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Department of Microbiology

B.Sc. (Physics)

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Eligibility criteria: Bachelor of Science (B.Sc.)

Sr. No	Course	Required Qualifications
1	B.Sc. Microbiology	12th Pass with PCB
2	B.Sc. Chemistry	12th Pass with PCB/PCM
3	B.Sc. Physics	12th Pass with PCB/PCM
4	B.Sc. Mathematics	12th Pass with PCM

Sr. No	Major	Minor
1	Microbiology	Chemistry
2	Chemistry	Microbiology: G-1 /Physics: G-2
3	Physics	Mathematics/Chemistry
4	Mathematics	Physics

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GUJARAT VIDYAPITH: AHMEDABAD
Faculty of Science
Department of Microbiology
Program Structure For B.Sc. Physics (3-years UG)
Effective from June 2024*
Summary

Broad Category of Course	**Sem-1**	**Sem-2**	**Sem-3**	**Sem-4**	**Sem-5**	**Sem-6**	**Total**	**Required**
Major (Core)	3+2= **05**	3+2= **05**	3+3= **06**	3 3 06 + 2(P) = 08	3 3 3 =9+5(P) =14	3+2=05 3+2=05 3+2=05 3+2=05 20	**60**	**60**
DSE (Discipline Specific Elective)	-	-	-	-	**2** **14+2= 16**	-		
Minor	3+2= **05**	3+2= **05**	3+3= **06**	3 3 **06 +2(P)= 08**	-	-	**24**	**24**
Multidisciplinary	**03**	**03**	**03**	-	-	-	**09**	**09**
Ability Enhancement course	**02**	**02**	**02**	**02**	-	-	**08**	**08**
Skill Enhancement Course	**03**	**03**	**03**	-	-	-	**09**	**09**
Value added Courses	**02**	**02**	-	**02**	-	-	**06**	**06-08**
Internship/In-house	-	-	-	-	**04**		**04**	**02-04**
Total	**20**	**20**	**20**	**20**	**20**	**20**	**120**	**120**

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GUJARAT VIDYAPITH: AHMEDABAD
Faculty of Science
Department of Microbiology
Program Structure For B.Sc Physics (Semester I to VI) Effective from June 2024

Availability of time for direct teaching in each semester = 15 weeks = **517.5 hours** (15weeks × 34.5 hours)
Monday to Friday (excluding prayer and recess) = 30 hours (6 hours × 5 days)
Saturday (excluding prayer and recess) = 4.5 hours
Therefore 1week = 34.5 hours

B.Sc. Semester-1							
Sr. No.	**Broad Category of Course**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	Major (Core)	Physics	First	45	60	3	2
2	Minor	G1: Mathematics G2: Chemistry	First	45	60	3	2
3	Multidisciplinary		First	45	-	3	-
4	Ability Enhancement course		First	30	-	2	-
5	Value added Courses		First	30	-	2	-
6	Skill Enhancement Course		First	-	90	-	3
Total				**195**	**210**	**13**	**07**

Available Total Credits= 20 Total required hours per semester=405
Total available hours per semester=517.5 hours
Available hours per week= 34.5 hours
Calculation of required hours per week
13 credits for theory=**13 hours**
07 credits for practicals=**14 hours**
Total required hours per week=27.0 hours, Extra hours =7.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

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B.Sc. Semester-2							
Sr. no	**Broad Category of Course**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	Major(Core)	Physics	Second	45	60	3	2
2	Minor	G1: Mathematics G2: Chemistry	Second	45	60	3	2
3	Multidisciplinary		Second	45	-	3	-
4	Ability Enhancement course		Second	30	-	2	-
5	Value added Courses		Second	30	-	2	-
6	Skill Enhancement Course		Second	-	90	-	3
Total				**195**	**210**	**13**	**07**

Available Total Credits= 20 Total required hours per semester=405
Total available hours per semester=517.5 hours
Available hours per week= 34.5 hours
Calculation of required hours per week
13 credits for theory=**13 hours**
07 credits for practicals=**14 hours**
Total required hours per week=27.0 hours, Extra hours =7.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

UG Certificate: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate **if, in addition, they complete one vocational course or internship / Apprenticeship of 4 credits during the summer vacation of the first year**. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

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B.Sc. Semester-3							
Sr. No.	**Broad Category of Course**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	Major (Core)	Physics	Third	45	90	3	3
2	Minor	G1: Mathematics G2: Chemistry	Third	45	90	3	3
3	Multidisciplinary		Third	45	-	3	-
4	Ability Enhancement course		Third	30	-	2	-
5	Skill Enhancement Course		Third	-	90	-	3
Total				**165**	**270**	**11**	**9**

Available Total Credits= 20 Total required hours per semester=435
Total available hours per semester=517.5 hours
Available hours per week= 34.5 hours
Calculation of required hours per week
11 credits for theory=**11 hours**
9 credits for practicals=**18 hours**
Total required hours per week= 29 hours
Extra hours =5.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

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B.Sc. Semester-4							
Sr. No.	**Broad Category of Course**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	Major (Core)	Physics	Fourth	45	-	3	-
2	Major (Core)	Physics	Fourth	45	-	3	-
3	Major (Core)	Physics	Fourth	-	60	-	2
4	Minor	G1: Mathematics G2: Chemistry	Fourth	45	-	3	-
5	Minor	G1: Mathematics G2: Chemistry	Fourth	45	-	3	-
6	Minor	G1: Mathematics G2: Chemistry	Fourth	-	60	-	2
7	Ability Enhancement course		Fourth	30	-	2	-
8	Value added Courses		Fourth	30	-	2	-
Total				**240**	**120**	**16**	**4**

Available Total Credits= 20 Total required hours per semester= 360
Total available hours per semester=517.5 hours
Available hours per week= 34.5 hours
Calculation of required hours per week
16 credits for theory=**16 hours**
4 credits for practical=**8 hours**
Total required hours per week=24 hours
Extra hours =10.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

UG Diploma: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma **if, in addition, they complete one vocational course or internship / Apprenticeship of 4 credits during the summer vacation of the second year.** These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

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B.Sc. Semester-5							
Sr. no	**Broad Category of Course**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	Major(Core)	Physics	Fifth	45	-	3	-
2	Major(Core)	Physics	Fifth	45	-	3	-
3	Major(Core)	Physics	Fifth	45	-	3	-
4	Major(Core)	Physics	Fifth	-	150	-	5
5	Major (DSE)	Physics	Fifth	30	-	2	-
6	Internship	Internship/ 20 days Workshop (Own Institute)	Fifth	-	120	-	4
Total				**165**	**270**	**11**	**09**

Available Total Credits= 20.0 Total required hours per semester=435
Total available hours per semester=517.5 hours
Available hours per week= 34.5 hours
Calculation of required hours per week
11 credits for theory=**11 hours**
9 credits for practicals=**18 hours**
Total required hours per week=29 hours
Extra hours =5.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

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B.Sc. Semester -6							
Sr. no	**Broad Category of Course**	**Subject Name**	**Semester**	**Hours**		**Credits**	
				Theory	**Practical**	**Theory**	**Practical**
1	Major (Core)	Physics	Sixth	45	60	3	2
2	Major (Core)	Physics	Sixth	45	60	3	2
3	Major (Core)	Physics	Sixth	45	60	3	2
4	Major (Core)	Physics	Sixth	45	60	3	2
Total				**180**	**240**	**12**	**8**

Available Total Credits= 20.0 Total required hours per semester=420
Total available hours per semester=517.5 hours
Available hours per week= 34.5 hours
Calculation of required hours per week
12 credits for theory=**12 hours**
8 credits for practical=**16 hours**
Total required hours per week=28 hours
Extra hours =6.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

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PROGRAM OUTCOMES (POs) FOR B.Sc. PROGRAM

Our program prepares graduates to achieve the following POs within three years of graduation.

