Veer Narmad South Gujarat University, Surat

Syllabus

B. Sc. Physics (Semester –V&VI)

MAJOR, MINOR & SEC Courses
As per NEP- 2020

Effective from Academic Year: 2025-2026

POs for All UG Science Programs

PO-01: Scientific Knowledge & Conceptual Understanding: Develop a strong foundation in scientific principles, theories and concepts across disciplines, fostering interdisciplinary learning, advance knowledge and problem-solving abilities.

PO-02: Analytical & Critical Thinking: Apply critical thinking and analytical reasoning to evaluate scientific data, hypotheses and real-world problems, leading to evidence-based conclusions.

PO-03: Research & Inquiry-based Learning: Develop investigative skills through experimentation, data analysis and scientific inquiry to contribute to research and innovation.

PO-04: Laboratory & Technical Skills: Gain hands-on experience with laboratory techniques, instrumentation and computational tools relevant to scientific research and industry applications.

PO-05: Digital & Computational Literacy: Utilize digital tools, computational techniques and emerging technologies such as AI, bioinformatics and statistical modelling to enhance scientific learning and problem-solving.

PO-06: Environmental & Societal Responsibility: Understand the role of science in addressing environmental, health and societal challenges, promoting sustainability and ethical responsibility.

PO-07: Effective Communication & Collaboration: Develop proficiency in scientific communication, both written and oral, for effective dissemination of knowledge while collaborating in multidisciplinary teams.

PO-08: Innovation & Entrepreneurship: Foster an entrepreneurial mind-set by applying scientific knowledge for innovation, technology development, and industry-oriented applications. Develop sustainable solutions to address real-world challenges in research and environmental management.

PO-09: Lifelong Learning & Professional Growth: Cultivate curiosity and adaptability for continuous learning, equipping students for higher education, research, and professional careers.

PO-10: Ethical Leadership & Value-based Education: Develop leadership qualities, ethical values, and a sense of responsibility in applying science for societal progress, aligning with Indian knowledge systems and global perspectives.

Program Specific Outcomes (PSOs)

Physics is the core of natural sciences. It explains how the universe works. In general a B.Sc. (Physics) program holds great importance both academically and professionally. It aims to develop analytical thinking, mathematical skills and problem solving abilities.
The program of B.Sc**. Physics** that includes theory and practical courses has been designed keeping in focus the below mentioned Program Specific Outcomes (PSOs):

PSO1. **Understanding Core Concepts of Physics:**

Students shall be able to inculcate in-depth knowledge of core areas of Physics such as classical mechanics, quantum mechanics, electromagnetism, statistical physics, optics, and thermodynamics through theory and practical courses.

PSO2. **Analytical and Problem-Solving Skills:**

Apply the concepts of physics to analyze physical systems, solve problems, and interpret experimental data.

PSO3. **Experimental and Laboratory Skills:**

Develop the ability to design and conduct physics-based experiments, use scientific instruments, record precise measurements, and analyze results to draw valid conclusion

PSO4.**Computational Proficiency:**

Use programming languages and computational tools (such as Python, C+, to model and solve physical problems.

PSO5. **Multidisciplinary Skill:**

Integrate knowledge from physics with related disciplines like mathematics, chemistry, environmental science, and emerging fields like nanotechnology and materials science.

PSO6.Ethics, Sustainability, and Societal Relevance:

Understand the ethical dimensions and environmental implications of scientific developments and apply physics knowledge for benefit of the society.

PSO7. **Career Readiness:**

Build the foundation for higher studies (M.Sc., integrated Ph.D., etc.), competitive exams like JAM, NET, GATE, TIFR and BARCor employment in education, industry, or scientific organizations such as ISRO, DRDO, BARC, CSIR etc.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. PHYSICSMAJOR

Course Structure of Semester V for major courses

SEMESTER – V							
Course Code	**Title of The Course**	**Course Credit**	**Hrs. Per Week**	**Internal Marks (CCE)**	**External Marks (SEE)**	**Duration of Exam (Hr.)**	**Total Marks**
PH-MJ-501- TH	Contribution of Indian Physicists and Magnetic Field in Matter	02	02	25	25	01	50
PH-MJ-501- PR	Practicals based on Contribution of Indian Physicists and Magnetic Field in Matter	02	04	25	25	04	50
PH-MJ-502 -TH	Classical & Statistical Mechanics	02	02	25	25	01	50
PH-MJ-502 -PR	Practicals based on Classical & Statistical Mechanics	02	04	25	25	04	50
PH-MJ-503 -TH	Mathematical Methods and Quantum Theory	02	02	25	25	01	50
PH-MJ-503 -PR	Practicals based on Mathematical Methods and Quantum Theory	02	04	25	25	04	50
	Total	**12**	**18**	**150**	**150**		**300**

SEMESTER V

PH-MJ-501-TH (Contribution of Indian Physicists and Magnetic Field in Matter)

Semester: V	
Course Code	PH-MJ-501-TH
Course Title	Contributions of Indian Physicists and Magnetic Field in Matter
Course Type	Major
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1: Understand contribution of great Indian physicists and their historical work. CO2: Understand the magnetic properties of materials and classify them as diamagnetic, paramagnetic, or ferromagnetic, analyze behavior of magnetic dipoles in external magnetic fields. CO3: Explain the origin and effects of bound currents and magnetization,apply Ampere's Law in the presence of magnetized materials, CO4: Distinguish between linear and non-linear magnetic media and explain magnetic susceptibility and permeability.
Mapping between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO:1							
CO :2-4							

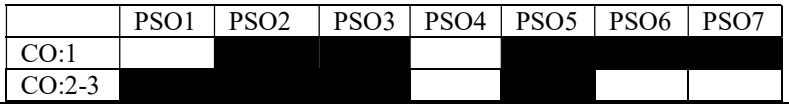
Course Content:

Unit No.	Content	Teaching Hours
		15
Unit-1	**Contribution of Indian physicists:** Raman's work on various musical instruments, Chandrasekhar's work on magneto hydrodynamic, Chandrasekha Limit. J.C.Bose's work on electromagnetic waves. N.S.Satya Murthy's Work on Superconducting Magnets. Homi Bhabha'S Work Megnath Saha's Contribution S.N Bose' contribution. **Text books:** 1. Raman and his effect by G. Venkataraman, University press. 2. Chandrasekhar and his limit by G. Venkataraman, University press Reference: Internet Archives on relevant topics.	
Unit-2	**Magnetic Field in Matter:** **1 Magnetization:** Diamagnets, Paramagnets, Ferromagnets (1.1), Torques and Forces on Magnetic Dipoles (1.2),Effect of magnetic field on Atomic orbits (1.3), Magnetization (1.4)	

