Academic Council Meeting No. and Date :11 / June 27, 2025
Agenda Number: 2 Resolution Number: 50, 51/2.5,2.11

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science
(Autonomous), Thane

Syllabus for

Programme Code: BUPH

Programme: Bachelor of Science Specific Programme: Physics

(Major/Minor)

[T. Y. B. Sc. Physics]

Level 5.5

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2025-2026

Preamble

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics. It will help the student to

- To develop analytical abilities towards real world problems
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem-solving, hands-on activities, study visits
- To develop good observation ability
- To understand links of Physics to other disciplines.
- To develop scientific temperament.
- To obtain solutions to scientific questions by use of qualitative and quantitative reasoning and by experimental investigation.

The syllabus is aimed to achieve certain objectives. The syllabus spanning three years, covers from fundamental concepts in Physics and give glimpses of the scenario at the frontier. The students will be ready for the higher educational opportunities and jobs available in different fields of Physics and related environment like:

- Master's degree in Physics
- Master's degree in Computer applications MCA.
- PG Course in Radiology
- Software Development (Programming C++)
- Careers that require Scientific or Technical expertise.
- Careers in Civil and administrative Services.

Dr. Sangita S. Meshram
Chairperson, BOS Physics
VPM's B.N.Bandodkar College of Science (Autonomous), Thane

PROGRAMME OUTCOMES (POs) OF BACHELOR OF SCIENCE (B.Sc.)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

PO1 - Disciplinary Knowledge

Lay a strong foundation of conceptual learning in science. Instill ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude

Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learners to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy

Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning processes.

PO4 - Sensitization towards Environment

Build a cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Teamwork

Encourage learners to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness

Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build an attitude of unbiased, truthful actions and avoid unethical behavior in all aspects of life.

Eligibility: 12th Science Pass

Duration: 3 years (Syllabus for Third Year semester V & VI)

Mode of Conduct: Offline lectures/ Online lectures

Discipline/Subject: Physics

Specific Programme: B.Sc. PHYSICS

Level: 5.5

Qualification Title: UG Degree Certificate

Discipline/Subject: PHYSICS

Program Specific Outcomes-Physics

1.	**PSO1: Mastery of Fundamental Physics Concepts** Learners will acquire a strong conceptual understanding of fundamental principles in classical mechanics, electromagnetism, optics, quantum physics, and thermodynamics, enabling them to apply scientific knowledge effectively in academic, professional, and real-life situations.	L1
2.	**PSO2: Application of Physics in Problem Solving and Research** Learners will develop analytical thinking, experimental skills, and problem-solving abilities that strengthen scientific inquiry and research aptitude, enabling them to design, perform, and interpret basic physics experiments and pursue innovative research ideas.	L2

3.	**PSO3: Proficiency in Computational Tools and Digital Resources** Learners will gain competency in using simulations, data-analysis software, digital laboratories, and online resources to support learning, model physical systems, and analyze scientific data with accuracy.	L3
4.	**PSO4: Understanding of Environmental Physics and Sustainability** Learners will understand physical principles behind environmental processes—such as energy production, climate systems, and renewable technologies—and will develop an awareness of sustainable practices and eco-friendly applications of physics.	L4
5.	**PSO5: Experimental Competence, Teamwork, and Scientific Collaboration** Learners will effectively carry out laboratory experiments, projects, and field activities both independently and as part of a team, demonstrating precision, systematic planning, and collaborative scientific practice.	L5
6.	**PSO6: Ethical Practice and Social Responsibility in Physics** Learners will recognize the ethical dimensions of scientific work, follow safety and integrity standards in laboratories, avoid data manipulation, and apply physics knowledge responsibly for the benefit of society.	L6
Specific Programme: T. Y. B. Sc. (PHYSICS -Major/ Minor)		

Assessment: Weightage for assessments (in percentage) For Major

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40%	60%

Proposed Structure and Credit Distribution for level 5.5 (T.Y.B.Sc)for the year of 2025-26

Level	SEM.	Faculty – DSC			Any Faculty	Vocational & Skill Enhancement Courses (VSC)	Field Project/ Apprenticeship/ Community Engagement& Services		Credit	Cumulative Credits
		Major	Elective	Minor	GE & OE	CREDITS = 02	Field Project / OJTOJT Apprenticeship/ On the job training			
		Credits	Credits	credits	CREDITS	VSC				
5.5	V.	12	04	02	-	02	02	-	22	44
	VI.	14	04	-	-	02	02	-	22	
Exit option: Award of UG Certificate in Major with 80-88 credits and an additional 4 credits core NSQF courses / Internship or Continue with Major and Minor.										
Transforming S.Y. BSc. Curriculum into NEP 2020 Structure provided by Government of Maharashtra.										
Cum cr.		14*2 = 28	02+04 = 06	02	-	2*2= 04	2*2 = 04	-	44	44

Level	SEM	Faculty – Science **(10T 8P) =** DSC (6 T+ 6P) + DSE – **SEM V** (2T+2P) credits 2 Opted Minor subject – (2T) credits 2 **(10T 8P) =** DSC (8 T+ 6P) + DSE – **SEM VI** (2T+2P) credits 4									Minor SEM V (2T)	Vocational & Skill Enhancement Courses (VSC)	Field Project	Credit	Cumulative Credits
		Major							Major DSE		Credits (02)				
		Theory Course– I	Theory Course – II	Theory Course –III	Theory Course– IV	Practical Course – I	Practical Course – II	Practical Course – III	Theory Course – I	Practical Course – II	Syllabus directly relevant to the employability /Entrepreneurship				
Level 5.5	V	02 (2T)	02 (2T)	02 (2T)	--	02 (2P)	02 (2P)	02 (2P)	(2T)	(2P)	(2T)	02 (1T + 1P)	02	22	44
	VI	02 (2T)	02 (2T)	02 (2T)	0 2 (2T)	02 (2P)	02 (2P)	02 (2P)	02 (2T)	02 (2P)	-	02 (1T + 1P)	02	22	
	Cum cr.	12+14 = 26							4+4 = 08		02	2*2 = 04	2*2 = 04 -	44	

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

T.Y.B.Sc.

Curriculum Structure for the Undergraduate Degree Program T.Y.B.Sc. Physics

Structure of Programme

Semester-wise Titles of the Papers in T.Y.B.Sc.