POs	Integrated Justification
PO1: Discipline-Specific Knowledge	The program develops a strong foundation in scientific principles through interdisciplinary learning, enabling students to apply Natural Sciences and Mathematics to real-world problems. It builds core competencies that prepare graduates for higher education and professional careers.
PO2: Problem Analysis	Graduates develop critical thinking and analytical skills by integrating knowledge from Natural Sciences and Mathematics. They apply scientific methodologies and quantitative techniques to independently solve complex issues.
PO3: Experimental Skills	Students gain hands-on experience in designing, conducting, and analyzing experiments using modern scientific tools. This fosters accuracy, reproducibility, and practical application across various domains.
PO4: Environment and Sustainability	The curriculum promotes ecological awareness and sustainable practices. By linking Natural Sciences with global environmental issues, students develop a scientific approach to sustainability and social responsibility.
PO5: Ethics and Values	Graduates uphold Gandhian values, professional ethics, and integrity. The program fosters responsible application of scientific knowledge within ethical frameworks, encouraging social accountability.
PO6: Communication	Students acquire strong oral and written communication skills, enabling them to articulate scientific concepts, write technical reports, and engage in interdisciplinary dialogue effectively.
PO7: Modern Tool Usage	The program familiarizes students with advanced scientific instruments, IT tools, and analytical software. Graduates can ethically and effectively apply these tools across research and industry sectors.
PO8: Teamwork and Leadership	Graduates are prepared to contribute meaningfully to multidisciplinary teams, demonstrating leadership and collaboration in diverse scientific and professional

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	environments.
PO9: Lifelong Learning	The program instills motivation for lifelong learning and adaptability. Students are equipped to independently explore and incorporate new knowledge and skills in a rapidly changing world.
PO10: Project Management	Graduates develop organizational and economic skills essential for managing scientific research projects and investigations. The curriculum emphasizes planning, execution, and evaluation of scientific work.
PO11: Innovation and Entrepreneurship	The program fosters creative thinking, problem-solving, and entrepreneurial mindset. Students are encouraged to develop innovative scientific solutions with societal impact.
PO12: Societal Contribution	Graduates understand the role of science in society and apply their knowledge for the public good. Emphasis is placed on rural development, informed public discourse, and Gandhian ideals of service and self-reliance.

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PROGRAMME SPECIFIC OUTCOMES (PSOs) FOR BACHELOR OF SCIENCE (B.Sc.-Microbiology)

After successful completion of "Three Year Degree Program" in Physics, a student will be able to:

PSO Number	**Programme Specific Outcomes (PSOs)**	**Justification**
PSO1	Gain a thorough understanding of fundamental concepts in classical mechanics, electromagnetism, optics, thermodynamics, quantum mechanics, and modern physics; apply these principles to solve physical problems; analyse physical systems and their behaviour; evaluate theoretical models and experimental outcomes; and synthesize knowledge across topics to explain complex physical phenomena.	This PSO supports the development of discipline-specific knowledge (PO1) and problem analysis (PO2) while fostering an understanding of microbial roles in environmental sustainability (PO4).
PSO2	Develop competence in handling Physics laboratory instruments; comprehend standard experimental protocols; apply appropriate techniques to perform experiments; analyse and interpret experimental data; evaluate the accuracy, precision, and reliability of results; and design conclusions based on scientific reasoning.	This PSO is grounded in experimental skills (PO3), enhances familiarity with modern tools (PO7), and prepares students for basic project management (PO10) in scientific settings.
PSO3	Integrate fundamental concepts of physics alongside principles from chemistry, mathematics, computer science, and engineering; apply this integrated knowledge to real-world scenarios; analyse complex scientific and technological problems; evaluate interdisciplinary approaches and solutions; and create innovative models or technologies that address challenges across diverse domains.	This outcome aligns with ethics and values (PO5), communication (PO6), teamwork (PO8), lifelong learning (PO9), and societal contribution (PO12) by fostering responsible citizenship and public health awareness.

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CO Attainment Matrix

Benchmark (Target attainment) is 60% for all courses of B.Sc. Program

Attainment Criteria	Level	Description
≥ 60% students scored ≥ Benchmark	Level 3	**High Attainment** – Most students achieved the expected outcome.
50–59% students scored ≥ Benchmark	Level 2	**Moderate Attainment** – Outcome partially achieved.
40–49% students scored ≥ Benchmark	Level 1	**Low Attainment** – Minimal outcome achieved.
< 40% students scored ≥ Benchmark	Level 0	**Not Attained** – Remedial action required

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B.Sc. (Physics) Semester-1	BPHY-101 -OPTICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….
CO1: Demonstrate understanding of key optical phenomena such as reflection, refraction, interference, and diffraction.
CO2: Explain the fundamental principles of LASER and the techniques used for its generation.
CO3: Explain the basic principles and applications of holography and fiber optics.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	P O6	PO 7	P O8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PS O1	PS O2	PS O3	Avg.
CO1	3	2	1	1	-	1	2	2	3	-	2	1	1.80	3	-	-	3
CO2	3	3	-	-	-	2	2	2	3	2	1	2	2.22	3	-	-	3
CO3	3	2	-	3	-	2	-	2	3	-	-	1	2.29	3	-	-	3
PO Avg.	3	2.3	1.0	2	-	1.7	2	2	3	2	1.5	1.33	2.1	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

1. Constructivism
2. Social Constructivism
3. Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**OPTICS**	**15 Hrs**
	Diffraction of Light Introduction Difference between Interference and Diffraction Fresnel and Fraunhofer Types of diffraction Diffraction pattern due to narrow slit **Resolving Power of Optical Instrument** Resolving power Limit of resolution of eye Resolving power of optical instruments Rayleigh's criterion of resolution Resolving power of a telescope Relation between magnifying power and resolving power of telescope Resolving power of a prism	

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	Resolving power of a plane transmission grating	
UNIT 2	**LASER**	**15 Hrs**
	● **Interaction of light with matter Absorption** ● Absorption ● Spontaneous emission ● Stimulated emission ● **Meeting the three requirements** ● Population inversion ● Metastable states ● Confining radiation within the medium ● **Components of LASER** ● Active medium ● Pumping ● Optical resonant cavity ● **Lasing Action** ● **Principal pumping schemes** ● Three-level pumping scheme ● Four-level pumping scheme ● **Types of LASERS** ● Ruby Laser ● Helium-Neon Laser ● Carbon Dioxide Laser ● **Semiconductor Laser** ● PN-Junction Laser ● **LASER beam characteristics** ● **Applications**	
UNIT 3	**HOLOGRAPHY AND FIBER OPTICS**	
	● **HOLOGRAPHY** ● Basic principle of holography ● Recording of holography ● Reconstruction of image from holography ● Applications of holography ● **FIBER OPTICS** ● Principle of Fiber optics ● Structure and classification of optical fiber ● The Numerical Aperture (NA) ● Fiber optics communication system ● Advantage of optical fiber communication system Applications	**15 Hrs**
References:	1. A Textbook of Optics, N. Subrahmanyam, Brij Lal, S. Chand Publishing, 2024 2. Optics, Ajoy Ghatak, Tata McGraw Hill, 2023 3. Engineering Physics, R. K. Gaur, S. L. Gupta, Dhanpat Rai Publications, 2023 4. Optics and Atomic Physics, D. P. Khandelwal, Himalaya Publishing House, 2022 5. Fiber Optics and Optoelectronics, R. P. Khare, Oxford University Press, 2022 6. An Introduction to Lasers: Theory and Applications, M. N. Avadhanulu, S. Chand Publishing, 2023	

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Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-1	BPHY-101P –PHYSICS PRACTICAL	MAJOR
Credit - 2, Teaching Hours - 60		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Correlate theoretical concepts with the practical handling of optical instruments.

CO2: Demonstrate hands-on ability to study the properties and behaviour of LASER.

CO3: Gain practical experience in analysing the transmission and behaviour of light through optical fibers.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	1	3	1	-	2	-	-	2	1	-	-	1.86	2	3	-	2.5
CO2	2	2	3	1	3	-	-	-	-	-	2	2	2.14	2	3	-	2.5
CO3	1	-	3	-	-	-	2	2	2	-	3	-	2.17	2	3	-	2.5
PO Avg.	2.00	1.5	3.0	1.0	3.0	2.0	2.0	2.0	2.0	1.0	2.50	2.00	2.06	**2**	**3**	-	**2.5**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

1. Constructivism
2. Social Constructivism
3. Behaviourism

Teaching Methods and Tools

- experimentation
- hands-on training

Experiments

- To determine the resolving power of prism.
- To determine Cauchy's constant A and B using a given formula and also find out with graph.
- To determine the wavelength of sodium light using plane diffraction grating.
- Find out the refractive index of different liquids using convex lenses.
- LASER characteristics
- Wireless communication using fiber optic

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	Term End Practical examination

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B.Sc. (Physics) Semester-2	BPHY-201 - WAVES AND ELECTRONICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Explain the basic properties, generation, and applications of X-rays as a form of electromagnetic radiation.

