First Semester

Course type	Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
			L	T	P	Internal	External		
PHYSICS-C-1	BSHP-111-21	Optics	3	1	-	40	60	100	4
PHYSICS-C-2	BSHP-112-21	Mechanics	3	1	-	40	60	100	4
PHYSICS-C	BSHP-113-21	Physics Lab-I	-	-	4	30	20	50	2
GE-1	BSHM-104-21	Calculus	4	1	-	40	60	100	4
GE-2	BHCL-103-21	Inorganic Chemistry	3	1	-	40	60	100	4
	BHCP-109-21	Chemistry Lab-I	-	-	4	30	20	50	2
AEC-1	BHHL-105-21	Communicative English-I	2	-	-	20	30	50	2
AEC-2	BHHL-106A-21 BHHL-106B-21	Punjabi Compulsory-I or Mudhli Punjabi-I	2	-	-	20	30	50	2
	TOTAL		**17**	**4**	**8**	**260**	**340**	**600**	**24**

PHYSICS-C: PHYSICS-Core General Elective: GE Ability Enhancement Compulsory: AEC
L:Lecture T: Tutorial P:Practical Cr: Credit

Second Semester

Course type	Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
			L	T	P	Internal	External		
PHYSICS-C-3	BSHP-121-21	Waves and Vibrations	3	1	-	40	60	100	4
PHYSICS-C-4	BSHP-122-21	Electricity and Magnetism	3	1	-	40	60	100	4
PHYSICS-C	BSHP-123-21	Physics Lab-II	-	-	4	30	20	50	2
GE-3	BSHM-204-21	Vector Algebra & Vector Analysis	4	1	-	40	60	100	4
GE-4	BHCL-114-21	Organic Chemistry	3	1	-	40	60	100	4
	BHCP-116-21	Chemistry Lab-II	-	-	4	30	20	50	2
AEC-3	BHHL-115-21	Communicative English-II	2	-	-	20	30	50	2
AEC-4	BHHL-116A-21 BHHL-116A-21	Punjabi Compulsory-II or Mudhli Punjabi-II	2	-	-	20	30	50	2
	TOTAL		**17**	**4**	**8**	**260**	**340**	**600**	**24**

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PHYSICS-C	BSHP-113-21	Physics Lab-I	L-0, T-0, P-4	2 Credits

Pre-requisite (If any): High-school education

Course Objectives: The aim and objective of the lab course is to introduce the students to the formal structure of electromagnetism and phenomenon of wave optics so that they can use these as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	2	1	2	3	2	3
CO2	3	3	1	-	2	2	1	1	1	3	2	3
CO3	3	3	2	-	2	1	2	1	1	3	2	3
CO4	3	2	2	2	-	2	2	1	1	3	2	3
CO5	2	2	2	2	-	2	2	1	1	3	2	3

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Note: Students are expected to perform about 8-10 experiments from the following list, selecting minimum of 6-7 from the Physical Lab and 2-3 from the Virtual lab.

List of experiments:

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the laser beam characteristics like; wavelength, aperture, spot size, etc. using diffraction grating.
3. To study the diffraction using laser beam and thus to determine the grating element.
4. To study wavelength and laser interference using Michelson's Interferometer.
5. To find the refractive index of a material/glass using spectrometer.
6. To find the refractive index of a liquid using spectrometer.
7. To determine the angle of prism and resolving power of a prism.
8. To study the magnetic field of a circular coil carrying current using a Steward and Gees Tangent Galvanometer.
9. Determine the radius of circular coil using the Circular coil.
10. To study B-H curve using CRO.
11. To find out polarizability of a dielectric substance.
12. To find out the horizontal component of earth's magnetic field (B_h).