	2 The field of a magnetized object: Bound Currents (2.1), Physical interpretation of Bound Currents (2.2), The Magnetic Field Inside Matter (2.3). **3 The Auxiliary Field H:** Ampere's Law in Magnetized Materials (3.1), A deceptive parallel (3.2). **4 Linear and Non-linear media:** Magnetic Susceptibility and Permeability (4.1), Ferro-magnetism (4.2). **Text book:** Introduction to Electrodynamics by David J. Griffiths, 4th Ed., Pearson India Education	

SEMESTER V

PH-MJ-501-PR: Practicals based on Contribution of Indian Physicists and Magnetic Field in Matter

Semester: V	
Course Code	PH-MJ-501-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practical Based on Contributions of Indian Physicists and Magnetic Fields in Matter
Course Outcome	At the end of the course, the students will be able to **CO-1:** In depth knowledge about Indian scientists contribution in particular field through project. **CO2:** Conduct experiments to measure magnetic fields **CO3:**analyze magnetic fields and material properties.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO:1							
CO:2-3							

Course Content

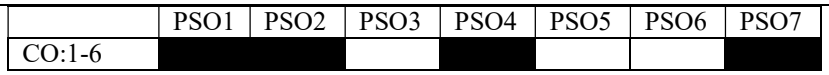
Sr. No.	Practical
1	To study the magnetic field due to solenoid.
2	To determine the temperature of resistance of platinum wire using Carey-Foster's bridge.
3	To determine the magnetic susceptibility of a liquid using Quincke's method.
4	To study hysteresis curve of a ferromagnetic material.
5	To determine self inductance of a coil using B.G.
6	To determine mutual inductance of pair of coils using B.G
7	Determination of earth's magnetic field components.
8	Study of Hysteresis curve.
9	Survey and report write up on Indian scientists' contribution in the field of Physics.(Equivalent to four experiments)
10	Project work. (Equivalent to four experiments)

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiment and Viva voce on survey report /project work. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

PH-MJ-502-TH: - Classical & Statistical Mechanics

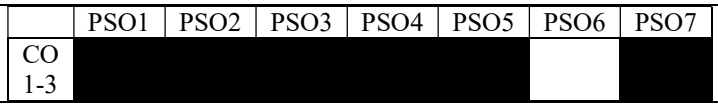
Semester: V	
Course Code	PH-MJ-502-TH
Course Title	Classical & Statistical Mechanics
Course Type	Major
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1: apply the concept of center of mass and mechanics of system of particles, linear

	and angular momentum. CO2: solve problems of dynamics; demonstrate an intermediate knowledge of central-force motion and the concept of converting two body problems to single body problem and apply advanced methods to complex central-force motion problems. CO3: explain equation of orbit; explain Kepler's three laws of planetary motion and apply Kepler's laws to calculate characteristics of orbits. CO4:deduce Lagrange's equation using different methods; correlate Hamilton's principle, D' Alembert's principle and Newton's laws of motion; understand conservation theorems, symmetry properties, Cyclic or ignorable coordinates; CO5: understand outline phase space and quantum state;, learn the significance of the state of the systemand distinguish between macro states and microstates. CO6: study types of ensembles; learn entropy and probability; obtain some deductions from Maxwell-Boltzmann statistics.
Mapping between COs and PSOs	

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Classical Mechanics:**	**15**
	Motion in a Central force Field: Introduction, Equivalent one body problem (5.1), Motion in a central force field (5.2), General features of the motion (5.3), Motion in an inverse square law force field (5.4), Kepler's laws of planetary motion (5.6). **Lagrangian Formulation:** Introduction, Constraints, Holonomic and Non-Holonomic constraints, Scleronomous and Rheonomous constrains (8.1), Generalized Coordinates (8.2), D' Alembert's Principle (8.3), Lagrange's Equations (8.4), Importance of Lagrangian formulation, A general expression for Kinetic energy (8.5), Symmetries and laws of conservation (8.6). **Text book:** Introduction to classical Mechanics by R. G. Takwale and P. S. Puranik, McGraw Hill Edu. (India) Pvt. Ltd. 2017.	
Unit-2	**Statistical Mechanics:**	
1.3	**Basic concept of statistical Mechanics:** Bridging microscopic and macroscopic behavior (12.2), phase space and quantum states (12.3), macro state and micro state (12.5), probability calculation (12.6), types of ensemble (12.7), entropy and probability (12.8), classical and quantum statistics (12.9), distribution functions (12.9.1), calculation of Ω (for MB, BE, FD) distribution functions for (MB, BE, FD). **Maxwell-Boltzmann Statistics**: The partition function for an ideal monoatomic gas (13.3, 13.3.1, 13.3.2), mixing of two different ideal gases, Gibb's paradox. **Text book:** Thermal physics by S. C. Garge, Bansal, Ghosh McGraw Hill publication.	

PH-MJ-502-PR: Practicals based on Classical & Statistical Mechanics

Semester: V	
Course Code	PH-MJ-502-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practicals Based on Classical and Statistical mechanics
Course Outcome	At the end of the course, the students will be able to CO1: Use computational tools (e.g., Excel) to visualize statistical and thermodynamic phenomena. CO2: Conduct classical mechanics experiments to verify theoretical principles. CO3: Apply statistical models to real-life thermal systems and validate with data plotting.
Mapping between Cos and PSOs	

Course Content

1. Use Microsoft Excel for solving the problems:
   Plot the probability of various macrostates in coin-tossing experiment (two level system) versus number of heads with 4, 8, 16 coins etc.

2. Use Microsoft Excel for solving the problems:
   Plot the Maxwell speed distribution function at different temperatures in a 3-dimensionsystem. Calculate the average speed, root mean square and most probable speed

3 Use Microsoft Excel for solving the problems:
Plot the Maxwell speed distribution function at different temperatures in a 3-dimensionsystem. Calculate the average speed, root mean square and most probable speed

4 Use Microsoft Excel for solving the problems:
Plot Specific Heat of Solids with respect to temperature.
   a) Dulong-Petit law
   b) Einstein distribution function
   c) Debye distribution function

5 Use Microsoft Excel for solving the problems of the following functions with energy at different temperatures
   a) Maxwell-Boltzmann distribution
   b) Fermi-Dirac distribution
   c) Bose-Einstein distribution

6 Use Microsoft Excel for solving the problems
Plot Planck's law of Black body radiation w.r.t. wavelength/frequency at different

temperatures. Compare it with Rayleigh-Jeans Law and Wien's distribution law for a given temperature.

7 To determine young's modulus by Koenig's method.
8 To determine gravitational acceleration by Kater's pendulum.
9 To determine angle of contact and surface tension of mercury by Quincke's method.
10 To determine thermal conducting of Rubber Tubing.
11 To study Resonance Pendulum.
12 To determine the spring constant for the oscillation of mass in the case of series combination of two springs.
13 To determine young's modulus by the method of vibration.
14 To verify Newton's law of cooling.
15 To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
16 To determine Stefan's Constant.