CO2: Demonstrate foundational knowledge of sound wave generation, propagation, and properties.

CO3: Acquire essential knowledge of basic electronic circuit elements and their applications.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	2	2	-	-	-	-	-	2	1	2	2	**2.00**	3	-	-	3
CO2	3	-	1	2	2	3	-	2	-	2	-	-	**2.14**	3	-	-	3
CO3	3	-	2	-	2	-	2	3	-	-	-	2	**2.33**	3	-	-	3
PO Avg.	**3**	**2.0**	**1.6**	**2**	**2**	**3**	**2**	**2.5**	**2**	**1.5**	**2**	**2**	**2.16**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

1. Constructivism
2. Social Constructivism
3. Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**X-RAYS**	**15 Hrs**
	Discovery of X-rays Properties of X-rays Production of X-rays Origin of X-rays Detectors of X-rays (Gieger Muller counter, Proportional counter, Scintillation counter) Diffraction of X-rays Bragg's law Crystallography by powder diffraction method Crystal rotating method Applications of X-rays	
UNIT 2	**SOUND**	**15 Hrs**
	1. Travelling waves Speed of propagation of waves in a stretched string	

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	Longitudinal waves in a bar Plane waves in fluid Transmission of energy by a travelling wave **Sound wave:** Introduction, Intensity & its level, Loudness & pitch Radiation efficiency of a sound source Newton's formula and Laplace's correction **Ultrasonic:** Introduction, Piezoelectric effect Piezoelectric oscillator Magnetostriction method characteristics of ultrasonic waves velocity of sound in liquid Applications of ultrasonic waves	
UNIT 3	**ELECTRONIC CIRCUITS**	**15 Hrs**
	Energy level in solids, Valance band, conduction band and forbidden band conductor semiconductor and insulator chemical bonds in semiconductor like germanium and silicon pure or intrinsic semiconductor impurity or extrinsic semiconductor The p-n junction The unbiased diode Forward and Reverse biased diodes – its characteristics **Rectifying Circuits** Half wave rectifier Voltage regulation Ripple factor Full wave rectifier Bridge rectifier **Filter Circuits** The inductor filter The capacitor filter L-C filter π filter Comparisons of filter circuits	

References

1. Engineering Physics, R. K. Gaur, S. L. Gupta, Dhanpat Rai Publications, 2023
2. Mechanics, Wave Motion and Heat, F. W. Sears, Addison-Wesley, 2020
3. A Textbook of Oscillations, Waves and Acoustics, M. Ghosh, D. Bhattacharya, S. Chand Publishing, 2022
4. Classical Mechanics, R. G. Takwale, P. S. Puranik, Tata McGraw Hill, 2023
5. Electronic Devices and Circuits: An Introduction, Allen Mottershead, Prentice-Hall India, 2022

Assessment Method

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Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-2	BPHY-201P –PHYSICS PRACTICAL	MAJOR
Po's Aligned PO-1, 3, 6 & 10	Credit - 2, Teaching Hours - 60	

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Apply practical techniques to study rectifier circuits with and without filters, and validate outcomes through theoretical analysis.

CO2: Apply experimental methods to study ultrasonic wave phenomena and assess their applications.

CO3: Develop hands-on skills to construct and test basic electronic circuits.

CO-PO-PSO mapping

COs	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	2	3	3	2	-	-	2	2	2	-	2	1	2.11	2	3	-	2.5
CO2	2	-	3	2	2	-	-	-	1	-	-	2	2.00	2	3	-	2.5
CO3	-	-	3	-	2	2	1	-	3	2	2	2	2.13	2	3	-	2.5
PO Avg.	2	3	3	2	2	2	1.5	2	2	2	2	1.67	2.08	**2**	**3**	**-**	**2.5**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- To study half wave rectifier with and without filter.
- To study full wave rectifier with and without filter.
- To study bridge rectifier with and without filter.
- To study the characteristics of Zener diode and use as voltage regulator.
- To verify Stefan Boltzman's fourth power law using an AC source.
- Determination of Miller Indices
- Find out light velocity by ultrasonic waves
- Capacitance measurements
- Inductance measurements

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	External Practical Examination

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B.Sc. (Physics) Semester-3	BPHY-301 - SOLID STATE, CLASSICAL AND NUCLEAR PHYSICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate understanding of fundamental concepts in solid state physics, including crystal structure and electronic properties of solids.

CO2: Apply basic principles of classical mechanics to analyze the motion of particles and rigid bodies under various force conditions.

CO3: Explain the core concepts of nuclear physics, including nuclear structure, stability, and types of nuclear reactions.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	CO Avg.	PSO 1	PSO 2	PSO 3	Avg.
CO1	3	2	-	3	2	3	-	2	-	1	-	2	**2.25**	3	-	-	3
CO2	3	1	2	-	-	-	2	2	3	2	-	-	**2.14**	3	-	-	3
CO3	3	-	1	-	-	-	2	-	-	3	2	-	**2.20**	3	-	-	3
PO Avg.	3	1.5	1.5	3.	2	3	2	2	3	2	2	2	**2.2**	**3**	*	-	**3**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**Solid State Physics**	**15 Hrs**
	Crystal Structure Periodic Arrays of Atoms Lattice translation vectors Basis, Lattice , Lattice primitive cell, Wigner-Seitz unit cell Fundamental Types of Lattice Two -dimensional lattice types, Oblique lattice , Bravice lattice Three dimensional lattice types Index system(indices) for crystal planes Simple Crystal Structures Sodium Chloride structure	

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	Cesium chloride structure Hexagonal closed packed structure (hcp) Diamond structure	
UNIT 2	**Classical Mechanics**	**15 Hrs**
	1. Central Force Equivalent One-body problem Motioning Central Force field General Features Of The Motion Motion in an inverse-square law force field **0. Oscillations and Collisions** Simple Harmonic Oscillator Damped Harmonic Oscillator Elastic and Inelastic Scattering Laboratory and Centre of Mass Systems Kinematics of Elastic Scattering in Lab System	
UNIT 3	**NUCLEAR PHYSICS**	**15 Hrs**
	1. Detector for Nuclear Particles ● Geiger Counter ● Solid state or semiconductor detector ● Compton suppressed germanium detector ● Cloudand bubble chambers **0. Particle Accelerators** ● Van de Graff generator ● The cyclotron ● The Synchrotron ● the betatron ● Beta Ray Spectrometer	

References

1. Elements of Solid-state Physics, J. P. Srivastava, PHI Learning, 2023
2. Classical Mechanics, R. G. Takwale, P. S. Puranik, Tata McGraw Hill, 2023
3. Introduction to Solid State Physics, Charles Kittel, Wiley, 2024
4. Nuclear Physics: An Introduction, S. B. Patel, New Age International, 2023

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-3	BPHY-301P –PHYSICS PRACTICAL	MAJOR
Credit - 2, Teaching Hours - 60		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: apply the principles of crystallography to experimentally determine Miller indices, and interpret their significance in identifying crystal planes.

CO2: analyze radiation data using a Geiger-Müller (GM) counter and draw conclusions regarding the nature and intensity of radioactive sources.

CO3: evaluate the relaxation time and effective length in simple, bar, and compound pendulums, and compare experimental values with theoretical predictions to assess the accuracy of classical mechanics principles.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	2	2	2	3	3	1	-	-	2	-	-	2	**2.13**	2	3	-	2.5
CO2	2	3	2	3	-	-	-	-	-	2	-	-	**2.4**	2	3	-	2.5
CO3	2	-	1	3	-	2	3	2	-	-	2	2	**2.13**	2	3	-	2.5
PO Avg.	2	2.5	1.6	3	3	1.5	3	2	2	2	2	2	**2.22**	**2**	**3**	**-**	**2.5**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- Miller Index
- GM counter
- Crystal system
- Relaxation time using simple pendulum
- Bar pendulum
- Compound pendulum

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	External Practical Examination

B.Sc. (Physics) Semester-4	BPHY-401 - THERMODYNAMICS,	MAJOR

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	MAGNETOSTATICS AND MODERN PHYSICS	
	Credit - 3, Teaching Hours - 45	

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate a fundamental understanding of heat and thermodynamic processes, including laws of thermodynamics and their applications.