Text and Reference Books:

1. A Textbook of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
2. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
4. Practical Physics, C L Arora. S. Chand & Company Ltd.
5. http://www.vlab.co.in

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General Elective (GE)-2	BHCL-102-21	INORGANIC CHEMISTRY	L-3, T-1, P-0	4 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: To teach the fundamental concepts of Inorganic chemistry and their applications.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the fundamental concepts and postulates of various theories regarding the structure of atom.
CO2	Learn the periodicity of the s & p block elements
CO3	Understand the various types of bonding present in the different inorganic compounds
CO4	Learn about the various theories pertaining to the different types of boding
CO5	

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	1	2	2	2	3	2	3
CO2	2	3	1	-	2	2	1	2	2	3	2	3
CO3	2	3	2	-	2	1	2	1	2	3	2	3
CO4	3	2	2	2	-	2	2	1	2	3	2	3
CO5	2	2	2	2	-	2	2	1	1	3	2	3

Detailed Syllabus:

PART-A

UNIT-I

Atomic Structure:

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: deBroglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial anc angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d*and *f* orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number

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UNIT-II

Chemical Bonding-I: Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

UNIT-III

Chemical Bonding-II: Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

UNIT-IV

Chemistry of s and p Block Elements:

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Reference Books :-

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
6. Shriver & Atkins, *Inorganic Chemistry 5th Ed.*

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General Elective (GE)-2	BHCP-102-21	CHEMISTRY LAB-I	L-0, T-0, P-4	2 Credits

Pre-requisite: Understanding of senior secondary level Chemistry

Course Objectives: The objective of this course is to provide practical knowledge and illustrative experiments about various types of inorganic titrations and preparation of simple inorganic compounds.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand to calibrate and run the instruments for analysis.
CO2	Learn to the quantitative analysis of various metal ions/cations and anions.
CO3	Understand the various principles of different techniques involved in the quantitative analysis.
CO4	Learn to prepare various inorganic compounds

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	1	2	1	2	3	2	3
CO2	2	3	1	3	2	2	1	1		2	2	3
CO3	2	3	2	3	2	1	2	1	1	2	2	3
CO4	2	2	2	2	1	2	2	1	1	3	2	3

List of Experiments:

(A) Titrimetric Analysis

(i) Calibration and use of apparatus

(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.

(ii) Estimation of carbonate and bicarbonate present together in a mixture.

(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference text:

1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.

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Ability Enhancement Compulsory (AEC)-1	**BHHL-105-21**	**Communicative English -I**	**L-2, T-0, P-0**	**2 Credits**

Pre-requisite: Basic proficiency in Communication Skills

Course Objectives: The main objective of this course is:

- To help the students become proficient in LSRW-Listening, Speaking, Reading & Writing skills
- To help the students become the independent users of English language
- To develop in them vital communication skills, integral to their personal, social and professional interactions
- To teach them the appropriate language of professional communication
- To prepare them for job market

Course Outcomes: At the end of the course, the student will

CO1	acquire basic proficiency in reading &listening, writing and speaking skills
CO2	be able to understand spoken and written English language, particularly the language of their chosen technical field.
CO3	be able to converse fluently.
CO4	be able to produce on their own clear and coherent texts.
CO1	become proficient in professional communication, such as, interviews, group discussions, office environments, important reading skills as well as writing skills and thereby will have better job prospects.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	3	2	3	2	2
CO2	2	2	2	1	1	2	2	3	2	3	2	2
CO3	1	-	2	1	2	2	2	3	2	3	2	2
CO4	1	-	-	1	1	2	2	3	2	3	2	2
CO5	2	-	-	1	1	2	2	3	2	3	2	2

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Detailed Syllabus:

Part –A

UNIT I-(Literature)

(A) *The Poetic Palette* (Orient Black Swan, Second Edition, 2016)

The following poems from this anthology are prescribed:

1. Pippa's Song: Robert Browning
2. Apparently With No Surprise: Emily Dickinson
3. Fool and Flea: Jeet Thayil

(B) *Prose Parables* (Orient Black Swan, 2013)

The following stories from the above volume are prescribed:

a. The Kabuliwallah: Rabindranath Tagore
b. The Eyes Are Not Here: Ruskin Bond
c. Grief: Anton Chekov

UNIT-II

Vocabulary: Word Formation Processes; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms, antonyms

Grammar: Subject-verb agreement; Noun-pronoun agreement; Misplaced modifiers; Articles Determiners; Modals; Prepositions;