Instructions:

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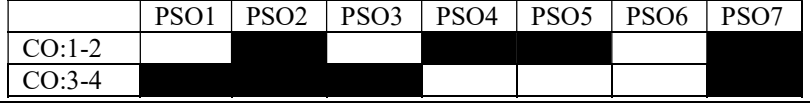
6.

PH-MJ-503-TH: Mathematical Methods and Quantum Theory

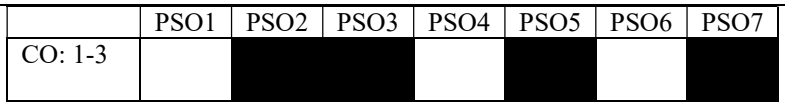
Semester: V	
Course Code	PH-MJ-503-TH
Course Title	**Mathematical Methods and Quantum Theory**
Course Type	Major
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1: Solve first-order and second-order ordinary and partial differential equations using various methods. CO2: Apply Frobenius (Series Solution) method for solving differential equations. CO3: Derive and solve the Schrödinger equation for the hydrogen atom, Interpret quantum numbers and predict atomic spectral features. CO4: Understand Zeeman effect and electron spin interactions, Concept of symmetric/anti symmetric wave functions.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO:1-2							
CO:3-4							

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Mathematical Methods :**	15
	Differential equations: Partial differential equations (9.1); First order Differential Equations (9.2); Separation of Variables (9.3); Singular Points (9.4); Series solutions – Frobenius Method (9.5). **Text Book:**Mathematical Method for Physicists by Arfken and Weber, Academic Press, 6th Ed	
Unit-2	**Quantum Theory**:	15
	Schrodinger's equation for the Hydrogen Atom (6.1), Separation of variables (6.2), Quantum numbers (6.3), Principal Quantum Numbers (6.4), Orbital Quantum Numbers (6.5), Magnetic Quantum Numbers (6.6), Electron Probability Density (6.7), Radiative transitions (6.8), Selection rules (6.9), Zeeman effect (6.10). Text Book:Introduction to Modern Physics by Arthur Beiser , 5th Ed., McGraw-Hill Higher Education.	

PH-MJ-503: PRACTICALS BAES ON MATHMATICAL METHODS AND QUANTUM THEORY

Semester: V	
Course Code	PH-MJ-503-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practicals Based on Mathematical Methods and Quantum Theory
Course Outcome	At the end of the course, the students will be able to CO1: Solve quantum mechanics problems using both analytical and computational techniques. CO2: Perform experiments to validate concepts of atomic physics and wave mechanics. CO3: Use programming (C language) to model and simulate quantum systems.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO: 1-3							

Course Content:

Sr. No.	Practical
1	To study Rutherford scattering experiment using "C" programming.
2	To study trajectory of an electron in H_2^+ ion using "C" programming.
3	To determine Rydberg's constant using hydrogen source.
4	To determine absorption coefficient of iodine molecule.
5	To determine temperature of flame.
6	To study oscillations of coupled oscillator in different modes.
7	To determine Planck's constant using photocell.
8	Why is it natural that three quantum numbers are needed to describe an atomic electron (apart from electron spin)?
9	Show that $\Theta_{20}(\theta) = \frac{\sqrt{10}}{4}(3\cos^2\theta - 1)$is a solution of $$\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right) + \left[l(l+1) - \frac{m_l^2}{\sin^2\theta}\right]\Theta = 0$$ and that it is normalized.
10	Show that $R_{10}(r) = \frac{1}{2\sqrt{6}a_o^{3/2}} exp\left(-\frac{r}{2a_o}\right)$is a solution of $$\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right) + \left[\frac{2m}{\hbar^2}\left(\frac{e^2}{4\pi \in_o r} + E\right) - \frac{l(l+1)}{r^2}\right]R = 0$$ and that it is normalized.
11	Verify orthogonality for the azimuthal wave functions $\Phi_{m_l}$of the hydrogen atom by calculating $\int_0^{2\pi}\Phi_{m_l}^*\Phi_{m_{l'}}d\phi$ for $m_l \neq m_{l'}$.
12	The azimuthal wave function for the hydrogen atom is $\Phi(\phi) = Aexp(im_l\phi)$. Show that the value of the normalization constant A is $\frac{1}{\sqrt{2\pi}}$ by integrating $\lvert\Phi\rvert^2$over all angles from 0 to 2π.
13	Compare the angular momentum of a ground-state electron in the Bohr model of the hydrogen atom with its value in the quantum theory.
14	What are the angles between $\vec{L}$ and the z axis for $l = 1$? For $l = 2$?
15	Find the percentage difference between L and the maximum value of L_z for an atomic electron in p, d and f states.

Instructions:

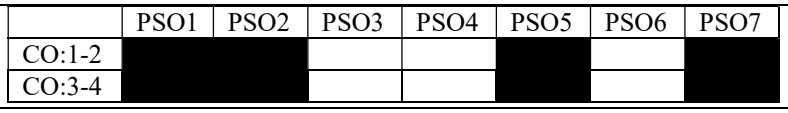
1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform twoexperiments. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. PHYSICS MINOR
Course Structure of Semester V

SEMESTER -V							
Course Code	**Course Title**	**Credit (Theory/ Practical)**	**Teaching duration per Week (in Hr.)**	**External Marks (SEE)**	**Internal Marks (CCE)**	**Exam Time Duration**	**Total (Marks)**
PH-MN-501-TH	**Optics and Electronics**	02	02	25	25	01	50
PH-MN-501-PR	**Practicals based on Optics and Electronics**	02	04	25	25	04	50
PH-MN-502-TH	**Modern Physics**	02	02	25	25	01	50
PH-MN-502-PR	**Practicals based on Modern Physics**	02	04	25	25	04	50

Semester V

PH-MN-501-TH: Optics and Electronics

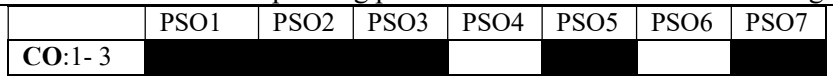
Semester: V	
Course Code	PH-MN-501-TH
Course Title	Optics and Electronics
Course Type	Minor
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1: Describe the interference of light using wave theory., analyze interference patterns using Young's double-slit and Fresnel biprism. CO2: Understand coherence, optical path difference, and conditions for constructive/destructive interference. CO3: Explain thermal instability in transistors and design biasing circuits. CO4: Compare various transistor biasing techniques and their impact on stability.
Mapping between COs and PSOs	