Year	Sem.	Course code	Course Title	Theory/ Practical	No. of Lectures	Credits
Third Year	V	**Major courses**				
		25BUPH5T01	Thermal and Statistical Physics	Theory	30	02
		25BUPH5T02	Solid state Physics	Theory	30	02
		25BUPH5T03	Atomic and Molecular Physics	Theory	30	02
		25BUPH5P01	Practicals based on 25BUPH5T01	Practical	60	02
		25BUPH5P02	Practicals based on 25BUPH5T02	Practical	60	02
		25BUPH5P03	Practicals based on 25BUPH5T03	Practical	60	02
			Total		**270**	**12**
		DSE				
		25BUPH5TE1	Electrodynamics	Theory	30	02
		25BUPH5PE1	Practicals based on 25BUPH5TE1	Practical	60	02
			Total		**90**	**04**
		OR				
		25BUPH5TE2	Material Science	Theory	30	02
		25BUPH5PE2	Practicals based on 25BUPH5TE2	Practical	60	02
			Total		**90**	**04**
		Minor				
		25BUPH5TMN	Application of Solar Energy	Theory	30	02
			Total		**30**	**02**
		VSC				
		25BUPH5VSC	Python-I	Theory	15	01
			Practicals based on 25BUPH5VSC	Practical	30	01

		25BUPH5OJT	On Job Training in Physics I	Practical	60	2
		OR				
		25BUPH5FPR	Field Project in Physics III	Practical	60	2
			Total		**105**	**04**
			Total		**495**	**22**
		Major courses				
		25BUPH6T01	Classical Mechanics	Theory	30	02
		25BUPH6T02	Electronics	Theory	30	02
		25BUPH6T03	Nuclear Physics	Theory	30	02
		25BUPH6IKS	Indian Contributions to Physics from Vedic to Modern Era	Theory	30	02
		25BUPH6P01	Practicals based on 25BUPH6T01	Practical	60	02
		25BUPH6P02	Practicals based on 25BUPH6T02	Practical	60	02
		25BUPH6P03	Practicals based on 25BUPH6T03	Practical	60	02
					300	**14**
		DSE				
		25BUPH6TE1	Astronomy	Theory	30	02
	VI	25BUPH6PE1	Practicals based on 25BUPH6TE1	Practical	60	02
					90	**04**
		OR				
		25BUPH6TE2	Arduino-based Embedded System	Theory	30	02
		25BUPH6PE2	Practical based on 25BUPH6TE2	Practical	60	02
					90	**04**
		VSC				
		25BUPH6VSC	Python-II	Theory	15	01
			Practicals based on 25BUPH6VSC	Practical	30	01
		25BUPH6OJT	On Job Training in Physics II	Practical	60	2
		OR				
		25BUPH6FPR	Field Project in Physics IV	Practical	60	2
			Total		**105**	**04**

			Total		**495**	**22**
Total Credits					**44**	

Semester V

Course Code 25BUPH5T01	Major – 1 Course Title: Thermal and Statistical Physics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Explain the statistical parameters of a Thermodynamic system.	L2
CO2	Illustrate the processes involved in thermal and adiabatic interactions.	L2
CO3	Apply the classical statistics to a given situation.	L3
CO4	Choose the quantum statistics in each situation.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	0	0	0	0
CO2	3	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	**1. Description of a system:** Why statistical approach, Particle-states, System-states, Microstates and Macro states of a system, Equilibrium and Fluctuations, Irreversibility, The equi-probability postulate, Statistical ensemble, Number of states accessible to a system, Phase space, Reversible processes. **2. Thermal and Adiabatic Interactions:** Thermal interaction, Canonical distribution, Energy fluctuations, Entropy of a system in a heat bath, Helmholtz free energy, Adiabatic interaction and enthalpy, General interaction and the first law of thermodynamics, Infinitesimal general interaction, Gibbs free energy, Phase transitions.	**15**
UNIT II	**1. Classical Statistics:** Phase space, the probability of a distribution, the most probable distribution, Maxwell-Boltzmann statistics, and Molecular speeds. **2. Quantum Statistics:** Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula, The Planck radiation formula, Fermi-Dirac statistics, Comparison of results, Transition between states.	**15**

Reference Books:

1. LG: Statistical and Thermal Physics- : S. Lokanathan and R. S. Gambhir. an introduction (Prentice Hall of India: 2008) (1.1 to 1.11,2.1, 2.3 to 2.11)
2. AB: Perspectives of Modern Physics: Arthur Beiser. (Mc Graw Hill International) (15.1 to 15.5,16.1 to 16.7)

Additional References:

1. A Treatise on heat: Saha and Srivastava. (Indian press, Allahabad)
2. Fundamentals of Statistical and Thermal Physics: F. Reif (Mc Graw - Hill)

Course Code 25BUPH5T02	Major – 2 Course Title: Solid state Physics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Apply electrical properties to understand fermi energy.	L3
CO2	Make use of Band theory of solids to differentiate metal, semiconductor and Insulator	L3
CO3	Summarize the semiconductor-diode characteristics.	L2
CO4	Utilize the theory of Superconductivity to study its characteristics.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	3	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT I	**Electrical properties and Band theory of solids** **1.** Assumptions of Classical and Somerfield Free Electron model, Classical free electron theory of metals and its Drawbacks, Failure of Sommerfeld's free electron Theory, Energy levels and Density of States (One and Three Dimensions) , Fermi energy, Fermi level **2.** Band theory of solids- Origin of energy gap, Energy bands in Solids, The Kronig- Penney model, Distinction between metal, semiconductor and insulator, Problems.	**15**
UNIT II	**Diode Theory and superconductivity** **1.** Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance. **2.** Superconductivity: Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS theory of superconductivity, Type I and Type II Superconductors, Vortex state.	**15**

Reference Books:

1. Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill. (Ch: 4, 5.1 to 5.8)
2. Solid State Physics: S. O. Pillai, New Age International, 6th Ed. (Ch: 6)
3. Introduction to Solid State Physics-Charles Kittel, 7th Ed. John Wiley & Sons:(Ch: 12.)

Course Code 25BUPH5T03	Major – 3 Course Title: Atomic and Molecular Physics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Apply Schrödinger's equation to the hydrogen atom.	L3
CO2	Explain electron spin and its applications.	L2
CO3	Develop the theory of diatomic molecular spectra and its key principles.	L3
CO4	Interpret Infrared spectroscopy & Microwave spectroscopy	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	0	0	0
CO2	3	0	0	0	0	0
CO3	1	0	0	0	0	0
CO4	3	0	0	0	0	0

UNIT I	**1. Application of Quantum Mechanics to Hydrogen atom**: Schrödinger's equation for Hydrogen atom, Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part). **2. Electron spin**: The Stern-Gerlach experiment, Pauli's Exclusion Principle Symmetric and Anti-symmetric wave functions. 1. Spin orbit coupling, Total angular momentum, Vector atom model, L-S and j-j coupling. Effect of Magnetic field on atoms, the normal Zeeman effect and its explanation (Classical and Quantum)	**15**
UNIT II	**1. Molecular spectra** (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibration energy levels, Vibration-Rotational spectra. Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation, Intensity of vibration-electronic spectra: The Franck-Condon principle. **2. Infrared spectroscopy & Microwave spectroscopy**: Raman effect: Quantum Theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, symmetric top molecules, Asymmetric top molecules, Vibration Raman spectra: Raman activity of vibrations, Experimental set up of Raman Effect.	**15**

Reference Books:

1. Perspectives of Modern Physics: Arthur Beiser Page 8 of 18 McGrawHill. (9.1 to 9.9,10.1,10.3.2,14.1, 14.3, 14.5, 14.7)
2. BM: Fundamentals of Molecular Spectroscopy: C. N. Barnwell& E. M. McCash (TMH). (4th Ed.)