PART-B

UNIT-III

Reading and Understanding: Close Reading; Comprehension;

UNIT-IV

Mechanics of Writing & Speaking Skills

Essay Writing (Descriptive/Narrative/Argumentative); Business letters; Précis Writing; Self Introductions; Group Discussion

TEXT AND REFERENCE BOOK

1. John Eastwood, Oxford Practice Grammar, Oxford University Press, 2014
2. Michael Swan, Practical English Usage, OUP. 1995.
3. F.T. Wood, Remedial English Grammar, Macmillan. 2007.
4. William Zinsser, On Writing Well, Harper Resource Book 2001.
5. Sanjay Kumar and Pushp Lata, Oxford University Press. 2011.
6. Communication Skills, Oxford University Press. 2011.
7. Liz Hamp-Lyons and Ben Heasly, Study Writing, Cambridge University Press. 2006.

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PHYSICS -C	BSHP-123-21	Physics Lab-II	L-0, T-0, P-4	2 Credits

Pre-requisites (if any): High-school education with Physics lab as one of the subject.

Course Objectives: The aim and objective of the Physics Lab course is to introduce the students of B. Sc. (Hons.) Physics to the formal structure of wave and vibrations and mechanics so that they can use these as per their requirement.

Course Outcomes: At the end of the course, the student will be

CO1	Able to understand the theoretical concepts learned in the theory course.
CO2	Trained in carrying out precise measurements and handling equipment.
CO3	Learn to draw conclusions from data and develop skills in experimental design.
CO4	Able to understand the principles of error analysis and develop skills in experimental design.
CO5	Able to document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	2	1	2	3	2	3
CO2	3	3	1	-	2	2	1	1	1	3	2	3
CO3	3	3	2	-	2	1	2	1	1	3	2	3
CO4	3	2	2	2	-	2	2	1	1	3	2	3
CO5	2	2	2	2	-	2	2	1	1	3	2	3

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Note: Students are expected to perform about 8-10 experiments from the following list, selecting minimum of 6-7 from the Physical Lab and 2-3 from the Virtual lab.

List of experiments:

1. Measurements of length (or diameter) using vernier caliper and screw gauge.
2. Measurement of volume using travelling microscope. Use of Plumb line and Spirit level.
3. To determine the frequency of an electrically maintained tuning fork in a) Transverse mode of vibration b) Longitudinal mode of vibration.
4. To verify the law of vibrating string Using Melde's experiment.
5. To compare mass per unit length of two strings by Melde's experiment.
6. To find out the frequency of AC mains using electric-vibrator/sonometer.
7. To determine the horizontal and vertical distance between two points using a Sextant.
8. To determine the height of an inaccessible object using a Sextant.
9. To determine the angular diameter of the sun using the sextant.
10. To determine the angular acceleration α, torque τ, and Moment of Inertia of flywheel.
11. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of **g** and (c) Modulus of rigidity.
12. To determine the time-period of a simple pendulum for different length and acceleration due to gravity.
13. To study the variation of time-period with distance between centre of suspension and centre of gravity for a compound pendulum and to determine: (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length. (ii) The value of g in the laboratory.
14. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.

Reference book and suggested readings:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Practical Physics, C L Arora. S. Chand & Company Ltd.
7. http://www.vlab.co.in

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General Elective (GE)-4	BSHC-113-21	ORGANIC CHEMISTRY	L-3, T-1, P-0	4 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives:

1. To teach the basic principles, reaction mechanisms and stereochemistry of organic compounds.
2. To impart knowledge regarding physical properties and chemical reactions of alkanes, alkenes, dienes, alkynes, arenes, alkyl and aryl halides etc.
3. To predict and account for the most commonly encountered reaction mechanisms (substitution, addition, and elimination) in organic chemistry.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the fundamental concepts of organic chemistry i.e. structure, bonding and various effects in organic compounds.
CO2	To learn the stereochemistry viz. optical isomerism, stereoisomerism and conformational isomerism of organic compounds.
CO3	To study the various known reactive intermediate in organic synthesis.
CO4	To learn the fundamental and advanced concepts of reaction mechanisms along with the study of reaction mechanisms in various types of substitution addition and elimination reactions.
CO5	To predict the relationships between organic chemical structures and their reactivity.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	3	2	3	2	3	2	2
CO2	2	2	2	1	1	3	2	3	2	2	2	2
CO3	3	1	2	1	2	2	2	3	2	2	2	2
CO4	3	2	2	1	1	2	2	3	2	3	2	2
CO5	3	1	1	1	1	2	2	3	2	3	2	2