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Optics (Interference):**	**15**
	Introduction (14.1); Light Waves (14.2); Superposition of Waves (14.3); Interference(14.4); Theory of Interference (14.4.1), Intensity Distribution (14.4.2); Superposition of Incoherent Waves (14.4.3); Superposition of Many Coherent Waves (14.4.4);Young's Double slit Experiment – Wave front Division (14.5); Optical Path Difference Between The Waves At P (14.5.1); Bright Fringes (14.5.1); Dark Fringes (14.5.3); Between Neighboring Bright Fringes (14.5.4); Coherence (14.6);Conditions for Interference (14.7); Techniques of Obtaining Interference (14.8);Fresnel Biprism (14.9); Experimental Arrangement (14.9.1); Determination of Wavelength of Light (14.9.2); Interference Fringes with White Light (14.9.3); Lateral Displacement of Fringes (14.9.4); Non-localized Fringes (14.13); Visibility of Fringes(14.14); Fringe Pattern with White Light (14.15). **Text book:** A text book of Optics by Subrahamnyam and Brij Lal, S. Chand & Co., **25 th Revised Ed.**	
Unit-2	**Electronics(Transistor):**	**15**
	Transistor (8.1) Naming the transistor terminals (8.2) Some facts about the transistor(8.3) Transistor action (8.4) Transistor symbols (8.5) Transistor circuit as an Amplifier(8.6) Transistor connections (8.7) Common base connection (8.8) Characteristics of common base connection (8.9) Common emitter connection	

	(8.10) Measurement of leakage current (8.11) Characteristics of Common emitter connection (8.12) Common collector connection (8.13) Comparison of transistor connections (8.14) Commonly used transistor connection (8.15) Transistor as an Amplifier in CE Arrangement (8.16)Transistor Load Line Analysis (8.17) Operating Point (8.18) Practical Way of Drawing CE Circuit (8.19) Output from Transistor Amplifier (8.20) Performance of Transistor Amplifier (8.21) Cut- off and Saturation Points (8.22) Power Rating of Transistor (8.23) **Text Book**: Principles of Electronics by V. K. Mehta and R. Mehta, S. Chand & amp; Co., 11 th Ed.	

PH-MN-501-PR: Practicals based on Optics and Electronics

Semester: VI	
Course Code	PH-MN-501-PR
Credit	02
Teaching Hour/ Week	4 Hours
Subject Title	Practicals based on Optics and Electronics
Course Outcome	At the end of the course, the students will be able to CO1: Perform experiments on interference and determine optical constants (e.g., wavelength, refractive index). CO2: Measure and analyze transistor characteristics in different configurations. CO3: Determine DC operating points and use transistors in switching applications
Mapping between Cos and PSOs	

Course Content

Practical

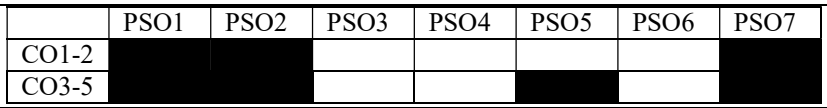
1. To determine the radius of curvature of a given lens using Newton's ring
2. Two determine the wavelength of the monochromatic light using Newton's ring
3. Determine wavelength of laser light using plane diffraction grating
4. To determine the resolving power of a telescope
5. To determine the refractive index of a given liquid using hollow prism
6. To determine separation between plates of a Fabry Perot Etalon.
7. Cardinal points of a lens system by Searle’s Goniometer
8. Determine the wavelength of sodium light with the help of a Fresnel’s biprism.
9. Characteristics of common emitter transistor circuit
10. Characteristics of common base transistor circuit

11. e/k using common emitter transistor
12. e/k using common base transistor
13. Determination of current Gain in common emitter transistor circuit
14. Determination of DC operating point of common emitter transistor circuit
15. Transistor as a switch

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform two experiments and. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

PH-MN-502-TH: - Modern Physics

Semester: VI	
Course Code	PH-MN-502-TH
Subject Title	Modern Physics
Course Type	Minor
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1. Understand the concept of blackbody radiation, photoelectric effect, and wave-particle duality. CO2.Study the structure and behavior of X-rays and their diffraction. CO3 Explain and derive Compton shift and its implications. CO4 Analyze quantum mechanical concepts such as wave function, Schrödinger's equation, and operators. CO5. Apply uncertainty principle to estimate quantum limits of measurements
Mapping between COs and POs	

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Modern Physics I**	**15**
	Black body Radiation (2.2), Photoelectric effect and Einstein's explanation (2.3), What is Light? (2.4) X-Ray (2.5), X-Ray Diffraction (2.6), Compton Effect (2.7), de Broglie Waves (3.1), Waves of What? (3.2), Describing a Wave (3.3), Phase and Group Velocities (3.4), Particle Diffraction (3.5), Particle in a Box (3.6), Uncertainty Principle (3.7). **Text book:** Concepts of Modern Physics by Arthur Beiser, McGraw Hill Publishing Co. Ltd., 6th Ed.	
Unit-1I	**Modern Physics II**	
	Quantum Mechanics (5.1), Wave Equation (5.2), Schrodinger's Equation: Time Dependent Form (5.3), Linearity and Superposition (5.4), Expectation Values (5.5), Operators (5.6), Schrödinger's Equation: Steady-State Form (5.7), Particle in a Box (5.8). **Text book:** Concepts of Modern Physics by Arthur Beiser, McGraw Hill Publishing Co. Ltd., 6th Ed.	

PH-MN-502-PR: Practicals based on modern physics

Semester: VI	
Course Code	PH-MN-502-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practicals Based on Modern Physics
Course Outcome	At the end of the course, the students will be able to CO1:Apply quantum mechanical concepts in numerical and experimental problems. CO2: Use computational tools for wave functions, normalization, and orthogonality. CO3: Perform spectral and diffraction-based experiments..
Mapping between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1-3							

Course Content

Sr. No.	Practical
1	Determination of plank constant using photocell.
2	Characteristics of photocell
3	Study of solar cell
4	Verification of Stefan's fourth power law for black body radiation.
5	Experimental study of photo electric effect.
6	To solve problems based on non relativistic de Broglie formula for wavelength of particle.
7	To solve problems based on relativistic de Broglie formula for wavelength of particle.
8	To find phase and group velocity of de Broglie waves of particles having specific speed/energy.
9	To show that phase velocity of de Broglie waves of a particle of mass m and de Broglie wavelength λ given by $v_p = c\sqrt{1 + \left(\frac{mc\lambda}{h}\right)^2}$
10	Problems based on energy levels of a particle in one dimension box.
11	Problems based on physical interpretation of wave function.
12	Problems based on expectation values and operators.
13	Project work.(equivalent to four experiments)

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiment and there will be a project viva also. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