Additional Reference:

1. GA: Molecular structure and spectroscopy: G Arul has (2ndEd) PHI learning Pvt Ltd.
2. Atomic Physics (Modern Physics):S.N.Ghoshal. S.Chand Publication (for problems on atomic Physics).

PRACTICALS

Course Code 25BUPH5P01	Course Title: Practical's based on 25BUPH5T01	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Determine temperature-dependent electrical properties of sensors and semiconductors.	L4
CO2	Compare classical and quantum statistical distributions to understand particle behavior.	L3
CO3	Apply experimental methods to determine Universal constants.	L3
CO4	Examine the thermal conductivity of a material.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	The energy gap of the thermistor of NTC.
2	The energy gap of the thermistor of PTC.
3	Diode as a temperature sensor.
4	Thermistor as a temperature sensor.
5	Calibration of resistance temperature device using Null method.
6	To determine Stefan's constant.
7	To determine plank's constant using Black body radiation.
8	Thermal conductivity of copper using Searle's Bar/Angstrom's method
9	Thermal Conductivity by Lee's method.
10	Thermal conductivity of good conductor by Forbes Method
11	Study of Adiabatic vs Isothermal Process.
12	Study of Fermi-Dirac Distribution and Fermi Energy of Electron Gas.
13	Verification of Maxwell–Boltzmann Distribution of Molecular Speeds.
14	*Bose-Einstein Distribution & BEC Onset.*
15	Maxwell-Boltzmann Speed Distribution.

** Students must perform at least 8 experiments.*

Course Code 25BUPH5P02	Course Title: Practical's based on 25BUPH5T02	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Evaluate charge transport parameters and electrical characteristics of semiconducting materials.	L4
CO2	Analyse the electronic band structure and crystal orientation of materials.	L4
CO3	Demonstrate the operation of optoelectronic devices.	L5
CO4	Investigate magnetic properties of materials and superconducting behavior.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	Determination of Hall coefficient using Hall effect set up keeping probe current constant.
2	Determination of Hall coefficient using Hall effect set up keeping magnetic current constant.
3	Band gap energy of **Ge** diode
4	Band gap energy of zener diode
5	Carrier lifetime of diode by pulse reverse method.
6	Resistivity of semiconductor using four-point probe method.
7	Electrical characteristics of thermistor.
8	Photodiode as a switch.
9	Phototransistor as a switch.
10	Magnetic susceptibility of liquid by Quincke's method.
11	Determination of Miller indices using XRD graph.
12	Efficiency and fill factor of a solar cell.
13	To study the charging characteristics of a rechargeable battery using a solar cell.
14	Determination of Critical Temperature (Tc) of Superconductor.
15	To study effect of magnetic field on superconductivity.

**Students must perform at least 8 experiments.*

Course Code 25BUPH5P03	Course Title: Practical's based on 25BUPH5T03	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Determine wavelengths and grating parameters using diffraction and interference techniques.	L4
CO2	Analyse crystal and molecular structures.	L4
CO3	Investigate atomic structure and quantum effects.	L4
CO4	Evaluate fundamental physical constants and molecular bonding characteristics.	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1.	Determination of wavelength of laser using grating.
2.	Determination of wavelength of sodium lamp using grating.
3.	Determination of grating element using sodium lamp.
4.	Determination of grain size of lycopodium powder using diffraction pattern.
5.	Determination of molecular size using XRD Graph.
6.	Bond strength of a molecule using FTIR graph.
7.	Determination of wavelength by Edser's A pattern.
8.	Determination of wavelength by Step slit.
9.	Determination of Rydberg's constant.
10.	Study of Zeeman effect.
11.	Frank-Hertz Experiment.
12.	Electron Spin Resonance.
13.	Millikan's Oil-Drop Experiment: Measured the elementary electric charge by observing charged oil droplets in an electric field.
14.	Determination of Bond Length of NaCl from Rotational Spectrum.
15.	Determination of Bond Length of HCl from Rotational Spectrum.

**Students must perform at least 8 experiments.*

Course Code 25BUPH5TE1	DSE Course Title: Electrodynamics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Apply the Gauss law to solve the problems in electrostatics	L3
CO2	Make use of the Gauss law to solve the problems in dielectrics.	L3
CO3	Apply Ampere's law to solve the problems in Magnetostatics.	L3
CO4	Utilize Ampere's law to solve the problem in Magnetized materials.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT I	**1. Coulomb & Gauss law**: The divergence of E, Applications of Gauss'. law, The curl of E. Introduction to potential, Comments on potential, The potential of a localized charge distribution. Poisson's equation and Laplace's equation, the classic image problem- point charge and grounded infinite conducting plane and conducting sphere. **2. Dielectrics**: Induced Dipoles, Alignment of polar molecules, Polarization, Bound charges and their physical interpretation, Gauss' law in the presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant and relation between them, Energy in dielectric systems	**15**
UNIT II	**1. Biot-Savart's law and Ampere's law:** Straight-line currents, The Divergence and Curl of B, Applications of Ampere's Law in the case of a long straight wire and a long solenoid, Comparison of Magnetostatics and Electrostatics, Magnetic Vector Potential. **2. Magnetization:** Bound currents and their physical interpretation, Ampere's law in magnetized materials. Energy in magnetic fields, Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions.	**15**

Reference Books:

1. DG: Introduction to Electrodynamics, David J. Griffiths (3rd Ed) Prentice Hall of India.
2. Solutions to Introduction to Electrodynamics: David J. Griffiths (3rd Ed) Prentice Hall of India.

Additional Reference:

1. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat, Narosa Publishing House.
2. Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH).
3. Foundations of Electromagnetic Theory: Reitz, Milford and Christy.