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Detailed Syllabus:

PART-A

Unit-I

Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules,Influence of hybridization on bond properties.*Electronic Displacements:* Inductive, electromeric, resonance and mesomeric effects,hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit-II

Stereochemistry:

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions;Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

OpticalIsomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers,Molecules with two or more chiral-centres,Distereoisomers, meso structures, Racemicmixture and resolution. Relative and absolute configuration: D/L and R/S designations.

A. Carbon-Carbon sigma bonds formation:-

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

PART-B

Unit-III

Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ AntiMarkownikoff addition), mechanism of oxymercuration-demercuration, hydroboration oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation(oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. *Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to formcarbonyl compounds, Alkylation of terminal alkynes.

Unit-IV

Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and

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heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Text and Reference Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry ofNatural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London,1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International,2005.

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General Elective (GE)-4	BSHC-119-21	CHEMISTRY LAB-II	L-0, T-0, P-2	2 Credits

Pre-requisite: Understanding of senior secondary level Chemistry

Course Objectives: which will act as a strong background if he/she chooses to pursue physics as a career.

Course Outcomes: At the end of the course, the student will be able to

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	3	2	3	2	2
CO2	2	2	2	1	1	2	2	3	2	2	2	2
CO3	3	3	2	1	2	2	2	3	2	2	2	2
CO4	2	3	-	1	1	2	2	3	2	3	2	2
CO5	2	1	1	1	1	2	2	3	2	3	2	2

List of Experiments:

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents: a) Water b) Alcohol, and c) Alcohol-Water.
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100°C by distillation and capillary method)
6. Chromatography a) Separation of a mixture of two amino acids by ascending and horizontal paper chromatography b) Separation of a mixture of two sugars by ascending paper chromatography, c) Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009).
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).

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Ability Enhancement Compulsory (AEC)-3	BHHL-115-21	Communicative English-II	L-2, T-0, P-0	2 Credits

Pre-requisite: Basic proficiency in communicative English

Course Objectives: This course is designed to

- help the students become proficient in LSRW-Listening, Speaking, Reading & Writing skills
- help the students become the independent users of English language
- develop in them vital communication skills, integral to their personal, social and professional interactions
- teach them the appropriate language of professional communication
- prepare them for job market

Course Outcomes: At the end of the course, the student will be able to

CO1	Students will acquire basic proficiency in reading &listening, writing and speaking skills.
CO2	Students will be able to understand spoken and written English language, particularly the language of their chosen technical field.
CO3	They will be able to converse fluently.
CO4	They will be able to produce on their own clear and coherent texts.
CO5	Students will become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills and thereby will have better job prospects.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	1	1	2	2	3	2	3	2	2
CO2	1	-	-	1	1	2	2	3	2	3	2	2
CO3	1	-	-	1	1	2	2	3	2	3	2	2
CO4	1	-	-	1	1	2	2	3	2	3	2	2
CO5	2	-	-	1	1	2	2	3	2	3	2	2

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Detailed Syllabus:

Part –A

UNIT I-(Literature)

(A) *The Poetic Palette* (Orient Black Swan, Second Edition, 2016)

The following poems from this anthology are prescribed:

1. The Soul's Prayer: Sarojini Naidu
2. I Sit and Look Out: Walt Whitman
3. Women's Rights: Annie Louise Walker

(B) *Prose Parables* (Orient Black Swan, 2013)

The following stories from the above volume are prescribed:

1. The Doctor's Word: R.K. Narayan
2. The Doll's House: Katherine Mansfield
3. Dusk: H.H. Munroe (Saki)

UNIT-II

Vocabulary: Standard abbreviations;Oneword substitution; Word Pairs(Homophones/Homonyms)
Grammar: Sentence Structures; Use of phrases and clauses in sentences; Transformation of Sentences; Importance of proper punctuation

PART-B

UNIT-III

Reading and Understanding: Summary Paraphrasing; Analysis and Interpretation; Translation (from Hindi/Punjabi to English and vice-versa)

UNIT-IV

Mechanics of Writing & Speaking Skills: Report writing, Career Documents- Job applications, Resume/CV writing, Common Everyday Situations: Conversations & Dialogues, Formal Presentations

TEXT AND REFERENCE BOOK

1. John Eastwood, Oxford Practice Grammar, Oxford University Press, 2014
2. Michael Swan, Practical English Usage, OUP. 1995.
3. F.T. Wood, Remedial English Grammar, Macmillan. 2007.
4. William Zinsser, On Writing Well, Harper Resource Book 2001.
5. Sanjay Kumar and Pushp Lata,Oxford University Press. 2011.
6. Communication Skills, Oxford University Press. 2011.
7. Liz Hamp-Lyons and Ben Heasly, Study Writing, Cambridge University Press. 2006.

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Third Semester

Coursetype	Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
			L	T	P	Internal	External		
PHYSICS-C-5	BSHP-211-21	Mathematical Physics-I	5	1	-	40	60	100	6
PHYSICS-C-6	BSHP-212-21	Elements of Modern Physics	3	1	-	40	60	100	4
	BSHP-213-21	Physics Lab-III	-	-	4	30	20	50	2
PHYSICS-C-7	BSHP-214-21	Analog Systems and Application	3	1	-	40	60	100	4
	BSHP-215-21	Physics Lab-IV	-	-	4	30	20	50	2
GE-5	BHCL-204-21	Physical Chemistry	3	1	-	40	60	100	4
	BHCP-208-21	Chemistry Lab-III	-	-	4	30	20	50	2
PHYSICS-SEC-1	BSHP-216-21	Workshop Skill Enhancement	-	1	2	30	20	50	2
	BSHP-217-21	Computational Physics							
	BSHP-218-21	Weather Forecasting							
	TOTAL		**14**	**5**	**14**	**280**	**320**	**600**	**26**

PHYSICS-SEC:PHYSICS-Skill Enhancement Elective Course

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PHYSICS-C	BSHP-213-21	PHYSICS LAB-III	L-0, T-0, P-4	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The laboratory experiments forming basis of quantum mechanics, photoelectric effect, ionization potential, absorption and emission spectra, diffraction, and tunneling effect.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	3	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	3	2	1	1	3	1	1
CO4	2	2	2	2	3	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

List of experiment:

1. Measurement of Planck's constant using black body radiation andphoto-detector.
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photoelectrons versus frequency oflight.
3. To determine work function of material of filament of directly heated vacuumdiode.
4. To determine the Planck's constant using LEDs of at least 4 differentcolours.
5. To determine the wavelength of H-alpha emission line of Hydrogenatom.
6. To determine the ionization potential ofmercury.
7. To determine the absorption lines in the rotational spectrum of Iodinevapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Barmagnet.
9. To setup the Millikan oil drop apparatus and determine the charge of anelectron.
10. To show the tunneling effect in tunnel diode using I-Vcharacteristics.
11. To determine (i) wavelength and (ii) angular spread of a laser using plane diffraction grating.
12. Dependence of scattering angle on kinetic energy and impact parameter in Rutherford scattering (mechanicalanalogue).
13. Measurement of the electrical and thermal conductivity of copper to determine its Lorentz number.
14. To determine energy band gap of a givensemiconductor.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse.
2. AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, KitabMahal.