CO2: Explain the key concepts of magnetostatics and analyze magnetic field behavior in various physical systems.

CO3: Describe the foundational principles of modern physics, including quantum theory and relativity, and their significance in contemporary scientific advancements.

CO-PO-PSO mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	CO Avg.	PSO 1	PSO 2	PSO 3	Avg.
CO1	3	-	-	2	1	2	-	2	-	3	-	-	**2.2**	3	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	1	**2**	3	-	-	3
CO3	3	-	1	-	2	-	-	-	-	2	-	3	**2.2**	3	-	-	3
PO Avg.	**3**	**2**	**1**	**2**	**1.5**	**2**	**-**	**2**	**-**	**2.5**	**-**	**2**	**2.1**	**3**	**-**	**-**	**3**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	HEAT & THERMODYNAMICS	15 Hrs
	Entropy Reversiblepart ofthe secondlaw(clauistheorem) Entropy Entropy of ideal gas T – S diagram Application of the entropy principle **Mathematical Methods** Characteristics functions Enthalpy Helmholtz and Gibb's function Maxwell's relations	

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	T ds equations Internal energy equations Heat capacity equations.	
UNIT 2	**MAGNETOSTATICS**	**15 Hrs**
	1. Steady Current and Magnetostatics Electric Current Ohm's Law - Electrical conductivity Magnetic Effects The Magnetic Field Force on a current Bio-Savart law The Laws of Magnetostatics The Magnetic potential Magnetic Media Magnetization Magnetic Field Vector Magnetic Susceptibility and Permiability	
UNIT 3	**MODERN PHYSICS**	**15 Hrs**
	Special Theory of Relativity Postulates of special relativity. (with Michelson Morley experiment) Time dilation Doppler effect Length contraction Relativity of mass Mass and energy Lorentz transformation Velocity addition	

References

1. Heat and Thermodynamics, Mark W. Zemansky, Richard H. Dittman, McGraw Hill, 2023
2. Electromagnetics, B. B. Laud, New Age International, 2023
3. Modern Physics, Kenneth Krane, Wiley, 2021

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-4	BPHY-402 - QUANTUM MECHANICS AND ELECTRONICS	MAJOR

Credit - 3, Teaching Hours - 45

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Explain the foundational principles of quantum mechanics and apply them to understand the behavior of microscopic particles.

CO2: Demonstrate knowledge of semiconductors and their devices, including diodes and transistors, and analyze their working principles.

CO3: Understand the basic concepts of digital electronics and apply logic gate operations in simple circuit design.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	2	3	-	-	1	3	-	-	-	-	3	**2.5**	3	-	-	3
CO2	3	2	-	1	-	-	3	2	-	3	-	3	**2.43**	3	-	-	3
CO3	3	2	1	2	-	2	-	-	-	-	3	1	**2**	3	-	-	3
PO Avg.	**3**	**2**	**2**	**1.5**	**-**	**1.5**	**3**	**2**	**-**	**3**	**3**	**2.33**	**2.31**	**3**	**-**	**-**	**3**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviourisms

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**QUANTUM MECHANICS**	**15 Hrs**
	General formalism of Wave Mechanics The Schrödinger equation and the probability interpretation for an N- particle system The fundamental postulates of wave mechanics . Representation of states I. Representation of dynamical variable; expectation values, observables The adjoint of an operator, and self-adjointness The eigen value problem; Degeneracy Eigen value and eigen function of self-adjoint operators The dirac delta function	

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	Observables : Completeness and normalization of eigenfunctions Physical interpretation of eigen vlaues, eigenfunctions and expansion coefficients The uncertainty principle States with minimum value for uncertainty products	
UNIT 2	**SEMICONDUCTOR PHYSICS**	**15 Hrs**
	Introduction to Semiconductors Classification of semiconductors Examples of band structure ● Silicon and Germanium ● Gallium Arsenide ● Determination of band gap Intrinsic Carrier densities General features of extrinsic semiconductors ● The n-type semiconductors ● The p-type semiconductors Population of donor and acceptor levels in the state of thermal equilibrium Extrinsic carrier densities Temperature dependence of electrical conductivity Hall effect and magnetoresistance The p-n junction Examples of p-n junction-based devices ● The Tunnel Diode The injection laser	
UNIT 3	**DIGITAL ELECTRONICS**	15 Hrs
	Circuit Analysis Boolean Laws and Theorems Sum of Product Method Truth Table to Karnaugh Map Pairs, Quads and Octets Karnaugh Simplifications Don't Care Conditions Product of Sums Method Product of sums Simplifications **Arithmetic Circuits** Binary Addition Binary Subtraction Unsigned Binary Numbers Sign-Magnitude Numbers 2's Complement Representation 2's Complement Arithmetic	

References:

1. A Textbook of Quantum Mechanics, P. M. Mathews, K. Venkatesan, Tata McGraw Hill, 2024
2. Elements of Solid State Physics, J. P. Srivastava, PHI Learning, 2023
3. Digital Principles and Applications, Albert Paul Malvino, Donald P. Leach, McGraw Hill, 2023

Assessment Method

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Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-4	BPHY-403P –PHYSICS PRACTICAL	MAJOR

Credit - 3, Teaching Hours - 90

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Analyse the temperature-dependent characteristics of semiconductor devices, such as PN junction diodes and thermistors, and interpret their performance variations under thermal influence.

CO2: perform binary arithmetic operations and operate digital-to-analog and analog-to-digital converters, applying the principles of digital electronics to practical circuit implementation.

CO3: Evaluate the Hall voltage in semiconductors using Hall effect measurements and determine key parameters like carrier concentration and type.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	1	-	3	-	2	-	1	-	-	2	3	3	**2.14**	2	3	-	2.5
CO2	3	2	3	-	1	-	-	-	2	-	2	-	**2.17**	2	3	-	2.5
CO3	-	-	3	-	-	1	2	2	-	-	-	-	**2**	2	3	-	2.5
PO Avg.	**2**	**2**	**3**	**-**	**1.5**	**1**	**1.5**	**2**	**2**	**2**	**2.5**	**3**	**2.1**	**2**	**3**	**-**	**2.5**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- PN junction diode characteristics (with temperature)
- Effect of temperature on semiconductor
- Thermocouple
- Thermistor
- Binary addition and subtraction
- Hall effect measurement
- Analog to digital converter
- Digital to Analog converter
- Characteristics of Tunnel Diode

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	External Practical Examination

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B.Sc. (Physics) Semester-5	BPHY-501 - ELECTRONICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Explain the fundamental principles of amplifiers and their role in signal processing applications.

CO2: Analyze the frequency response of amplifiers and interpret its effect on signal amplification and bandwidth.

CO3: Understand and apply basic concepts of digital electronics, including logic gates and digital circuit design.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	1	-	2	-	-	-	2	-	-	2	3	**2.17**	3	-	-	3
CO2	3	-	2	-	-	-	1	-	3	-	1	-	**2**	3	-	-	3
CO3	3	3	1	-	-	-	2	1	-	-	-	3	**2.17**	3	-	-	3
PO Avg.	**3**	**2**	**1.5**	**2**	**-**	**-**	**1.5**	**1.5**	**3**	**-**	**1.5**	**3**	**2.11**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**AMPLIFIER CHARACTERISTICS**	**15 Hrs**
	1. General amplifier characteristics (Distortion) Introduction, concept of amplification, amplifier notations, current gain, voltage gain, power gain, amplifier input resistance, amplifier output resistance, maximum power transfer, conversion efficiency, classes of amplifier operation, harmonic distortion, three point method of calculating harmonic distortion, five point method of calculating harmonic distortion, oscilloscope display of an amplifier dynamic transfer curve, measurement of harmonic distortion, other types of amplifier distortion **2. General amplifier characteristics (Decibels)** Introduction, Decibels, other equations for decibel computation, zero dB reference level, use of voltmeter as dB indicator, voltmeter range correction factor, impedance correction factor, frequency response curves, amplifier	