Course Code **25BUPH5PE1**	**Course Title:** **Practical's based on 25BUPH5TE1**	**Credit** **2**	**No. of Lecture** **60**

Course Outcomes:

CO1	Apply bridge methods and AC circuit principles.	L3
CO2	Analyze the electromagnetic properties of material.	L4
CO3	Examine the application of Inductance.	L4
CO4	Demonstrate and verify fundamental laws of electromagnetism.	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	De'Sauty bridge.
2	L/C by Maxwell's bridge.
3	Design and study of the Wien bridge oscillator.
4	Magnetic Hysteresis.
5	Determination of the dielectric constant of solids.
6	Determination of the dielectric constant of liquids.
7	Determination of e/m by Thomson's method.
8	To determine the Inductance of a coil.
9	To study LVDT.
10	To calculate resonating frequency of LCR series resonance.
11	To calculate resonating frequency of LCR parallel resonance.
12	To verify Biot-Savart's law.
13	To verify Ampere's law for solenoid.
14	Verification of Coulomb's law.
15	To demonstrate electrostatic repulsion between like charges using a Van de Graaff generator.

**Students must perform at least 8 experiments.*

Course Code: 25BUPH5TE2	DSE Course Title: Material Science	Credit 2	No. of Lecture 15

Course Outcomes:

CO1	Explain the material properties in solid state physics.	L2
CO2	Demonstrate the Imperfections and defects in crystals for different solids.	L2
CO3	Summarize the purpose and applications of phase diagrams in materials science.	L2
CO4	Apply the phase rule to identify the types of Phase diagrams.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT I	**1. Defects in Solids** Material Properties – Mechanical, Electrical, and thermal, Hall Effects, Mobility, Hall angle, Impurities in solids, Solid solutions in metals, Rules of solid solubility, Imperfection in crystals, Defects in solids point, line, surface, and volume, atomic diffusions definition, mechanism, Fick's laws, Deformation, Elastic and Plastic deformation.	**15**
UNIT II	**2. Phase Diagrams** Basic terms System, Surrounding, Component, Coordinates, Phase, Equilibrium, Phase Diagram definition, importance, and objective, Lever rule, Gibb's phase rule. Phase diagram of a) Sugar water b) NaCl water, Types of phase diagrams with construction, Type I Lens type CuNi phase diagram, Type II Only introduction, Type III Eutectic type Pb-Sn phase diagram, Isothermal cuts	**15**

Reference Books:

1. VR: Materials Science and Engineering - V. Raghavan (*6.1, 6.2, 6.3, 6.4, 7.1, 7.2, 7.3, 7.5, 7.6, 7.7. 8.1, 8.2, 8.3, 8.5)*

Additional reference

1. LHV: Elements of Materials Science and Engineering L. H. Vanvlach (4th Edition)

Course Code 25BUPH5PE2	Course Title: Practical's based on 25BUPH5TE2	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Evaluate the Magnetic and electrical properties of a material.	L5
CO2	Estimate the Mechanical properties of materials.	L5
CO3	Analyze thermal and thermoelectric properties.	L4
CO4	Characterize molecular polarity, microstructure and nanoscale properties of materials	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	To determine the dipole moment of a given liquid.
2	To determine the bending strength of metal beam under load.
3	To determine the magnetic susceptibility of $FeCl_3$.
4	To determine the magnetic susceptibility of $MnCl_2$.
5	To determine the specific heat of materials.
6	Determination of the yield point and the breaking point of an elastic material
7	Ionic conductivity of NaCl/ NaI
8	Surface tension of liquid material.
9	Seeback effect and measurement of thermoelectric power.
10	Grain size and grain boundary measurement using optical microscope.
11	Synthesis and characterization of Nanoparticle.
12	Young's Modulus by Y-Bending method.
13	Determination of Hall Coefficient of a Semiconductor
14	Thermal Conductivity of a Metal Rod
15	Study of Peltier Effect

**Students must perform at least 8 experiments.*

Course Code 25BUPH5OJT	Course Title: On Job Training in Physics I	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Apply theoretical knowledge and practical skills to real-world workplace tasks.	L3
CO2	Identify areas for improvement.	L5
CO3	Evaluate work performance through supervisor feedback and self-assessment	L6
CO4	Compile the reports and outcome of On job Training.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Course Code 25BUPH5FPR	Course Title: Field Project in Physics III	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Analyze the Project problem.	L4
CO2	Choose a Scientific methodology.	L5
CO3	Evaluate the collected data and project problem findings.	L5
CO4	Compose the Project outcomes through written reports, presentations, or prototypes.	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Course Code 25BUPH5TMN	Minor Course Title: Application of Solar energy	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Interpret the composition of the Sun's radiation and its effects on Earth.	L2
CO2	Explain the fundamental principles of solar radiation geometry.	L2
CO3	Utilize performance analysis methods to optimize solar PV systems.	L3
CO4	Explain the types of solar power plants.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	3	0	0
CO2	2	0	0	3	0	0
CO3	1	0	0	3	0	3
CO4	2	0	0	3	0	3

UNIT I	**Solar Radiation:** **1.** Structure of the sun, Solar constant, Sun's radiation, Composition of Sun's radiation, basic sun-earth angle, tilt factor. **2.** Solar Radiation Geometry (Altitude angle, Zenith angle, solar azimuth angle, Surface azimuth, Incident angle), Solar Radiation Measurements, Sunshine recorder.	**15**
UNIT II	**Solar Energy:** **1.** Solar photovoltaic (PV) energy conversion/Photovoltaic effect, Performance analysis of solar photovoltaic (PV) Cell, Current in a short circuit, voltage in an open circuit, Power delivered to the load, Maximum current, Maximum power, Efficiency of solar cell, fill factor, Limitation of Solar Cell. **2.** Solar cell material, Solar power plant, ON/OFF grid power plant, Grid-connected Solar power plant, Solar photovoltaic (PV) energy conversion limitations	**15**

Reference Books:

1. Non- Conventional Energy Sources - A textbook of Engineering students by G. D. Rai,6th edition, Khanna publishers, 2017 (2.1, 2.2, 2.3, 2.3.4, 2.4.1- 2.4.7, 2.6, 2.7, 2.9, 2.10)
2. Non- Conventional Energy Sources by B. L. Singhal, Tech-Max publication (2.1 – 2.7)
3. Physics of Solar Energy by C. Julian Chen, John Wiley & Sons INC., 2011(3.3)
4. Solar Energy - Fundamentals, Economic and Energy Analysis by Saurabh Kumar Rajput,Nitra Publication, 1st edition, 2017 (3.1, 3.2, 3.2.1, 3.2.2. 3.2.3, 3.2.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8, 3.3, 3.4, 3.5, 3.5.1, 3.5.2, 3.6.)