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PHYSICS-C-7	**BSHP-214-21**	**ANALOG ELECTRONICS**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The course content covers basic semiconductor physics and devices, diodes, bipolar junction transistors, amplifiers, feedback concepts, Operation amplifiers and applications.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Illustrate working principle of different electronic circuit and their applications in real life.
CO2	Understand the working of semiconductor device and different operating condition and their performanceparameter.
CO3	Design and analyse the different types of amplifiers and understand the feedback mechanism.
CO4	Design and analyse the different types of oscillators.
CO5	Recognize different signal processing circuit and the use in industrial, real life, modern control system application.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

Detailed Syllabus:

PART-A

UNIT-I

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode. **(10 Lectures)**

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UNIT-II

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3)Solar Cell.

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff andSaturationRegions.**(12 Lectures)**

PART-B

UNIT-III

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B &CAmplifiers. Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response.

(10 Lectures)

UNIT-IV

Oscillators: Introduction, Types of oscillators, Fundamental principle of oscillators, Feedback oscillators, Tunes collector oscillator, Hartley and Colpitts Oscillator, Phase shift oscillator, Wein bridge oscillator, crystal oscillators. **(9 Lectures)**

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B. G. Streetman & S. K. Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S. Salivahanan& N. S. Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn, Oxford University Press.
7. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
8. Semiconductor Devices: Physics and Technology, S.M. Sze, 2ndEdn., 2002, Wiley India
9. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
10. Electronic Devices, 7thedn. Thomas L. Floyd, 2008, Pearson India

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PHYSICS-C	**BSHP-215-21**	**PHYSICS LAB-IV**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The laboratory exercises have been so designed that the students learn to study characteristics of various diodes, solar cells, and BJT and their biasing aspects, amplifiers, oscillators, ADC and DAC based application circuits.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Illustrate working principle of different electronic circuit and their applications in real life.
CO2	Understand the working of semiconductor device and different operating condition and their performanceparameter.
CO3	Design and analyse the different types of amplifiers and understand the feedback mechanism.
CO4	Design and analyse the different types of oscillators.
CO5	Recognize different signal processing circuit and the use in industrial, real life, modern control system application.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

1. To study I-V characteristics of different diodes - Ge, Si, LED and Zener.
2. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters. Use of Zener diode and ICregulators.
3. To study common emitter characteristics of a given transistor and to determine various parameters.
4. Study of I-V & power curves of solar cells and find maximum power point &efficiency.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage dividerbias.
6. To study the frequency response of voltage gain of a RC-coupled transistoramplifier.
7. To design a Wien bridge oscillator for given frequency using anop-amp.
8. To design a phase shift oscillator of given specifications usingBJT.
9. To study the Colpitts'soscillator.
10. To design a digital to analog converter (DAC) of givenspecifications.
11. To study the analog to digital convertor (ADC)IC.
12. To design an inverting amplifier using Op-amp (741,351) for dc voltage of givengain and study its frequencyresponse.
13. To draw the characteristics of a given triode and to determine the tubeparameters.
14. Calibration of a Si diode, a thermistor, and thermocouple for temperaturemeasurements.
15. To measure low resistance by Kelvin's double bridge/Carey Foster'sbridge.

Reference Books:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc- GrawHill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, PrenticeHall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-GrawHill.
4. Electronic Devices & circuit Theory, R.L. Boylestad& L.D. Nashelsky, 2009,Pearson.

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General Elective (GE)-5 Chemistry	BHCP-208-21	Chemistry Lab-III	L-0, T-0, P-4	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: To provide students practical knowledge and skills about various topics taught in theory class of physical chemistry, which in turn will enhance their problem solving and analytical skills.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basic procedures for carrying out a physical chemistry practical like preparation and standardization of solutions, handling the equipment and measuring with precision.
CO2	Correlate the theoretical and practical aspects and know about the limits of the experimental error.
CO3	Determine the various physical parameters for the various problems under consideration.
CO4	Verify various laws studied in the theory part.

Mapping of course outcomes with the program outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	3	-	-	3
CO2	-	3	-	-	3
CO3	-	3	-	-	3
CO4	-	3	-	-	3
CO5	-	3	-	-	3

Detailed Syllabus

UNIT-I

Preparation and Standardization of Solutions.

UNIT-II

Surface tension measurements.

a)Determine the surface tension by (i) drop number (ii) drop weight method.

b) Study the variation of surface tension of detergent solutions with concentration.