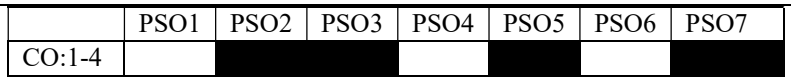
B. Sc. PHYSICS

Skill Enhancement Course Structure of Semester V

SEMESTER V

Course Code	Course Title	Credit (Practical Only)	Teaching duration per Week (Hrs.)	External Marks (SEE)	Internal Marks (CCE)	Exam Time Duration (Hrs.)	Total (Marks)
PH-SEC-501-PR	**C –Programming**	02	04	25	25	04	50
PH-SEC-502-PR	**Python Programming**	02	04	25	25	04	50
PH-SEC-503-PR	**Electronic Circuits and Designing**	02	04	25	25	04	50

PH-SEC-501-PR : C–Programming(Practical only)

Semester: V	
Course Code	PH-SEC-501-PR
Course Title	C -Programming
Course Type	Skill Enhancement Course
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Objective	At the end of the course, students will be able to CO1: Understand basic C programming syntax, logic, and structure. CO2: Write algorithms and flowcharts for problem solving. CO3: Develop programs for mathematical, logical, and data processing applications. CO4: Use functions, loops, arrays, and conditional statements effectively.
Mapping between Cos and PSOs	

Course Content:

Write algorithm, draw flow chart and prepare program to study the following:

Sr. No.	Practical
1	Solving quadratic equation with the use of switch statement.
2	Illustrating the use of switch statement for tax calculation.
3	Simulation of a small computer (SMAC).
4	A program to process students results.
5	Questionnaire program development.
6	To define a function in C to reverse a given integer.
7	A program to check if an integer is a palindrome.
8	A program to generalize interest calculation.
9	A program sort rows of a matrix.
10	A program for transposing a matrix.
11	Project work (equivalent to 4 experiments).

Reference Books:

1. Computer programming in C by V. Rajaraman. (PHI Learning Pvt. Ltd.).
2. ANSI C by E. Balaguruswamy, Tata McGraw Hill Publication.

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiment and there will be a project viva also. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

PH-SEC-502-PR: Python Programming (Practical only)

Semester: V	
Course Code	PH-SEC-502-PR
Course Title	Python Programming
Course Type	Skill Enhancement Course
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, students will be able to **CO-1:** Understand the basics of Python programming and IDE usage.

	CO-2: Perform mathematical operations and simulations using Python libraries. **CO-3:**Use lists, dictionaries, and user-defined functions to solve physics problems. **CO-4:**Plot and analyze graphs using matplotlib and perform data analysis with NumPy/Pandas.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							

Course Content:

Write algorithm, draw flow chart and prepare program to study the following:

Sr. No.	Practical
1	Install and configure Python IDÉ.
2	Write simple Python program to display message on screen.
3	Write a program to convert bits to Megabytes, Gigabytes and Terabytes.
4	Write simple Python program to check whether a given number is a Fibonacci term or not.
5	Write python program to demonstrate Percentage Discount Calculator: (Here, we are implementing a program, it will input sale amount and calculate the discount based on input amount using nested if else.)
6	Write python program to calculate the gravitational force between a planet and different objects on its surface.
7	Write python program to create a tuple and find the minimum and maximum number from it.
8	Write python program to find common wavelengths and unique wavelengths from two different experiments.
9	Write a Python program to combine two dictionaries adding values for common keys. a. d1 = {'a': 100, 'b': 200, 'c':300} b. d2 = {'a': 300, 'b': 200, 'd':400} OR Write a Python script to sort (ascending and descending) a dictionary by value.
10	Write Python program to find area and perimeter of a circle and sphere using math library. OR Write a Python program to generate a random float where the value is between 5 and 50 using Python math module.
11	Write a Python function that accepts a string and calculate the number of upper case letters and lower case letters.
12	Write Python program to find the solution of a quadratic equation.
13	Write Python program to find the values of variables from a system of three linear equations.
14	Write a Python program to find charge of a capacitor that discharges in a RC circuit and draw necessary plots.
15	Write Python program to plot sine and cosine over the range of { π , -π }

EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in

conduct of practicals, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications
1	Computer system (Any computer system with basic configuration)
2	'Python' Interpreter/ IDE

Suggested Learning Resources:

UNIT-1: Python Fundamentals

1.1 Concepts of Interpreter based programming language
1.2 Python Variables
1.3 Python Data types
1.4 User defined function.

UNIT-2: Python Strings and Operators

2.1 Python Strings
2.2 Operators

UNIT-3: Python conditional and iterative statements

3.1 If statement, if..elif statement, if..if…else statements, nested if
3.2 Iterative statements
3.3 List: creating list, indexing, accessing list members, range in list, List methods (append, clear, copy, count, index, insert, pop, remove, reverse, sort).

UNIT-4: Python Collections and Library

4.1 Python Collections
4.2 Introduction to Numpy and Pandas

Reference Books:

1. Core Python Programming – by Wesley J Chun ISBN-13: 978- 0132269933
2. Python for Everybody: Exploring Data in Python 3, by Charles Severance
3. (Author), Aimee Andrion (Illustrator), Elliott Hauser (Editor), Sue Blumenberg (Editor)
4. An Introduction to Python - by van Rossum Guido ISBN: 9780954161767, 0954161769
5. Core Python Application Programming – by Wesley J Chun Prentice Hall

Software/Learning Websites:

a) https://www.tutoria1spoint.com/python/index.html
b) nptel.ac.in/courses/117106113/34
c) https://www.w3schools.com/python/default.asp
d) https://www.programiz.com/python-programming
e) http://spoken-tutorial.org/
f) https://docs.python.org/3/tutorial/errors.html
g) https://www.w3resource.com/python-exercises/
h) https://www.anandology.com/python-practice-book/

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiment and there will be a project viva also. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

PH-SEC-503-PR: Electronic Circuits and Designing (Practical only)

Semester: V	
Course Code	PH-SEC-503-PR
Course Title	Electronic Circuits and Designing
Course Type	Skill Enhancement Course
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, students will be able C01: Apply fundamental concepts of digital and analog electronics to design and build functional circuits using basic electronic components and ICs. CO2: Design and simulate logic-based systems such as counters, shift registers, multiplexers, and flip-flops to solve real-world problems. CO3: Build and test electronic circuits (filters, voltage regulators, clock generators) using discrete components and operational amplifiers with proper instrumentation. CO4: Analyze the performance of electronic systems by interpreting results from experimental data and comparing them with theoretical values. CO5: Integrate knowledge from multiple domains (e.g., digital, analog, and power electronics) to design projects that address practical or societal needs.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO:1-2							
CO:3-4							

Course Content:

The following experiments are to be performed in the design built and test (DBT) mode.

1. To study RS- flip flop using NOR and NAND gate with and without clock.
2. Up/down counter using IC 7493.
3. Shift register (left and right).
4. Multiplexer 4 to1 using basic gates.
5. D- multiplexer using basic gates.
6. Clock circuit using IC 7400 NAND gate.
7. Notch filter using IC- 741.
8. First order low pass butter-worth filter using IC 741.
9. First order high-pass butter-worth filter using IC using IC 741.
10. Voltage regulator using transistor SL-100 and Zener Diode.
11. Project work (equivalent to 4 experiments).