Course Code 25BUPH5VSC	VSC Course Title: Python I	Credit 2	No. of Lecture 45

Course Outcomes:

CO1	Explain the basics of Python programming concepts.	L2
CO2	Make use of control flow in Python programs using conditional statements and control statements	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	3	0	0	0
CO2	2	0	3	0	0	0

UNIT I	**1. Introduction:** The Python Programming Language, History, features, Installing Python, Running Python program, Debugging: Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging, Formal and Natural Languages, The Difference Between Brackets, Braces, and Parentheses. **Variables and Expressions Values and Types**, Variables, Variable Names and Keywords, Type Conversion, Operators and Operands, Expressions, Interactive Mode and Script Mode, Order of Operations. **2. Conditional Statements**: if, if-else, nested if –else Looping: for, while nested loops **Control statements**: Terminating loops, skipping specific conditions (break, pass, continue) **Strings**: A String Is a Sequence, Traversal with a for Loop, String Slices, Strings Are Immutable, Searching, Looping and Counting, String Methods, The in Operator, String Comparison, String Operations	**15**

Reference Books:

1. Core Python Programming by R. Nageswara Rao, 3ed, Dreamtech Press
2. Scientific Computing in Python by Abhijit Kar Gupta.
3. Think Python: How to Think Like a Computer Scientist by Allen B. Downey, 2nd Edition, Shroff/O'Reilly Publication

Course Code 25BUPH5VSC	VSC Practical Course Title: Python I	Credit 2	No. of Lecture45

Course Outcomes:

CO3	Develop programs using input–output operations, conditional statements, loops and control statements.	L3
CO4	Apply string manipulation techniques and counting logic using methods, slicing, searching and loops.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO3	2	0	3	0	0	0
CO4	2	0	3	0	0	0

1	Program based on Input, Output Statements.
2	Program based on if-else statement.
3	Program based on nested if statement.
4	Program based on for loop.
5	Program based on while loop.
6	Program based on do-while loop.
7	Program based on break statement.
8	Program based on pass statement.
9	Program based on continue statement.
10	Program based on counting string methods.
11	Program based on counting string slicing.
12	Program based on counting string searching.
13	Program based on looping and counting.
14	Program based on string comparison.
15	Program based on string operations.

**Students must perform at least 5 experiments.*

Semester VI

Course Code 25BUPH6T01	Major – 1 Course Title: Classical Mechanics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Apply the laws of motion under the central force.	L3
CO2	Construct equations of motion for rigid body rotation.	L3
CO3	Develop equations for the motion of fluids.	L3
CO4	Apply the Lagrange's equations for the given situation.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	1. Motion under a central force, The central force inversely proportional to the square of the distance, Elliptical orbits. Kepler's laws. 2. Moving origin of co-ordinates, Rotating co-ordinate systems, Laws of motion on the rotating earth, The rotation of a Rigid body in space, Euler's equations of motion for a rigid body, Euler's angles.	**15**
UNIT II	1. Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. 2. Lagrange's equations: D'Alembert's principle, generalized coordinates, Lagrange's equations using D'Alembert's principle and its Examples. Systems subject to constraints and its Examples	**15**

Reference Books:

1. Mechanics: Keith R. Symon. (Addision Wesely) 3rd Ed.(Ch:3.13 to 3.15, 7.1 to 7.3, 11.1 to 11.4, 8.6 to 8.9, 9.1 to 9.6)

Additional References:

1. Classical Mechanics: Herbert Goldstein (Narosa 2nd Ed.)
2. An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow Tata Mc Graw Hill (Indian Ed. 2007)

Course Code 25BUPH6T02	Major – 2 Course Title: Electronics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Explain the scope and applications of power electronics in industry, domestic appliances, and renewable energy systems.	L2
CO2	Make use of power semiconductor devices.	L3
CO3	Construct the applications of Op Amp.	L3
CO4	Summarize logic families.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	1	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	**Introduction to Power Electronics:** Scope and applications of power electronics in industry, domestic, and renewable systems, Difference between power devices and signal devices, Characteristics and applications of power semiconductor devices, Devices covered: Power diodes, Power transistors (BJT, MOSFET, IGBT)	**15**
UNIT II	**1. Op Amp Applications:** Log amplifier, Instrumentation amplifiers, Voltage controlled current sources (grounded load), First order Active filters, Astable using OP AMP, square wave and triangular wave generator using OP AMP, Wein-bridge oscillator using OP AMP, Comparators with Hysteresis, Window Comparator. **2. Logic families:** Standard TTL NAND, TTL NOR, Open collector gates, three state TTL devices, MOS inverters, CMOS NAND and NOR gates, CMOS characteristics.	**15**

Reference Books:

1. MB: Electronic Principles, Malvino & Bates -7th Ed TMH Publication. (13.1 to 13.9, 14.1, 14.2, 14.4, 14.6, 17.1 to 17.5,20.5, 20.8, 21.4, 22.2, 22.3, 22.7, 22.8, 23)
2. AM: Electronic Devices and Circuits, Allen Mottershead -PHI Publication.(28.1, 28.5)
3. P.S. Bimbhra – Power Electronics (Khanna Publishers, New Delhi, 5th Edition, 2012)(Ch. 1,2)
4. M.D. Singh & K.B. Khanchandani – Power Electronics (Tata McGraw-Hill Education (Ch. 2)
5. R.S. Kanchan & B.V. Natesan – Power Electronics (Oxford University Press India, 2014).
6. Umanand L. – Power Electronics: Essentials & Applications (Wiley India, 2009).
7. Jain & Jain – Power Electronics: Principles & Applications (Dhanpat Rai & Sons, Delhi).
8. Thyristors (SCR, TRIAC, DIAC) – working, V-I characteristics, ratings, triggering methods

Additional References:

1. KVR: Functional Electronics, K.V. Ramanan-TMH Publication
2. ML: Digital Principles and Applications, Malvino and Leach (4th Ed)(TMH).