UNIT-III

Viscosity measurement using Ostwald's viscometer.

a) Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.

b) Study the variation of viscosity of sucrose solution with the concentration of solute.

UNIT-IV

pH metry

a) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and

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their mixtures.
b) Preparation of buffer solutions of different pH;
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide
c) pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
d) Determination of dissociation constant of a weak acid.

Recommended Books

1. J.B. Yadav, Practical Physical Chemistry, Krishna
2. Findlay, Practical Physical Chemistry, Longman, New York

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PHYSICS-SEC -1	BSHP-216-21	PHYSICS WORKSHOP SKILL	L-0, T-1, P-2	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode, and to improve the abilities of the students to frame and tackle problems in Physics.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the different types of unit's system and their conversion
CO2	Introduced the concept of prime movers.
CO3	Apply the Mechanical Skills and understand the concept of workshop practices.
CO4	Understand the learned concepts to electronics and electrical circuits.
CO5	

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

PART-A

Unit-I

Introduction: Measuring units. conversion to SI and CGS unit system. Familiarization with meter scale, Vernier caliper, Screw gauge and their utilities. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. **(4 Lectures)**

Unit-II

Introduction to prime movers: Gear and gear mechanism, lever and lever mechanism, Brakes and braking mechanism, Pulley and pulley mechanism, power generator system. **(6 Lectures)**

PART-B

Unit-III

Mechanical Skills: Concept of workshop practice. Overview of manufacturing methods: foundry, machining, forming, and welding. Types of welding joints and welding defects. Common materials used for manufacturing like, metals, alloys, and composites. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Introduction to sheet metal, operations, and job of funnel fabrication. **(5 Lectures)**

Unit-IV

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, electronic switch using transistor and relay. **(5 Lectures)**

Reference Books:

1. A textbook in Electrical Technology - B L Theraja – S. Chand and Company.
2. Performance and design of AC machines – M.G. Say, ELBS Edn.
3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

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UNIT-II

Scientific Programming using C++/Python: Introduction to the Concept of Object-Oriented Programming; Advantages of C++; Structure of a C++ program, concepts of compiling and linking, IDE and its features; Basic terminology - Character set, tokens, identifiers, keywords, fundamental data types, literal and symbolic constants, declaring variables, initializing variables, type modifiers. Operators in C++, Input/output using extraction and insertion operators, writing simple C++ programs, comments in C++, stages of program execution. **(5 Lectures)**

PART-B

UNIT-III

Control Statements: Types of Logic, Branching Statements, Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO), Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. **(5 Lectures)**

UNIT-IV

Programming:

1. Exercises on syntax on usage of C++/Python
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in C++/Python.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
3. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
4. Computational Physics: An Introduction, R. C. Verma et al., New Age International Publishers, New Delhi (1999)
5. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
6. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. 2007, Wiley India Edition.

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PHYSICS-SEC -2	BSHP-217-21	COMPUTATIONAL PHYSICS	L-0, T-1, P-2	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of this course is to*

- *Highlights the use of computational methods to solve physical problems*
- *Course will consist of hands-on training on the Problem solving on Computers.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Introduced the concept of using the computers in Physics.
CO2	analyze practical and theoretical aspects of physics problems with the help of asuitable mathematical model.
CO3	describe and evaluate sources of error for the modeling and calculation for a given problem.
CO4	mathematical modeling and numerical analysis of problems in science and technology.
CO5	how scientific knowledge is achieved by an interplay between theory, modeling and simulation.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

Detailed Syllabus:

PART-A

UNIT-I

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Operating system, Usage of Linux as an editor, Algorithms and Flowcharts. Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

(5 Lectures)

