonian and momentum densities, Neutral and Charged scalar fields and their quantization, Momentum representation and frequency splitting, Identification of various particle operators, Charge operator, Algebra of field operators, Invariant delta function and its representations, Covariant commutation relations and their properties.	**9**
II	Quantization of Spinor Field Lagrangian formulation for Spinor field, Hamiltonian and momentum densities, Quantization of Spinor Field, Momentum representation and frequency splitting, Identification of various particle operators, Charge operator for Spinor field, Algebra of Spinor field operators, Covariant form of anti-commutation relations.	**9**
III	Quantization of Electromagnetic Field Classical electromagnetic field theory and its gauge formulation, Covariant Lagrangian formulation for EM field.	**9**
IV	Quantization of EM field, Momentum representation and frequencysplitting, Identification of various particle operators, Concept of longitudinal, temporal and transverse photons.	**9**
V	Covariant commutation relations for EM potential operators, Problems with temporal photons and Lorentz condition, Resolution through Gupta-Bleular formulation	**9**

Suggested Readings:

1. B. W. Pandey. 2005. Natural Resource Management. Mittal Publication, New Delhi
2. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House,New Delhi.
3. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and ResourceConservation. Anamaya Publications, New Delhi.
4. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Course. prerequisite: To study this course, the students must have had Science Subjects in class 12th

Suggested Activities: Calculation and analysis of ecological footprint, Ecological modelling, Collections of data on forest cover of specific area.

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc. (Honours/Honours with Research) in Physics		Year: B.Sc. 4th Year	Semester: VIIIth
Pedagogy:			
Course Code: PHY-23115A	**Course/Paper Title:**	Dissertation/Research Project & Viva voce [For Hons. with Research Students]	

Course Outcomes: After completing this course, the students will be able to -

CO 1: acquire Research Skills and awareness about Methodology
CO 2: develop critical thinking skills for evaluating existing literature and research gaps.
CO 3: develop Communication Skills, Analytical and Problem-Solving abilities.
CO 4: develop Project Management and will be able to contribute to existing knowledge
CO 5: Collaborate in Interdisciplinary Skills.

Credit: 0+0+12	Paper (Core Compulsory / Elective): Elective
Max. Marks : 100	

Total Number of Lectures (Lecture – Tutorials – Practical): 0+0+360

Units:	Topics:	Practicals Hrs
I	Dissertation/ Research Project & Viva Voce	360

Suggested Readings:

General Research Methodology

1. Kothari, C. R. & Garg, Gaurav
   Research Methodology: Methods and Techniques
   – New Age International Publishers
   - A foundational book on qualitative and quantitative research methods.
2. Creswell, John W.
   Research Design: Qualitative, Quantitative, and Mixed Methods Approaches
   – SAGE Publications
   - Comprehensive guidance for designing and conducting research.
3. Neuman, W. Lawrence
   Social Research Methods: Qualitative and Quantitative Approaches
   – Pearson Education
   - Ideal for social sciences and interdisciplinary studies.
4. Ranjit Kumar
   Research Methodology: A Step-by-Step Guide for Beginners
   – SAGE Publications
   - Practical guide with examples, useful for first-time researchers.

Academic Writing & Dissertation Structuring

5. Turabian, Kate L.
   A Manual for Writers of Research Papers, Theses, and Dissertations
   – University of Chicago Press
   - Covers formatting, citation styles, and academic tone.
6. Walliman, Nicholas
   Your Research Project: A Step-by-Step Guide for the First-Time Researcher
   – SAGE Publications
   - Student-friendly guide to planning and writing a dissertation.
7. Booth, Wayne C., Colomb, Gregory G., & Williams, Joseph M.
   The Craft of Research
   – University of Chicago Press
   - Insightful resource on forming arguments, framing research questions, and structuring.

Subject-Specific & Technical Writing

8. Day, Robert A. & Gastel, Barbara
   How to Write and Publish a Scientific Paper
   – Cambridge University Press
   - Ideal for students in science, engineering, and health disciplines.
9. Denscombe, Martyn
   The Good Research Guide: For Small-Scale Social Research Projects

– Open University Press
- Excellent for undergraduate dissertations and small research projects.

Plagiarism, Referencing & Ethics

10. American Psychological Association (APA)
    Publication Manual of the APA (7th Edition)
    – APA
    - For academic writing, referencing, and ethical research practices.
11. MLA Handbook (9th Edition)
    – Modern Language Association
    - Referencing guide for literature, humanities, and liberal arts.
12. Office of Research Integrity (ORI), USA
    Introduction to the Responsible Conduct of Research
    - Free online guide on ethics, plagiarism, authorship, and data handling.

Suggested continuous Evaluation Methods –

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects –	05 Marks
Internal Class Test –	10 Marks
Attendance/Behavior –	05 Marks

Or

Field Visit/ Educational Tour Visit based Report & Viva Voce [Course Code : PHY-23115B] for (Hons. Students)

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Completion of the Programme: **Bachelor Degree with Honours/Honours with Research** in Major Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme. **[NHEQF Level 6.0]**

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