Course Code 25BUPH6T03	Major – 3 Course Title: Nuclear Physics	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Illustrate the properties of Alpha and Beta decay.	L2
CO2	Summarize the concept of Gamma decay.	L2
CO3	Explain the concept of nuclear fission with particle accelerators	L2
CO4	Identify the elementary particles based on their properties.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT I	**Unit-I: Alpha, Beta & Gamma Decay** **1.** Alpha Decay: Velocity, energy, and Absorption of alpha particles: Range, Ionization and stopping power, nuclear energy levels. Beta decay: Introduction, Velocity and energy of beta particles, Energy levels and decay schemes, Pauli's neutrino hypothesis **2.** Gamma decay: Introduction, selection rules, Internal conversion, nuclear isomerism, Mossbauer effect. Liquid drop model, Magic numbers in the nucleus.	**15**
UNIT II	**Unit-II: Particle Accelerator and Elementary Particles:** **1.** Nuclear energy: Asymmetric fission - Mass yield, Emission of delayed neutrons, nuclear release in fission, Nature of fission fragments, Energy released in the fission of U235, Fission chain reaction, Particle Accelerators: Van de Graaff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider. **2.** Elementary particles: Introduction, Classification of elementary particles, Particle interactions, Conservation laws (linear &angular momentum, energy, charge, baryon number & lepton number), particles and antiparticles (Electrons and positrons, Protons and anti-protons, Neutrons and anti- neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative). Problems	**15**

Reference Books:

1. Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6th Ed.) (TMH).
2. Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.)(4. II. 1, 4. II. 2, 4. II. 3, 1.II.3 ,4. III. 1, 4. III. 2, 4. III. 3, III. 5,4. IV. 1, 4. IV.2, 4. IV. 3, 4. IV. 4, 9.4)
3. Nuclear Physics, Irving Kaplan (2nd Ed.) (Addison Wesley).(: 13. 1, 13.2, 13.5,14.1, 14.7,
4. Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)(5.5.)
5. Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5th ed.(18.1, 18.2,18.3, 18.4, 18.5 to 18.9 AB: 13.5)

Course Code 25BUPH6IKS	Major – 4 Course Title: Indian Contributions to Physics from Vedic to Modern Era	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Explain the philosophical foundations of Nyaya and Vaisheshika schools	L2
CO2	Interpret Physics references in the Vedic texts.	L2
CO3	Outline the pioneering contributions of Indian Scientist prior to Independence Era	L2
CO4	Outline the pioneering contributions of Indian Scientist post-Independence Era	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	**1. Philosophical Foundations:** Nyaya and Vaisheshika schools: Concepts of atoms (anu), time. Classification of Predicable (Padartha), States of matter, Theory gravitation and laws of motion in Vaisheshik Philosophy Vedic concepts about Electricity, Sound and acoustics. **2. Astronomy and Physics in Vedic Texts:** Astronomical references in the Vedas, Astronomical model and algorithms of the Vedāṅga-jyotiṣa, The Pañca-siddhāntikā of Varāhamihir- Meteorology and planetary science Āryabhaṭīya of Āryabhaṭa Calendrical computations.	**15**
UNIT II	**Pre-Independence Era:** **1. J.C. Bose:** a. **Contributions** to electromagnetism and the demonstration of wireless communication. b. Studies on the properties of metals and plant physiology from a physical perspective. 2. **C.V. Raman:** a. Raman Effect: Scattering of light and its implications in spectroscopy. b. Nobel Prize-winning work and its applications. 3. **Meghnad Saha:** a. Saha Ionization Equation: Its importance in astrophysics and stellar atmospheres. 4. **Satyendra Nath Bose:** a. Bose-Einstein statistics and its role in quantum mechanics. b. Collaboration with Albert Einstein. **Post-Independence Era:** 5. **Homi Bhabha:** a. Development of nuclear physics in India. b. Contributions to cosmic ray research. o Vikram Sarabhai: c. Contributions to space physics and the establishment of ISRO. **6. Harish-Chandra:**	**15**

	a. Work in mathematical physics and representation theory.	

Reference Books:

1. R. Balasubramanian, Indian Philosophy and Physics: From Quantum Mechanics to Consciousness.
2. S. Radhakrishnan, Indian Philosophy.
3. Debiprasad Chattopadhyaya, History of Science and Technology in Ancient India.
4. Āryabhaṭīya of Āryabhaṭa, K. S. Shukla and K. V. Sarma, Indian National Science Academy, 1976
5. Studies in Indian Mathematics and Astronomy: Selected Articles of Kripa Shankar Shukla, Kolachana et. al. (eds.), Culture and History of Mathematics 12, HBA, 2019
6. Rajinder Singh, J.C. Bose: The First Modern Scientist in India.
7. G. Venkataraman, Bhabha and His Magnificent Obsessions.
8. R. Parthasarathy, The Bose-Einstein Phenomena

PRACTICALS

Course Code 25BUPH6P01	Course Title: Practical's based on 25BUPH6T01	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Determine acceleration due to gravity using different types of pendulum.	L5
CO2	Evaluate the physical properties of given materials.	L5
CO3	Investigate wave behaviour, surface phenomena and interference effects.	L5
CO4	Analyse relativistic effects and cosmological parameters.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	Determination of 'g' by Kater's pendulum.
2	Determination of 'g' using bar pendulum.
3	Study of Resonance Pendulum.
4	Young's modulus by Searle's method.
5	Young's modulus using Flat spiral spring.
6	Modulus of rigidity using Flat spiral spring.
7	Surface tension of mercury by Quincke's method.
8	The velocity of sound in air using CRO.
9	Calculation of Redshift of celestial objects.
10	Calculation of Blueshift of celestial objects.
11	Calculation of Hubble's constant.
12	Study of Michelson Interferometer.
13	Calculate Gravitational red shift.
14	Experiments based on Length contraction.
15	Experiments based on Time dilation.

**Students must perform at least 8 experiments.*

Course Code 25BUPH6P02	Course Title: Practical's based on 25BUPH6T02	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Design, construct and analyse op-amp based circuits.	L3
CO2	Analyse power electronic components.	L3
CO3	Build an interfacing of a load with TTL gates.	L3
CO4	Examine the characteristics and operating regions of FET-based devices.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	Log Amplifier using op-amp.
2	Comparator using op-amp.
3	Astable using op-amp.
4	Square wave generator using op-amp.
5	First-order active low-pass filters.
6	First-order active high-pass filters.
7	Interfacing of a buzzer with TTL NAND gate.
8	I-V characteristics of Power Diode.
9	Half wave-controlled rectifier using Power Diode.
10	Full wave-controlled rectifier using Power Diode.
11	Voltage regulator using LM317.
12	Constant current source using LM317.
13	Study of JFET characteristics.
14	Study of UJT characteristics.
15	Study of MOSFET characteristics.