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	bandwidth, phase relationship in amplifier square wave testing.	
UNIT 2	**FREQUENCY RESPONSE OF A TRANSISTOR AMPLIFIER**	**15 Hrs**
	1. Low frequency response of a transistor amplifier: Introduction, Effect of an emitter by pass capacitor on low frequency response, effect of coupling capacitor on low frequency response, cascading of CE stages, mid frequency gains, low frequency response of cascaded stages, Amplifier low frequency response to a square wave, transformer coupled transistor amplifier, low frequency response of TC amplifier, step response of a TC amplifier. **2. High frequency response of a transistor amplifier:** Introduction, High frequency model for a CE amplifier, approximate CE high frequency model with a resistive load, CE short circuit current gain, high frequency current gain with a resistive load, high frequency response of cascaded CE stages, amplifier high frequency response to a square wave, high frequency response of a transformer coupled amplifier.	
UNIT 3	**DIGITAL ELECTRONICS**	15 Hrs
	1. **Circuit analysis, design** Boolean laws and theorems, sum of products method, truth table to Karnaugh map, pairs, quads and octets, Karnaugh simplification, don't care conditions, product of sums method product of sums simplification. Text Book and Reference Book : **2. Arithmetic circuits:** Binary addition binary subtraction, unsigned binary number, sign magnitude numbers, 2 S compliment representation, 2'S compliment arithmetic building blocks. **2. FLIP- FLOP** RS flip flop, clocked RS flip flop, D flip flop, Edged triggered D flip flop, JK flip flop, JK master slave flip flop	

References

1. Digital Principles and Applications, Albert Paul Malvino, Donald P. Leach, McGraw Hill, 2023
2. Electronic Devices and Circuits: An Introduction, Allen Mottershead, Prentice-Hall India, 2022

Assessment Method

Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-5	BPHY-502 - QUANTUM MECHANICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Solve exactly solvable eigenvalue problems in quantum mechanics and interpret their physical significance.

CO2: Explain the concepts of eigenvalues, eigenfunctions, and binding energy in the context of quantum systems.

CO3: Demonstrate an understanding of representations, transformations, and symmetries and their role in the formulation of quantum mechanics.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
3	3	-	2	2	-	2	-	3	1	-	-	**2.29**	3	3	-	-	3
3	1	-	-	2	3	1	-	2	2	3	-	**2.13**	3	3	-	-	3
3	3	2	-	1	-	-	1	-	2	-	3	**2.14**	3	3	-	-	3
3	**2.33**	**2**	**2**	**1.6**	**3**	**1.5**	**1**	**2.5**	**1.6**	**3**	**3**	**2.18**	**3**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**EXACTLY SOLUBLE EIGEN VALUE PROBLEMS**	**15 Hrs**
	Introduction, the simple harmonic oscillator, the Schrödinger equation and energy eigen values, the energy eigen functions, properties of stationary states, the abstract operator method, Coherent states, the angular momentum operators, the eigen value equation for L2, separation of variables, admissibility conditions on solutions, eigen values, the eigen functions, Spherical harmonics, Physical interpretation, Parity. Angular momentum in stationary states of systems with spherical symmetry	
UNIT 2	**THREE DIMENSIONAL SQUARE WELL POTENTIAL:**	**15 Hrs**
	Solutions in interior region, Solutions in the exterior Region and Matching, Theory of Hydrogen atom: Solution of the radial Equation, energy levels, Stationary state wave functions, Discussion of bound states, Other problems	

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	in three dimensions: The anisotropic oscillator, the isotropic oscillator, normal modes of coupled systems of particles.	
UNIT 3	**Representations, Transformations and Symmetries:**	15 Hrs
	Quantum states, state vectors and wave function, The Hilbert space of state vectors, Dirac notation, Dynamical variables and linear operators, Representations, Continuous basis – The Schrödinger representation, Degeneracy, Labeling by commuting observable, change of basis, Unitary transformations, Unitary transformation induced by change of coordinate system: translation, Unitary transformation induced by Rotation of coordinate system, The algebra of Rotation generators, transformation of dynamical variables, Symmetries and conservation laws, the space inversion, time reversal.	

References

1. A Textbook of Quantum Mechanics, P. M. Mathews, K. Venkatesan, Tata McGraw Hill, 2024
   rinciples of Quantum Mechanics, R. Shankar, Springer, 2023
2. Quantum Mechanics: Concepts and Applications, Nouredine Zettili, Wiley, 2023
3. Introduction to Quantum Mechanics, David J. Griffiths and Darrell F. Schroeter, Cambridge University Press, 2024
4. Modern Quantum Mechanics, J. J. Sakurai and Jim Napolitano, Cambridge University Press, 2021
5. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Robert Eisberg and Robert Resnick, Wiley, 2022
6. Quantum Mechanics, G. Aruldhas, PHI Learning, 2022

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-5	BPHY-503- CLASSICAL MECHANICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate a fundamental understanding of classical mechanics, including Newtonian and Lagrangian formulations.

CO2: Explain the principles governing the motion of rigid bodies and apply them to analyze rotational dynamics.

CO3: Understand and describe the basic concepts of transformations and their applications in classical mechanics.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	-	-	-	2	3	-	3	2	1	-	-	**2.33**	3	-	-	3
CO2	3	-	-	1	-	-	2	-	-	-	-	2	**2**	3	-	-	3
CO3	3	3	1	-	1	1	3	-	2	-	-	1	**1.88**	3	-	-	3
PO Avg.	**3**	**3**	**1**	**1**	**1.5**	**2**	**2.5**	**3**	**2**	**1**	**-**	**1.5**	**2.07**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**Lagrangian Formulations**	
	Constraints Generalized coordinates D'Alembert's principle Lagrange's equations Cyclic or ignorable coordinates **Moving Coordinate System** Coordinate systems with relative translation motion Rotating coordinate systems The Coriolis systems Motion on the earth	
UNIT 2	**Motion of a rigid body**	**15 Hrs**
	Introduction, Euler's theorem, Angular momentum and kinetic energy, The inertia tensor, Euler's equations of	

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	motion, Torque free motion, Euler's Angles, Motion of a symmetric top, Nutational motion. 2. Variational principle Introduction, Configuration space, Some techniques of calculus of variation, the delta-notation, Applications of the variational principle.	
UNIT 3	**Lagrange's and Hamiltons equations & Canonical Transformations**	
	1. Lagrange's and Hamiltons equations Hamilton's principle, Equivalence of Lagrange's and Newton's equations, Advantages of the Lagrangian formulation -Electromechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for non-holonomic systems, Applications of the Lagrangian method of undetermined multipliers, Hamilton's equations of motion, some applications of the Hamiltonian formulation, Phase space, Comments on the Hamiltonian formulation. 2. Canonical Transformations Gauge transformation, Canonical transformation, Condition for transformation to be canonical, Illustrations of canonical transformations.	

References

1. Classical Mechanics, R. G. Takwale, P. S. Puranik, McGraw Hill, 2023
2. Classical Mechanics, J. C. Upadhyaya, Himalaya Publishing House, 2023
3. Mechanics, D. S. Mathur, S. Chand Publishing, 2022
4. Mechanics (University Physics Volume 1), Hugh D. Young, Roger A. Freedman, Pearson, 2023
5. Introduction to Mechanics, Mahendra K. Verma, Universities Press, 2021
6. Classical Mechanics, M. G. Venkatesh, Ane Books, 2022
7. Principles of Mechanics, S. P. Taneja, S. Chand Publishing, 2023
8. Classical Mechanics and General Properties of Matter, S. L. Kakani, C. Hemrajani, Viva Books, 2022
9. Concepts of Classical Mechanics, P. S. Raghavan, PHI Learning, 2021
10. University Physics (Volume I – Mechanics), Ronald Lane Reese, Cengage Learning, 2020

Assessment Method

Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-5	BPHY-504P –PHYSICS PRACTICAL	MAJOR

Credit - 5, Teaching Hours - 150

Course Outcome (Co's)

After studying this course, the student will be able to….
CO1: Develop practical skills to construct and analyze the working of amplifier and oscillator circuits.
CO2: Design and implement a regulated power supply circuit using IC 78XX series to understand voltage regulation techniques.
CO3: Perform precise measurements of inductance using a ballistic galvanometer and interpret the experimental results.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	1	1	3	1	-	2	-	-	2	3	-	**2**	2	3	-	2.5
CO2	3	-	2	3	3	3	-	3	-	-	3	-	**2.86**	2	3	-	2.5
CO3	3	-	2	2	-	-	-	2	-	-	1	-	**2**	2	3	-	2.5
PO Avg.	3	1	1.6	2.6	2	3	2	2.5	-	2	2.33	-	**2.29**	2	3	-	2.5