Instructions:

1. The duration of each experiment is of 2 hours.

2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiment and there will be a project viva also. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. PHYSICS MAJOR

Course Structure of Semester VI for major courses

SEMESTER – VI							
Course Code	**Title of The Course**	**Course Credit**	**Hrs. Per Week**	**Internal Marks (CCE)**	**External Marks (SEE)**	**Duration of Exam (Hr.)**	**Total Marks**
PH-MJ-601- TH	Bhartiya Darshan in Physical Science and Atomic Physics	02	02	25	25	01	50
PH-MJ-601- PR	Practicals based on Bhartiya Darshan in Physical Science and Atomic Physics	02	04	25	25	04	50
PH-MJ-602 -TH	Relativity and Solid state Physics	02	02	25	25	01	50
PH-MJ-602 -PR	Practicals based on Relativity and Solid state Physics	02	04	25	25	04	50
PH-MJ-603 -TH	Electrodynamics and Electronics	02	02	25	25	01	50
PH-MJ-603 -PR	Practicals based Electrodynamics and Optics	02	04	25	25	04	50
	Total	**12**	**18**	**150**	**150**		**300**

SEMESTER VI

PH-MJ-601-TH (Atomic and Nuclear Physics)

Semester: VI	
Course Code	PH-MJ-601-TH
Course Title	Bhartiya Darshan in Physical Science and Atomic Physics
Course Type	Major
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1**:** Understand the concept of Panchamahabhutas (Five Great Elements) and their origins in Vedic literature such as the Rigveda**.**Analyze the interpretation of five elements in different philosophical schools like Samkhya**,** Nyaya, and Vaisesika**,** and their connection to physical and metaphysical concepts CO2**:** Evaluate the role of three gunas (Sattva, Rajas, Tamas**)** in shaping the characteristics of the five elements and their relevance in understanding human nature and health.Compare and contrast Indian atomic theories (especially Nyaya-Vaisesika) with Greek atomic philosophy, highlighting the global and rational nature of ancient Indian thought. CO3**:** Reflect on how classical Indian philosophical systems contributed to early physical ideas and their potential relevance in modern interdisciplinary education. CO4: Understand and apply quantum mechanical principles such as electron spin, Pauli exclusion principle, and wave function symmetry to explain atomic structure and the periodic table; CO5: Analyze the effects of spin-orbit coupling and total angular momentum; and interpret X-ray spectra as evidence of electronic structure. .

Mapping between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO-1-2							
CO 3-4							

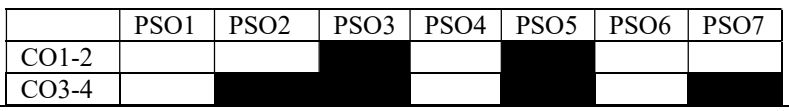
Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Bhartiya Darshan in Physical Sciences:**	**15**
	Introduction (Page-445); A striking feature of Rigveda (P-453); The Doctrine of Five Elements(P-455); The Generation of The Gross Matter (in terms of the five elements)(P-457); The Samkhya Doctrine of Five Elements & The Ayurveda(P-458) ; The Five Elements in Terms of Three Gunas (i.e Satva, Rajas, &Tamas)(P-459);Assessment of Five Elements by Vaisesika &Nyaya System (P-459); The Nyaya-Vaisesika & Greek Atomic View (P-465); Attribute of Matter (Gurutva &	

	Elasticity only)(P-470); Akash , Space & Time (P- 475) ; Role of Vaisesika System in The Growth of Physical ideas in India (P-483). **Book**: A Concise History of Science in India Publisher: Indian National Science Academy (Chapter-9: The Physical World: Views and Concepts)	
Unit-2	**Atomic Physics:**	
	(7.1) Electron Spin, (7.2) Exclusion Principle, (7.3), Symmetric and Antisymmetric Wave Functions (7.4) Periodic Table, (7.5) Atomic Structures, (7.6) Explaining the Periodic Table, (7.7) Spin-Orbit Coupling, (7.8) Total Angular Momentum, (7.9) X-Ray Spectra. Text Book: Concepts of Modern Physics by Arthur Beiser, McGraw Hill Publishing Co. Ltd. New Delhi, 6thEd.	

SEMESTER VI

PH-MJ-601-PR: Practical Based on Bhartiya Darshan in Physical Sciences and Atomic Physics

Semester: V	
Course Code	PH-MJ-602-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practical Based on Bhartiya Darshan in Physical Sciences and Atomic Physics
Course Outcome	At the end of the course, the students will be able to CO1**:** Inculcate Indian knowledge system (Bhartiya Gyan Pramapara) through project work. CO2**:**Reflect on how classical Indian philosophical systems contributed to early physical ideas and their potential relevance in modern interdisciplinary education. CO4:Solve the problems and apply quantum mechanical principles such as electron spin, Pauli exclusion principle, and wave function symmetry to explain atomic structure and the periodic table; CO5: Analyze the effects of spin-orbit coupling and total angular momentum; and interpret X-ray spectra as evidence of electronic structure.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1-2							
CO3-4							

Course Content:

1.	Calculation of Rydberg constant from hydrogen/helium discharge spectrum using diffraction grating.
2.	Verification of Bohr's model by plotting $\frac{1}{\lambda} \rightarrow \frac{1}{n^2}$ from spectral lines.
3.	Photo Electric effect. Study of relationship between stopping potential and frequency.
4.	Determination of Plank's constant using photocell.
5.	Study of fine structure of sodium D-lines.
6.	Determination of e/m by Thomson method.
7	Solving problems based on total angular momenta.
8.	Solving problems based on spin orbit coupling.
9.	Project Work (Equivalent to 4 experiments)detailed survey and report write up about topic relevant to Bhartiya Darshan in Physical Sciences **Reference:** student must refer Rigveda, Vaisesika Darshan orany One of the Upanishad viz Chandogya Upanishad, Taittirya Upanishad, Aitareya Upanishad, Maitri Upanishad, and Prasna

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiments and Viva voce of project work. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

SEMESTER VI

PH-MJ-602-TH (Relativity and Solid state Physics)

Semester: VI	
Course Code	PH-MJ-602-TH
Course Title	Relativity and Solid state Physics
Course Type	Major
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to **CO1**.Explain and apply the key concepts of **Special Relativity** including time dilation, length contraction, relativistic momentum and energy, and the twin paradox using Lorentz transformations. **CO2.** Understand and analyze the **Doppler Effect** in the relativistic context and describe the unification of electricity and magnetism under special relativity. Distinguish between Special and **General Relativity**, and understand the basic conceptual framework of space time geometry. **CO3.** Classify different types of **solids** based on the nature of bonding: ionic, covalent, metallic, molecular, and van der Waals forces. Understand and interpret the **Band Theory of Solids**, including its justification through quantum principles and applications to conductors, insulators, and semiconductors. **CO4.** Describe the behavior of **electrons in metals** and the origin of electrical conductivity using quantum concepts. Explain the phenomenon of **superconductivity**, its properties, and the conditions under which it occurs. Differentiate between **intrinsic and extrinsic semiconductors**, and analyze the working principles of basic **semiconductor devices** such as diodes and transistors.