**Students must perform at least 8 experiments.*

Course Code 25BUPH6P03	Course Title: Practical's based on 25BUPH6T03	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Determine radioactive decay parameters.	L5
CO2	Analyse the operating characteristics of GM counters.	L4
CO3	Investigate the interaction of nuclear radiation with matter.	L5
CO4	Evaluate detector efficiency, energy calibration and spectral characteristics using NaI detectors.	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	Determine the age of fossils.
2	Determine the half-life of the radioactive source using GM counter.
3	Determine the Decay constant of radioactive sources.
4	Determine the mean life of radioactive sources.
5	Characteristics of GM counter.
6	Statistical Variation of data using GM Counter.
7	Verify the inverse square law for γ-ray using the Geiger-Müller counter.
8	Determine Linear Absorption coefficient using GM counter.
9	Resolving time correction Using GM counter.
10	Analyze the backscattering of beta particles off different materials.
11	Determine the background radiation count rate in the lab environment.
12	To estimate the efficiency of GM detector for beta and gamma source.
13	To perform energy calibration of NaI detector and determine the energy resolution of known decay transition.
14	To perform spectrum analysis of ^{60}Co and ^{137}Cs with NaI detector using single channel analyzer.
15	To determining the efficiency of a given unknown alpha emitting radio isotope

** All Above are data analysis experiments using software. Students must perform at least 8 experiments.*

Course Code 25BUPH6OJT	Course Title: On Job Training in Physics II	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Apply theoretical knowledge and practical skills to real-world workplace tasks	L3
CO2	Identify areas for improvement.	L5
CO3	Evaluate work performance through supervisor feedback and self-assessment	L6
CO4	Compile the reports and outcome of On job Training.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Course Code 25BUPH6FPR	Course Title: Field Project in Physics IV	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Analyze the project problem.	L4
CO2	Choose a Scientific methodology.	L5
CO3	Evaluate the collected data and project problem findings	L5
CO4	Compose the project outcomes through written reports, presentations, or prototypes	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Course Code 25BUPH6TE1	DSE Course Title: Astronomy	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Explain the structure of Sun and its components.	L2
CO2	Illustrate the solar system and its formation.	L2
CO3	Summarize the tools used to observe the astronomical objects.	L2
CO4	Apply all-sky surveys and virtual observatories for observations.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	**Classical Astronomy:** 1. The celestial Sphere, Position of stars Proper motions of stars, Distances of nearby stars 2. The brightness of the stars, Color-magnitude diagrams (The Hertzsprung-Russell (HR) diagrams), The luminosities of the stars, Effective temperatures of stars.	**15**
UNIT II	**The Solar System**: 1. The Sun, The Physical Processes in the solar system. 2. The Terrestrial and the Giant Planets, Formation of Planetary Systems **Tools of Astronomy:** 1. Telescopes: Basic optics, Optical telescopes, radio telescopes, infrared, Ultraviolet, Xray and gamma ray astronomy. 2. all sky surveys and virtual observatories.	**15**

Reference Books:

1. An Introduction to Modern Astrophysics, 2nd Edition by Carroll B.W., Ostlie D.A (ch: 6, 11, 19,20,21,23)
2. Introduction to stellar Astrophysics, Volume 1, Erika Bohm-Vitense (ch: 1,2,3,4,5,6,8)
3. An Introduction to Modern Astrophysics, 2nd Edition by Carroll B.W., Ostlie D.A(ch 1)

Additional reference

4. Astrophysics for Physicists, by Arnab Rai Chaudhary.
5. Introduction to stellar Astrophysics, Volume 1, Erika Bohm-Vitense

Course Code 25BUPH6PE1	Course Title: Practical's based on 25BUPH6TE1	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Analyze planetary motion and orbital characteristics.	L4
CO2	Investigate solar activity and solar atmospheric properties	L4
CO3	Determine physical properties of stars using spectral analysis	L4
CO4	Apply observational tools and simulation techniques.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	3	0
CO2	2	0	0	0	3	0
CO3	2	0	0	0	3	0
CO4	2	0	0	0	3	0

1	Measure the distances of internal planets in our Solar System using Stellarium.
2	Measure the distances of external planets in our Solar System using Stellarium.
3	Study Retrograde motion of Planets
4	Find the orbital inclination of a planet with respect to orbital plane of Earth using Stellarium.
5	Tracking sunspots.
6	Study of the solar spectrum.
7	Study of Solar Limb Darkening.
8	Measure the distance using the parallax method.
9	Identify the celestial objects in the night sky using Stellarium.
10	Spectral classification of stars.
11	Determination of Apparent and Absolute Magnitude of Stars.
12	Construction and Analysis of HR Diagram.
13	Determination of Stellar Temperature using B–V Index
14	Verification of Kepler's Laws using Orbit Simulator.
15	Study of Optical Astronomy.

**Students must perform at least 8 experiments.*

Course Code 25BUPH6TE2	DSE Course Title: ARDUINO based Embedded System	Credit 2	No. of Lecture 30

Course Outcomes:

CO1	Interpret the basic design of embedded system	L2
CO2	Explain the hardware and software of Arduino	L2
CO3	Demonstrate the function of sensors and actuators.	L2
CO4	Apply the knowledge in reading various sensor data and display in the output.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT I	**1. Embedded System design: Basics** Introduction to embedded systems, Components of embedded system, Applications and Examples of real time embedded systems. **2. Learning Arduino Platform** Introduction to ARDUINO, ARDUINO History and Family, Programming in Embedded-C, Concepts of C language, General Hardware Interfacings: • LED's • Switches • Seven Segment Display • Multi Segment Displays • Relays (AC Appliance Control) • LCD • Buzzer • IR Sensors • Other Digital Sensors	**15**
UNIT II	**1. The basic sensors and actuators using Arduino:** Introduction to sensors and actuators, how to connect and work with different sensors, such as Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal to ARDUINO Board. **2. Controlling embedded system-based devices using Arduino:** Reading various sensor data on serial monitor and LCD Display, Functioning of actuator.	**15**

Reference Books:

1. Arduino-Based Embedded Systems : By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury.
2. https ://www.arduino.cc/en/Tutorial/HomePage
3. Arduino Made Simple by Ashwin Pajankar
4. Embedded C, Pont, Michael J

Course Code 25BUPH6PE2	Course Title: Practical's based on 25BUPH6TE2	Credit 2	No. of Lecture 60

Course Outcomes:

CO1	Apply Arduino to light, temperature sensors.	L3
CO2	Apply Arduino to IR, Ultrasonic sensors.	L3
CO3	Apply Arduino to Moisture, humidity sensor.	L3
CO4	Apply Arduino to PIR motion sensor and water level sensor.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	3	0	3	0
CO2	2	0	3	0	3	0
CO3	2	0	3	0	3	0
CO4	2	0	3	0	3	0

1	Reading light sensor data on the serial monitor using Arduino.
2	Application of a light sensor using Arduino.
3	Reading temperature sensor data on the serial monitor using Arduino.
4	Application of a temperature sensor using Arduino.
5	Reading IR sensor data on the serial monitor using Arduino.
6	Application of IR sensor using Arduino.
7	Reading Ultrasonic sensor data on the serial monitor using Arduino.
8	Application of Ultrasonic sensor using Arduino.
9	Reading the Moisture sensor data on the serial monitor using Arduino.
10	Reading humidity sensor data on the serial monitor using Arduino.
11	Reading PIR motion sensor data on the serial monitor using Arduino.
12	Reading water level sensor data on the serial monitor using Arduino.
13	Reading accelerometer data on the serial monitor using Arduino.
14	Reading different sensor data on LCD display using Arduino.
15	Operating seven segment display using Arduino.