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- Acceleration due to gravity by Kater's pendulum (fixed knife edges).
- Viscosity by Log decrement
- Gonio meter
- Mutual Inductance by Ballistic Galvanometer
- Determination of Curie temperature of ferroelectric ceramic
- Use of Excel for data analysis and graph plotting.
- Heaviside Mutual Inductance Bridge.
- Numerical integration by computer
- Hartley Oscillator. Measurement of frequency by C.R.O. (Transistorized).
- Half adder, Full adder and subtraction using IC 7483.
- Series resonance. To find the band width and Q value of a coil.
- Frequency response of CE amplifier
- Study of voltage regulated circuit using IC7805

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	External Practical Examination

B.Sc. (Physics) Semester-5	DSE-501 BIOSENSORS	ELECTIVE

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Credit - 2, Teaching Hours - 30

Course Outcome (Co's)

CO1: Explain principles, types, and features of thermal, optical, and vacuum sensors.
CO2: Apply biosensing elements to understand biosensor functions and uses.
CO3: Analyze immobilization methods and assess their use in biosensing.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	P O6	PO 7	P O8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PS O1	PS O2	PS O3	Avg.
CO1	3	1	2	3	1	-	2	-	-	2	3	-	**2**	2	3	-	2.5
CO2	3	-	2	3	3	3	-	3	-	-	3	-	**2.86**	2	3	-	2.5
PO Avg.	3	1	2	3	2	3	2	3	-	2	3	-	**2.5**	**2**	**3**	**-**	**2.5**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

Unit-1	**Sensors and Biosensors**	**15 hr**
	What are Sensors / Transducers? Importance of Sensors , Principles of sensor, static characteristics, dynamic characteristics, Characterizations- electrical, mechanical, high temperature **Biosensors:** Introduction, applications of biosensor, generation of biosensors, glucose biosensor, urea biosensor.	
Unit 2	**Immobilization and techniques**	**15 hr**
	Introduction, Enzymes, Examples of Enzyme Biosensors, Tissue Materials, Microorganism, Mitochondria, antibodies, Nucleic Acid, Receptors.	
	Adsorption, Micrencapsulation, Entrapment, Cross linking, Covalent Bonding, Modified electrodes, Examples of applications of different immobilization methods.	

References

1. Sensors and Transducers, D. Patranabis, Prentice Hall India, 2022
2. Biosensors: An Introduction, Brian Eggins, Wiley-VCH, 2008
3. Advances in Biosensors, Anthony P. F. Turner (Ed.), Jai Press, 1993

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4. Instrumental Analysis, Douglas A. Skoog, F. James Holler, Timothy A. Nieman, Cengage Learning, 2020	
Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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Credit - 2, Teaching Hours - 30

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Apply Beer-Lambert's law to interpret UV-Visible absorption data, and analyze the effects of chromophores and auxochromes on absorption spectra.

CO2: Analyze the principles and instrumentation of X-ray spectroscopy techniques, including powder and single crystal diffraction, and evaluate their application in structural analysis.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	-	-	3	1	2	3	2	-	3	3	1	**2.33**	3	-	-	3
CO2	3	-	-	3	-	-	-	2	3	1	-	-	**2.4**	3	-	-	3
PO Avg.	**3**	**-**	**-**	**3**	**1**	**2**	**3**	**2**	**3**	**2**	**3**	**1**	**2.5**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**UV AND IR Spectroscopy**	**15 hr**
	Introduction of instrumental methods and its classification. Introduction to UV – Visible Absorption Spectroscopy, Absorption laws Beer's-Lambert's law, its Principle, Applications and limitations. Types of transitions, Instrumentation, Chromophoric effect, auxochromic effect, Bathochromic effect and Hypsochromic effect. **IR Spectroscopy:** Introduction, Principle, theory, instrumentation, applications and limitations of- Infrared (IR)	
UNIT 2	**X-ray Spectroscopy**	**15 Hrs**
	Origin of X-ray, Production of X-rays, Mono chromator, detectors Instrumentation, diffraction, powder diffraction, single crystal diffractometer	

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References:

1. Spectroscopy, Gurdeep R. Chatwal, Himalaya Publishing House, 2022
2. Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Cengage Learning, 2022
3. Introduction to Spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, Cengage Learning, 2023
4. Modern Spectroscopy, J. Michael Hollas, Wiley, 2022
5. Analytical Instrumentation, Bela G. Liptak, CRC Press, 2021
6. Spectroscopy and Instrumentation in Analytical Chemistry, David Kealey, P. J. Haines, Garland Science, 2020
7. UV-VIS and IR Spectroscopy: Analytical Techniques, Heinz-Wolfgang Hübschmann, Wiley-VCH, 2022

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

B.Sc. (Physics) Semester-5	**DSE-503 STATISTICS**	**ELECTIVE**

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Po's Aligned PO-1, 3, 6,7 & 10	Credit - 2, Teaching Hours - 30

Course Outcome (Co's)

After studying this course, the student will be able to….
CO1: Apply measures like mean, median, mode, and standard deviation to interpret biological data.
CO2: Analyze binomial, Poisson, and normal distributions to solve problems.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	3	2	-	-	1	-	-	2	1	1	2	**1.88**	3	-	-	3
CO2	3	-	1	2	1	-	-	2	-	-	1	3	**1.86**	3	-	-	3
PO Avg.	**3**	**3**	**1.5**	**2**	**1**	**1**	**-**	**2**	**2**	**1**	**1**	**2.5**	**2**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**Representation of Data** Definition and scope of biostatistics, Measures of central tendency (definition), characteristics of ideal measure of central tendency, Mean, mode and median for both ungrouped and grouped data (for discrete and continuous frequency distribution), Empirical relationship among mean, mode and median, Merits, demerits and uses of mean, mode and median, Graphic location of median and mode, Selection of appropriate measure of central tendency, Measures of dispersion- definition, Need of measures of dispersion, Mean deviation and standard deviation	**15 hr**

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UNIT 2	**Probability and Standard Probability distributions** Random experiment, Definition of probability, Elementary properties of probability, mutually exclusive events, Dependant and independent events, Addition rule and multiplication rule for probability (without proof), Conditional probability, Bayes's theorem, Random variable, Discrete and continuous random variables, Probability distributions, Bernoulli trials, Binomial and Poisson distributions and their properties, Mean and variance of these distributions, Recurrence relations for probabilities related to binomial distribution and Poisson distributions, Normal distribution and its properties, standard normal variable, Fitting of binomial, Poisson and normal distributions.	**15 hr**

References:

1. Fundamentals of Mathematical Statistics, S. C. Gupta, V. K. Kapoor, Sultan Chand & Sons, 2023
2. Introduction to the Practice of Statistics, David S. Moore, George P. McCabe, Bruce A. Craig, W. H. Freeman, 2023
3. Statistics, Robert S. Witte, John S. Witte, Wiley, 2022
4. Basic Statistics, B. L. Agarwal, New Age International Publishers, 2023
5. Biostatistics, B. K. Mahajan, Jaypee Brothers Medical Publishers, 2023
6. An Introduction to Biostatistics, P. S. S. Sundar Rao, J. Richard, PHI Learning, 2022
7. Statistics: Theory, Methods and Applications, D. C. Sancheti, V. K. Kapoor, Sultan Chand, 2021

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-6	BPHY-601 -NUCLEAR PHYSICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate a fundamental understanding of nuclear physics, including nuclear structure, stability, and radioactivity.

CO2: Explain the basic theoretical concepts related to elementary particles and their interactions.