Mapping between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO-1-2							
CO 3-4							

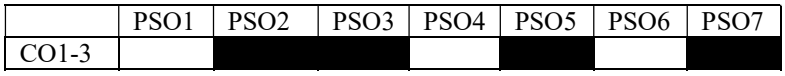
Course Content:

Unit No.	Content	Teaching Hours
		15
Unit-1	**Relativity:**	
	Special Relativity (1.1); Time Dilation(1.2); Doppler Effect (1.3);Length Contraction(1.4); Twin Paradox(1.5); Electricityand Magnetism(1.6); Relativistic Momentum (1.7);Massand Energy (1.8); Energyand Momentum(1.9) ; General Relativity(1.10). APPENDIX 1: The Lorentz Transformation APPENDIX 2: Space Time **Text Book: Concepts of Modern Physics by Arther Beiser, 6TH Edition. McGrew Hill (India) Publication**	

Unit-2	**Solid State Physics:**	**15**
	Ionic Solids (11.1); Covalent Solids (11.2); Other Solid Bonds(11.3); Band Theoryof Solids(11.4); JustificationofBand Theory(11.5); Electrons in Metals (11.6); Super Conductivity(11. 7); Intrinsicand Impurity Semiconductors (11.8); Semiconductor Devices (11.9). Text Book: Modern Physics by Kenneth Krane, Second Edition, Publishedby John Wiley& Sons	

SEMESTER VI

PH-MJ-602-PR: Practical Based on Relativity and Solid state Physics

Semester: V	
Course Code	PH-MJ-602-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practical Based on Relativity and Solid state Physics
Course Outcome	At the end of the course, the students will be able to **CO-1:** Solve Numerical problem based on special theory of relativity **CO2:**Perform experiments of solid state physics **CO3**: develop measurement skills and operation of instruments.
Mapping between Cos and PSOs	

Course Content : s

Sr. No.	**Content**
1.	To solve the problems based on Doppler Effect
2.	To solve the problems based on Length Contraction
3.	To solve the problems based on Twin Paradox
4.	To solve the problems based on Relativistic Momentum
5.	To solve the problems based on Mass and Energy
6.	To solve the problems based on Energy and Momentum
7.	To determine the band gap of a semiconductor (like silicon or germanium) using reverse saturation current vs. temperature.
8.	To measure the Hall coefficient and determine the type (n-type or p-type) and density of charge carriers.
9.	To study Bragg's law and crystal structure using X-ray diffraction pattern

10.	To find the lattice constant of cubic crystals using diffraction techniques (X-ray) by analyzing given patterns.
11.	To measure dielectric constant of a material at room temperature using capacitor with dielectric sample, LCR meter, frequency generator.
12.	To study how resistance varies with temperature in a thermistor and finding energy band gap.
13.	To study forward and reverse characteristics; observe breakdown voltage of Zener diode and energy band structure.
14.	To determine the resistance and the resistivity of a metallic conductor using meter bridge.

Instructions:

6. The duration of each experiment is of 2 hours.
7. There should not be more than 10 students per batch as per NEP 2020 guidelines.
8. In the external examination, a student will have to perform two experiments and. The duration of external examination will be of 4 hours.
9. There should be two examiners per batch in the external examination.
10. There should not be more than 10 students per examiner per session in the external examination.

SEMESTER VI

PH-MJ-603-TH (Electrodynamics and Electronics)

Semester: VI	
Course Code	PH-MJ-602-TH
Course Title	Electrodynamics and Electronics
Course Type	Major
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to **CO1**: **Explain the concept of electromotive force and apply Ohm's Law** to analyze electric circuits, including the behavior of motional emf in moving conductors. **Apply Faraday's laws of electromagnetic induction and describe the induced electric field** in dynamic systems, and evaluate energy storage in magnetic fields through the concept of inductance. *(Related to 7.2.1–7.2.4)* **CO2**: **Interpret and apply Maxwell's equations** in both vacuum and material media, understand their physical implications, and analyze boundary conditions and the concept of magnetic charge. **Demonstrate understanding of electromagnetic conservation laws** including the continuity equation and Poynting's theorem, and apply these to analyze power and energy transfer in electromagnetic systems. *(Related to 8.1.1–8.1.2)* **CO3**: **Analyze and design basic Op-Amp circuits with negative feedback**, including voltage series and voltage shunt configurations, and evaluate their performance using

	DC and AC analysis.**Simulate and verify Op-Amp configurations using PSpice**, and interpret simulation results for practical circuit behavior. *(Related to 3.6)* **CO4**: **Design and implement Op-Amp based signal processing applications** such as integrators, differentiators, voltage-to-current converters, and function generators for use in analog electronics. *(Application-focused: OP-Amp Applications)*

Mapping between COs and PSOs

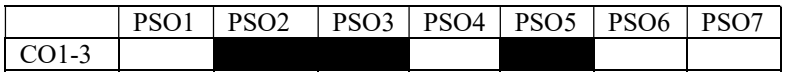
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO-1-2							
CO 3-4							

Course Content:

Unit No.	Content	Teaching Hours
		5
Unit-1	**Electrodynamics:**	
	Electromotive Force: Ohm's Law (7.1.1), Electromotive Force(7.1.2), Motional emf(7.1.3). **Electromagnetic Induction:**Faraday's Law (7.2.1), The Induced Electric Field (7.2.2)Inductance (7.2.3), Energy in Magnetic Field (7.2.4). **Maxwell's Equations:** Electrodynamics before Maxwell (7.3.1), How Maxwell fixAmpere's Law (7.3.2), Maxwell's Equation (7.3.3), Magnetic Charge (7.3.4), Maxwell'sEquations in Matter (7.3.5), Boundary Conditions (7.3.6). **Conservation laws:** The continuity equation (8.1.1), Poynting's theorem (8.1.2).	**15**
Unit-2	**Op Amp with Negative Feedback:**	**15**
	Introduction (3.1); Block diagram representation of feedback configurations (3.2); Voltage series feedback amplifier (3.3); Voltage Shunt Feedback Amplifier (3.4); Differential amplifiers (3.5); PSpice simulation (3.6); DC and AC amplifiers (6.1, 6.2). **OP-Amp Applications:** Integrator, Differentiator, Voltage to Current Converter, Function Generator **Text Books:** Op Amps and Linear Integrated Circuits by Ramakant Gayakwad, 4th Ed., Pearson	