**Students must perform at least 8 experiments.*

Course Code 25BUPH6VSC	VSC Course Title: Python II	Credit 2	No. of Lecture 45

Course Outcomes:

CO1	Apply fundamental Python concepts related to lists, tuples, and functions	L3
CO2	Utilize Python libraries for matrix calculation and graph plotting.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0

UNIT I	**1. Lists**: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List, Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods. [List methods- append, extend, insert, pop, sort, Max( ), min(). **Tuples**: Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in Tuple Functions. **Functions**: Function Calls, Type Conversion Functions, Math Functions, Composition, Adding New Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters Are Local, Fruitful Functions and Void Functions, Why Functions? Importing with from, Return Values, Increment, Composition, Boolean Functions, More Recursion **2. NumPy**: Creating arrays creating n-dimensional arrays using np.array and array, operations (indexing and slicing), mathematical operation (addition, subtraction, multiplication, division, remainder, max, min, mean, medium) np.linespace, trigonometric functions, np.linalg Matrix = np.power, np.zeros, np.eye, np.full, np.empty, transpose, reciprocal, inverse, **Matplotlib:** Plotting: using "matplotlib" (Line plot, Bar plot, Histograms, pie chart, Scatter plot), subplots, 2D plot, plot graph of sin ,cos functions.	**15**

Reference Books:

1. Core Python Programming by R. Nageswara Rao, 3ed, Dreamtech Press
2. Scientific Computing in Python by Abhijit Kar Gupta.
3. Think Python: How to Think Like a Computer Scientist by Allen B. Downey, 2nd Edition, Shroff/O'Reilly Publication
4. NumPy Documentation: https://numpy.org/doc/stable/reference/index.html
5. Python Documentation : https://docs.python.org/3/tutorial/index.html
6. Matplotlib Documentation:

1. https://matplotlib.org/stable/gallery/index.html
2. https://matplotlib.org/stable/api/pyplot_summary.html
3. https://matplotlib.org/stable/tutorials/introductory/pyplot.html#sphx-glr-tutorials-introductory-pyplot-py

Course Code 25BUPH6VSC	VSC: Practical Course Title: Python II	Credit 2	No. of Lecture 45

Course Outcomes:

CO3	Construct Python program related to lists, tuples, and functions	L3
CO4	Develop Python program for matrix calculation and graph plotting.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO3	2	0	3	0	0	0
CO4	2	0	3	0	0	0

1	Program using List.
2	Traversing, Updating and Deleting Elements from Lists.
3	Program using Tuples.
4	Program based on methods to handle Tuples.
5	Program using Dictionaries
6	Program to study function declaration, function calling and function prototype.
7	Recursive and Boolean Functions in Python.
8	Program to study recursion function.
9	Creation and Manipulation of NumPy Arrays
10	Mathematical Operations on NumPy Arrays
11	Matrix Operations using NumPy (Transpose, Inverse, Determinant).
12	Get a line plot using matplotlib library.
13	Get a scatter plot using matplotlib library.
14	Get a bar plot using matplotlib library.
15	Get a bar piechart using matplotlib library

**Students must perform at least 5 experiments.*

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme T.Y.B.Sc Physics

	SEMESTER – V	**Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)**			**Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)**			
Course Code	**Major Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
25BUPH5T01	Thermal and Statistical Physics	--	--	√	--	--	--	--
25BUPH5T02	Solid state Physics	--	--	√	--	--	--	--
25BUPH5T03	Atomic and Molecular Physics	--	--	√	--	--	--	--
25BUPH5P01	Practical's based on 25BUPH5T01	√	√	√	√	--	--	--
25BUPH5P02	Practical's based on 25BUPH5T02	√	√	√	√	--	--	--
25BUPH5P03	Practical's based on 25BUPH5T03	√	√	√	√	--	--	--
DSE								
25BUPH5TE1	Electrodynamics	--	--	√	--	--	--	--
25BUPH5PE1	Practical's based on 25BUPH5TE1	√	√	√	√	--	--	--
OR								
25BUPH5TE2	Material Science	--	--	√	--	--	--	--
25BUPH5PE2	Practical's based on 25BUPH5TE2	√	√	√	√	--	--	--
Minor								
25BUPH5TMN	Application of Solar Energy	√	√	√	√	--	√	√
VSC								
25BUPH5VSC	Python-I	√	√	√	√	--	--	--
	Practical based on 25BUPH5VSC	√	√	√	√	--	--	--
25BUPH5OJT	On Job Training in Physics I	√	√	√	√	√	√	√
OR								
25BUPH5FPR	Field Project in Physics III	√	√	√	√	√	√	√
	Total	**09**	**09**	**14**	**09**	**01**	**02**	**02**

	SEMESTER – VI	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Major Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
25BUPH6T01	Classical Mechanics	--	--	√	--	--	--	--
25BUPH6T02	Electronics	--	--	√	--	--	--	--
25BUPH6T03	Nuclear Physics	--	--	√	--	--	--	√
25BUPH6IKS	Indian Contributions to Physics from Vedic to Modern Era	--	--	√	√	√	√	--
25BUPH6P01	Practical's based on 25BUPH6T01	√	√	√	√	--	--	--
25BUPH6P02	Practical's based on 25BUPH6T02	√	√	√	√	--	--	--
25BUPH6P03	Practical's based on 25BUPH6T03	√	√	√	√	--	--	--
DSE								
25BUPH6TE1	Astronomy	--	--	√	--	--	--	--
25BUPH6PE1	Practical's based on 25BUPH6TE1	√	√	√	--	--	--	--
OR								
25BUPH6TE2	Arduino-based Embedded System	√	√	√	--	--	--	--
25BUPH6PE2	Practical's based on 25BUPH6TE2	√	√	√	--	--	--	--
VSE								
25BUPH6VSC	Python-II	√	√	√	√	--	--	--
	Practical's based on 25BUPH6VSC	√	√	√	√	--	--	--
25BUPH6OJT	On Job Training in Physics II	√	√	√	√	√	√	√
OR								
25BUPH6FPR	Field Project in Physics IV	√	√	√	√	√	√	√
	Total	**09**	**09**	**14**	**07**	**02**	**02**	**02**