CO3: Understand the principles of nuclear energy production and its applications in power generation and technology.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	1	2	1	3	-	2	2	1	-	2	-	**1.89**	3	-	-	3
CO2	3	1	2	2	2	1	2	2	1	-	3	2	**1.91**	3	-	-	3
CO3	3	3	1	3	2	3	3	-	-	-	3	-	**2.63**	3	-	-	3
PO Avg.	**3**	**1.6**	**1.6**	**2**	**2.33**	**2**	**2.3**	**2**	**1**	**-**	**2.67**	**2**	**2.14**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**Constituents of Nucleus**	
	Introduction, Rutherford Scattering and estimation of the nuclear size, Measurement of nuclear radius, Constituents of the nucleus and their properties, Nuclear spin, moments and statistics. 2. **Alpha Rays** Range of alpha particles, Disintegration energy of the spontaneous alpha decay, Alpha decay paradox - barrier penetration.	
UNIT 2	**Beta Rays & Gamma Rays**	
	1. **Beta Rays** Introduction, Continuous Beta ray spectrum - difficulties encountered to understand it, Pauli's Neutrino Hypothesis, Fermi's theory of Beta decay, the detection of	

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	neutrino, Parity non-conservation in Beta decay. 2. **Gamma Rays** Introduction, Gamma ray emission- selection rules, Internal conversion, Nuclear Isomerism	
UNIT 3	**The liquid drop model of the nucleus**	15 Hrs
	1. **The liquid drop model of the nucleus** Introduction, Binding energies of nuclei : plot of B/A against A., Weizsacher's semi empirical mass formula Nucleon emission. 2. **Nuclear Energy** Introduction, Neutron induced fission, Asymmetrical fission- Mass Yield, Emission of delayed neutrons by fission fragments, Energy released in the fission of 235U, Fission on lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor, Nuclear reactors.	

References

1. Nuclear Physics: An Introduction, S. B. Patel, New Age International, 2023
2. Introduction to Nuclear Physics, H. A. Enge, Addison-Wesley, 2020
3. Nuclear Physics, D. C. Tayal, Himalaya Publishing House, 2022

Assessment Method

Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-6	BPHY-601P –PHYSICS PRACTICAL	MAJOR
Credit - 2, Teaching Hours - 60		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate the ability to compare the relative intensities of different radioactive sources using a Geiger-Müller (G.M.) tube.

CO2: Explain the working principles of various radiation counters used in the detection of nuclear particles.

CO3: Understand and interpret the simulation of nuclear decay processes using appropriate software tools.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	2	2	3	2	-	2	2	-	2	-	-	-	**2.14**	2	3	-	2.5
CO2	2	3	3	3	1	2	-	3	-	2	-	3	**2.44**	2	3	-	2.5
CO3	2	-	3	1	1	2	-	-	2	-	2	-	**1.86**	2	3	-	2.5
PO Avg.	**2**	**2.5**	**3**	**2**	**1**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2.15**	2	3	-	2.5

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- Nuclear Decay (Simulation)
- Determination of dead time of G.M. tube.
- Comparison of relative intensities of different sources using G.M. Tube.
- Determination of Operating Voltage for Scintillation Detector
- Activity measurement of Gamma – Source (relative method) Using Scintillation Detector

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	Term End Practical examination

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B.Sc. (Physics) Semester-6	BPHY-602 - ELECTRONICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Explain the fundamental concepts of feedback in amplifiers and analyze its impact on gain, bandwidth, and stability.

CO2: Demonstrate an understanding of the basic principles and applications of operational amplifiers in analog circuits.

CO3: Describe the construction, operation, and characteristics of field-effect transistors (FETs) and assess their role in electronic circuit design.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	1	3	1	-	2	-	-	2	1	-	-	1.86	3	-	-	3
CO2	2	2	3	1	3	-	-	-	-	-	2	2	2.14	3	-	-	3
CO3	1	-	3	-	-	-	2	2	2	-	3	-	2.17	3	-	-	3
PO Avg.	2	1.5	3	1	3	2	2	2	2	1	2.5	2	2.06	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**FEEDBACK**	15 Hrs
	1. **Negative Feedback in transistor amplifier:** General theory of feedback, reasons for negative feedback, loopHaapy Birthdayaapy Birthdaygain, types of negative feedback in transistor circuits. 2. **Transistor Oscillators** Introduction, Effect of positive feedback, requirements for oscillations, the phase shift oscillator, Wien bridge oscillator, Resonant circuit oscillators (Colpit and Hearley oscillators), the maximum frequency of oscillation of a transistor.	
UNIT 2	**FET AND OPAMP**	15 Hrs
	1. Field effect transistor amplifier Introduction, Advantages and disadvantages of the FET, Basic construction of the JFET (Revision), Characteristics curve of the JFET, Principle of operation of the JFET, Effect of the VDS on channel conductivity, Channel ohmic region and	

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	pinch off region, Characteristics parameters of the FET(Revision), Common source AC amplifier **2. Operational Amplifier** Introduction, The operational amplifier, the inverting differential operational amplifier, the non-inverting differential operational amplifier, the differential amplifier, General purpose IC operational amplifier, Applications of operational amplifier.	
UNIT 3	**REGULATED POWER SUPPLY AND CRO**	15 Hrs
	1. Regulated Power Supply: Introduction, stabilization, limitations of Zener diode regulator, Transistor series voltage regulator, transistor shunt voltage regulator, a series regular with two transistors, current regulator 2. Electronic Instruments: Cathode ray oscilloscope: CRO, CRT, electrongun, deflecting plates, screen, methods of focusing, deflection systems, mathematical expression for electrostatic deflection sensitivity, electromagnetic deflection system, magnetic deflection in CRT, Time base (without circuits), CRO Parts, operation of a typical oscilloscope control, uses of CRO.	

References:

1. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky, Pearson, 2023
2. Principles of Electronics, V. K. Mehta, Rohit Mehta, S. Chand Publishing, 2023
3. Basic Electronics: Devices, Circuits and IT Fundamentals, B. L. Theraja, S. Chand Publishing, 2022
4. Electronic Principles, Albert Malvino, David Bates, McGraw Hill Education, 2023
5. Operational Amplifiers and Linear Integrated Circuits, Ramakant A. Gayakwad, Pearson, 2022
6. Electronic Devices and Circuits, David A. Bell, Oxford University Press, 2022
7. Fundamentals of Electronics, J. Millman, C. C. Halkias, Tata McGraw Hill, 2023
8. Modern Digital Electronics, R. P. Jain, McGraw Hill Education, 2022
9. A Textbook of Applied Electronics, R. S. Sedha, S. Chand Publishing, 2023
10. Electronic Instrumentation and Measurements, David A. Bell, Oxford University Press, 2023
11. Electronic Devices and Circuits: An Introduction, Allen Mottershead, Prentice-Hall India, 2022

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-6	BPHY-602P –PHYSICS PRACTICAL	MAJOR
Credit - 2, Teaching Hours - 60		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Develop practical skills to analyze the characteristics and applications of field-effect transistors (FETs) and oscillator circuits.

CO2: Gain hands-on experience in performing numerical differentiation using computer-based tools for data analysis.

CO3: Apply operational amplifier (OPAMP 741) in various analog circuit applications and evaluate their performance through experimentation.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	2	-	3	2	-	2	2	-	1	-	2	3	**2.13**	2	3	-	2.5
CO2	2	2	3	-	1	-	2	-	2	2	-	2	**2**	2	3	-	2.5
CO3	2	-	3	2	2	1	2	-	2	-	-	2	**2**	2	3	-	2.5
PO Avg.	**2**	**2**	**3**	**2**	**1.5**	**1.5**	**2**	**-**	**1.6**	**2**	**2**	**2.33**	**2.04**	2	3	-	2.5

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- Hands on training

Experiments

- Negative feedback
- Colpit oscillators
- FET characteristics
- Frequency response of a common source FET amplifier.
- Study of Hysterisis using C.R.O.
- Zener diode as voltage regulator
- Regulated power supply
- A.C. Circuit analysis by C.R.O. Measurement of frequency and phase difference
- IC-741 OPAMP
- Numerical differentiation by computer

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	Term End Practical examination

B.Sc. (Physics) Semester-6	BPHY-603 - MATHEMATICAL PHYSICS	MAJOR

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Credit - 3, Teaching Hours - 45

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate fundamental understanding of mathematical physics concepts used to describe physical systems and solve scientific problems.

CO2: Explain the basic principles of numerical techniques and apply them to solve differential equations relevant to physical phenomena.