SEMESTER VI

PH-MJ-602-PR: Practical Based on Electrodynamics and Electronics

Semester: V	
Course Code	PH-MJ-603-PR
Credit	02
Teaching Hour/ Week	4 Hours
Course Title	Practical Based on Electrodynamics and Optics
Course Outcome	At the end of the course, the students will be able to **CO1**: Study and analyze the working of an **inverting amplifier and non-inverting amplifier using an Op-Amp**, and determine its voltage gain and input-output characteristics. **CO2**: **Design, construct, and test an adder circuit, subtractor circuit, integrator circuit and other applications** using an Op-Amp, and verify the linear addition of multiple input voltages. **CO3**: Undertake **project work based on Electrodynamics** (equivalent to four experiments) demonstrating application of theoretical concepts in practical systems, and develop skills in experimental design, data analysis, and problem-solving.
Mapping between Cos and PSOs	

Course Content :

Sr. No.	Practical
1.	To study inverting amplifier using Op Amp.
2.	To study non-inverting amplifier using Op Amp.
3.	To design, build and test adder using Op Amp.
4.	To design, build and test subtractor using Op Amp.
5.	To design, build and test integrator using Op Amp.
6.	To design, build and test differentiator using Op Amp.
7.	To design, build and test voltage to current converter using Op Amp.
8.	To design, build and test instrumentation amplifier using Op Amp.

9.	To design, build and test Wien bridge oscillator using Op Amp.
10	To design, build and test phase shift oscillator using Op Amp.
11	Project work Based on Electrodynamics (equivalent to 4 experiments)

Instructions:

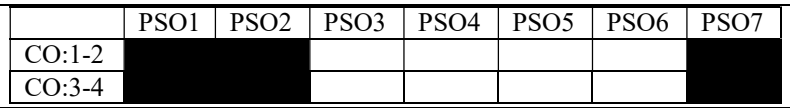
1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiments and viva-voce for project work. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
5. There should not be more than 10 students per examiner per session in the external examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. PHYSICS MINOR
Course Structure of Semester VI

SEMESTER -VI							
Course Code	**Course Title**	**Credit (Theory/ Practical)**	**Teaching duration per Week (in Hr.)**	**External Marks (SEE)**	**Internal Marks (CCE)**	**Exam Time Duration**	**Total (Marks)**
PH-MN-601-TH	**Electricity-Magnetism and Solid State Physics**	02	02	25	25	01	50
PH-MN-601-PR	**Practicals based on Electricity-Magnetism and Solid State Physics**	02	04	25	25	04	50

Semester VI

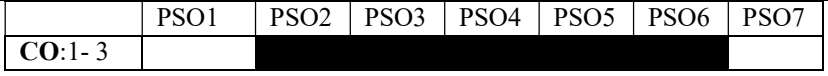
PH-MN-601-TH: Solid state Physics and Electronics

Semester: V	
Course Code	PH-MN-601-TH
Course Title	**Electricity-Magnetism and Solid State Physics**
Course Type	Minor
Credit	2
Course Level	300-399
Teaching Hour/ Week	2 Hours
Teaching Time	15×2= 30 Hours
Course Outcome	At the end of the course, the students will be able to CO1: Describe the interference of light using wave theory.,analyze interference patterns using Young's double-slit and Fresnel biprism. CO2: Understand coherence, optical path difference, and conditions for constructive/destructive interference. CO3: Explain thermal instability in transistors and design biasing circuits. CO4: Compare various transistor biasing techniques and their impact on stability.
Mapping between COs and PSOs	

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Electricity-Magnetism**	**15**
	Electric and Magnetic Properties of Materials Type of materials (29.1), A conductor in an electric field: Static conditions (29.2), A conductor in an electric field: Dynamic conditions (29.3), Ohmic materials (29.4), Ohm's law: A macroscopic view (29.5),An insulator in an electric field (29.6). The Magnetic dipole (35.1), The force on a dipole in non uniform field (35.2), Atomic and Nuclear magnetism (35.3),Magnetization (35.4), Magnetic materials (35.5), Gauss' law for magnetism(35.7). **Text book:** **Physics by Halliday, Resnik and Krane, Vol. 2, 5th Edition, Wiley.**	
Unit-2	**Solid State Physics**	**15**
2.1	Crystallography :Introduction(1); Lattice Points and Space Lattice (2); The Basis and Crystal Structure(3);Unit Cells and Lattice Parameters(4);Unit Cells Verses Primitive Cells (5);Crystals System (6); Crystal Symmetry(7);The Twenty -Three Symmetry Elements in a Cubic Crystal (8);To Show That 5-Fold Rotation Axis is Not Compatible With a Lattice (9);The Bravais Space Lattice (14);Metallic Crystal Structures(i) Simple cubic structure (ii) Body centered cubic (bcc) structure (iii) Face centered cubic (fcc) Structure (15) ; Directions, Planes and Miller Indices (18); Important Features of Miller Indices of Crystal Planes (19); Important Planes and Directions in a Cubic Crystal (20); Reciprocal Lattice (Concept of reciprocal lattice and Geometrical construction only) (25),X-Ray Diffraction **Text Book**: Solid State Physics by S.O.Pillai (New Revised Sixth edition)	

PH-MN-601-PR: Practicals based on Electricity-Magnetism and Solid State Physics

Semester: VI	
Course Code	PH-MN-601-PR
Credit	02
Teaching Hour/ Week	4 Hours
Subject Title	Practicalsbased on Electricity-Magnetism and Solid State Physics
Course Outcome	At the end of the course, the students will be able to CO1: Perform experiments on interference and determine optical constants (e.g., wavelength, refractive index). CO2: Measure and analyze transistor characteristics in different configurations. CO3: Determine DC operating points and use transistors in switching applications
Mapping between Cos and PSOs	

Course Content

Sr. No.	Practical

1.	To verify Ohm's Law and distinguish between ohmic and non-ohmic conductors.
2.	To determine the resistance and calculate the resistivity of a metallic conductor using meter bridge.
3.	To studyCharging and Discharging of a Capacitor andfinding the time constant.
4.	To measure dielectric constant of a material at room temperature using capacitor with dielectric sample, LCR meter, frequency generator.
5.	To Study Magnetic Hysteresis Loop.
6.	To find Magnetic Susceptibility using Gouy's Method.
7.	To find figure of merit of ballistic galvanometer
8.	To find value of capacitor using ballistic galvanometer
9.	To find value of inductance using ballistic galvanometer.
10.	Study of tangent galvanometer.
11.	Project work (equivalent to 4 experiments)

Instructions:

1. The duration of each experiment is of 2 hours.
2. There should not be more than 10 students per batch as per NEP 2020 guidelines.
3. In the external examination, a student will have to perform one experiments and viva-voce for project work. The duration of external examination will be of 4 hours.
4. There should be two examiners per batch in the external examination.
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