CO3: Understand and apply essential mathematical tools and methods to analyze and interpret physical problems across various domains.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	2	2	1	3	2	2	-	2	2	2	-	**2.1**	3	-	-	3
CO2	3	-	1	2	-	-	-	-	-	2	-	-	**2**	3	-	3	3
CO3	3	2	2	1	2	2	-	-	2	2	-	2	**2**	3	-	3	3
PO Avg.	**3**	**2**	**1.6**	**1.3**	**2.5**	**2**	**2**	**-**	**2**	**2**	**2**	**2**	**2.03**	**3**	**-**	**-**	**3**

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**Numerical Techniques & Differential equations**	15 Hrs
	1. Numerical Techniques: Curve Fitting: Introduction, Least squares method, Fitting a straight line, Fitting a Parabola, Fitting a Curve of the form y=axb, Fitting an exponential curve. Integration: Integration by Trapezoidal Rule, Simpson's (1/3) rule, Eigen value and its problems. **2. Differential equations** Some partial differential equations in physics, the method of Separation of variables, separation of Helmboltz equation in Cartesian coordinates, in spherical polar and cylindrical Coordinates, Laplace's equation in various coordinates, Choice of coordinate system and separability of a partial differential equation, Parabolic coordinates system, Prolate Spheroidal coordinates system, various examples based on the	

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	separation of variables.	
UNIT 2	**2nd Order Differential Equations**	15 Hrs
	Ordinary and Singular points, Series solution around an ordinary point, Series solution around a regular singular point: the method of Frobenius, Getting a second solution, Alternative method of getting the second solution, System of linear first order differential equations, Non-linear differential equations, related examples.	
UNIT 3	**Some special functions in Physics**	15 Hrs
	Bessel functions, Bessel functions of the second kind, Henkel functions, Spherical Bessel functions, Legendre polynomials, Associated Legendre polynomials and spherical harmonics, Hermite polynomials, Laguerre polynomials, The gamma function, the Dirac delta function, examples.	

References:

1. Mathematical Methods for Physicists, George B. Arfken, Hans J. Weber, Frank E. Harris, Academic Press, 2023
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley, 2023
3. A Textbook of Mathematical Physics, H. K. Dass, S. Chand Publishing, 2023
4. Mathematical Physics, B. D. Gupta, Vikas Publishing House, 2022
5. Mathematical Methods in the Physical Sciences, Mary L. Boas, Wiley, 2023
6. Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson, S. J. Bence, Cambridge University Press, 2022
7. Differential Equations and Their Applications, M. Braun, Springer, 2021
8. Numerical Methods for Engineers, Steven C. Chapra, Raymond P. Canale, McGraw Hill Education, 2023
9. Special Functions for Scientists and Engineers, W. W. Bell, Courier Dover Publications, 2021
10. Special Functions and Their Applications, N. N. Lebedev, Dover Publications, 2022

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-6	BPHY-603P –PHYSICS PRACTICAL	MAJOR
Credit - 2, Teaching Hours - 60		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate fundamental skills in using computers to perform physics-based practical experiments and simulations.

CO2: Apply error analysis techniques to experimental data and interpret the significance of uncertainties in measurement.

CO3: Utilize Microsoft Excel for effective data organization, analysis, and graphical representation in scientific investigations.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	2	3	3	2	-	2	1	3	2	-	1	-	**2.11**	3	-	-	3
CO2	2	-	3	1	-	2	-	-	-	3	-	-	**2.2**	3	-	3	3
CO3	2	-	3	2	3	1	-	2	3	2	-	2	**2.22**	3	-	3	3
PO Avg.	2	3	3	1.6	3	1.6	1	2.5	2.5	2.5	1	2	**2.18**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- Numerical differentiation by computer
- Analysis of error
- Curve Fitting by Least squares method, Fitting a straight line, Fitting a Parabola
- Curve Fitting by Fitting a straight line and Fitting a Parabola
- Special functions Bessel functions of the second kind
- Legendre polynomials,
- Associated Legendre polynomials
- spherical harmonics
- Use of Excel for data analysis.

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	Term End Practical examination

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B.Sc. (Physics) Semester-6	BPHY-604 - SOLID STATE PHYSICS	MAJOR
Credit - 3, Teaching Hours - 45		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate fundamental knowledge of solid state physics, including crystal structure, bonding, and electronic properties of solids.

CO2: Explain the basic concepts and theoretical foundations of dielectric materials and superconductivity.

CO3: Describe the properties, types, and applications of superconductors in modern physics and technology.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	3	-	2	-	2	2	1	-	2	3	3	-	**2.25**	3	-	-	3
CO2	3	2	1	-	-	2	3	-	2	2	2	2	**2.11**	3	-	-	3
CO3	3	2	3	2	-	2	-	-	1	-	2	-	**2.14**	3	-	-	3
PO Avg.	3	2	2	2	2	2	2	-	1.6	2.5	2.33	2	**2.17**	3	-	-	3

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Direct Teaching using Black board,
- Presentations,
- Multimedia resources,
- Diagrams and Layouts,
- Group discussion and activity,
- experimentation,
- hands on training

UNIT 1	**Free Electron Fermi Gas**	15 Hrs
	Introduction, Energy levels in one dimension, Effect of temperature on the Fermi-Dirac distribution, Free electron gas in three dimensions and density of states, Heat capacity of the electron gas and experimental heat capacity of metals, Electrical conductivity and ohm's law, Experimental electrical resistivity of metals, Thermal conductivity of metals, ratio of thermal to electrical conductivity.	
UNIT 2	**Theory of Dielectrics**	15 Hrs
	Polarization, Dielectric constant, Local Electric field, Dielectric polarizability, Sources of polarizability, theory of electric polarizability and optical absorption, ionic polarization, polarization from dipole orientation, dielectric losses,	

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	Applications to optical phonon modes in ionic crystals, the longitudinal optical mode, the transverse optical mode, the interaction of electromagnetic waves with optical modes, application to the motion of electrons in polar crystals.	
UNIT 3	**Super conductivity**	15 Hrs
	Experimental Survey, Occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, Heat capacity, energy gap, Microwaves and infrared properties, Isotope effect, Theoretical Survey, London equation, BCS theory of superconductivity, Flux quantization in a superconducting ring, Type –I & Type -II superconductors.	

References:

1. Solid State Physics, S. O. Pillai, New Age International Publishers, 2023
2. Introduction to Solid State Physics, Charles Kittel, Wiley, 2024
3. Solid State Physics: Structure and Properties of Materials, M. A. Wahab, Narosa Publishing House, 2023
4. Solid State Physics, Ashcroft and Mermin, Cengage Learning, 2023
5. Elements of Solid State Physics, J. P. Srivastava, PHI Learning, 2022
6. Fundamentals of Solid State Physics, B. S. Saxena, R. C. Gupta, C. P. Saxena, Pragati Prakashan, 2022
7. Solid State Physics and Electronics, R. K. Puri, V. K. Babbar, S. Chand Publishing, 2023

Assessment Method	
Internal/Online Assessment (40%)	1. Written test (20 Marks) 2. Quiz / Group Discussion (10 Marks) 3. Assignments / Seminar (10 Marks)
External Assessment (60%)	Term End Theory examination (Written test 60 Marks)

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B.Sc. (Physics) Semester-6	BPHY-604P –PHYSICS PRACTICAL	MAJOR
Credit - 2, Teaching Hours - 60		

Course Outcome (Co's)

After studying this course, the student will be able to….

CO1: Demonstrate an understanding of how magnetic fields influence the electrical resistivity of metals through experimental observation.

CO2: Develop practical skills to investigate dielectric polarization in materials and interpret experimental results.

CO3: Analyze the effect of temperature on the resistivity of metals and compare findings with theoretical predictions.

CO-PO-PSO mapping

COs	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	CO Avg.	PSO 1	PS O2	PS O3	Avg.
CO1	2	-	3	3	-	2	-	2	-	2	1	-	**2.14**	2	3	-	2.5
CO2	2	2	3	-	2	2	-	2	-	2	-	-	**2.14**	2	3	-	2.5
CO3	2	1	3	2	2	-	2	-	-	3	-	2	**2.13**	2	3	-	2.5
PO Avg.	**2**	**1.5**	**3**	**2.5**	**2**	**2**	**2**	**2**	**-**	**2.3**	**1**	**2**	**2.14**	2	3	-	2.5

(1-weak correlation; 2-medium correlation; 3-strong correlation)

Teaching Pedagogy

- Constructivism
- Social Constructivism
- Behaviorism

Teaching Methods and Tools

- Experimentation
- hands on training

Experiments

- Effect of temperature on resistivity of metal
- Determination of Dielectric constant
- Hall effect
- Effect of magnetic field on resistivity of metal
- To study dielectric polarization
- Fresnel's Biprism
- To analyse elliptically polarized light using Babinate compensator.

Assessment Method

Internal/Online Assessment (40%)	Internal Practical Examination
External Assessment (60%)	Term End Practical examination