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Fourth Semester

Coursetype	Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
			L	T	P	Internal	External		
PHYSICS-C-8	BSHP-221-21	Mathematical Physics-II	5	1	-	40	60	100	6
PHYSICS-C-9	BSHP-221-21	Thermal Physics	3	1	-	40	60	100	4
	BSHP-223-21	Physics Lab-V	-	-	4	30	20	50	2
PHYSICS-C-10	BSHP-224-21	Digital Electronics	3	1	-	40	60	100	4
	BSHP-225-21	Physics Lab-VI	-	-	4	30	20	50	2
GE-6	BSHM-408-21	Matrices & Ordinary Differential Equations	4	1	-	40	60	100	4
AEC-5	EVS-101A	Environmental Studies	2	-	-	20	30	50	2
PHYSICS-SEC-2	BSHP-226-21	Electrical Circuits and Network Skills	-	1	2	30	20	50	2
	BSHP-227-21	Basic Instrumentation Skills							
	BSHP-228-21	Scientific Word Processing							
	TOTAL		**17**	**5**	**10**	**270**	**330**	**600**	**26**

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PHYSICS-C	**BSHP-223-21**	**PHYSICS LAB-V**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The laboratory exercises have been so designed on measurements of thermal conductivity, Temperature Coefficient of Resistance, and use of various temperature transducers.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To measure the coefficient of linear expansion for different metals andalloys.
3. To determine the value of Stefan's Constant ofradiation.
4. To determine the Coefficient of Thermal Conductivity of Cu by Searle'sApparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom'sMethod.
6. To measure the thermal conductivity and thermal diffusivity of aconductor.
7. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's discmethod.
8. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer(PRT).
9. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions. To calibrate a thermocouple to measure temperature in a specified Range using (i) Null Method, (ii) Direct measurement using Op-Amp difference amplifier and to determine NeutralTemperature.
10. To determine thermal conductivity of a bad conductor disc using Advance kit involving constant current source for heating and thermocouples for temperaturemeasurements.
11. Calibration of Si diode and Copper -Constantan thermocouple as temperature sensor.
12. Measurement of Planck's constant using black body radiation.
13. To determine Stefan's Constant.
14. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
15. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
16. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse
2. A Textbook of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, KitabMahal
3. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann EducationalPublishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal,1985, Vani Pub.

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PHYSICS-C-10	BSHP-224-21	DIGITAL ELECTRONICS	L-3, T-1, P-0	4 Credits

Pre-requisite: Understanding of basics of electronics.

Course Objectives: *The course covers basics of integrated circuit technology, binary arithmetic, Logic gates, sequential and combinational circuits, Timers and counters, and Computer organization.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the fundamentals of codes and number system
CO2	Understand the binary arithmetic, logics, and Boolean functions.
CO3	Understand the functions and working of flipflop circuits register s and counters.
CO4	Understand the applications into memory circuits.
CO5	Understand synchronous sequential circuits, registers and multiplexer-demultiplexer.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

PART-A

UNIT-I

Digital Circuits: Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **(11 Lectures)**

UNIT-II

Data Processing Circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.**(9 Lectures)**

PART-B

UNIT-III

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop. Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).
Lectures) **(10**

UNIT-IV

Counters and Converters: Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter. Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Digital to analogue converter, analogue to digital converter using counter.
Lectures) **(10**

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011,Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics G K Kharate ,2010, Oxford University Press
5. Digital Systems: Principles & Applications, R.J.Tocci, N.S. Widmer, 2001, PHI Learning
6. Logic circuit design, Shimon P. Vingron, 2012, Springer.
7. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
8. Digital Electronics, S.K. Mandal, 2010, edition, McGraw Hill

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PHYSICS-C	BSHP-225-21	PHYSICS LAB-VI	L-0, T-0, P-4	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory course of digital electronics. It covers practical training on basic Logic gates, flip-flops, sequential and combinational circuits, Timers, and counters.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	2	1
CO3	3	2	2	2	2	1	2	1	1	3	2	1
CO4	2	2	2	2	1	1	2	1	1	3	2	1
CO5	2	2	2	2	1	1	2	1	1	3	2	1

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Detailed Syllabus:

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

List of Experiments:

1. To measure (a) Voltage, and (b) Time period of a periodic waveform usingCRO.
2. To test a Diode and Transistor using aMultimeter.
3. To design a switch (NOT gate) using atransistor.
4. To verify and design AND, OR, NOT and XOR gates using NANDgates.
5. To design a combinational logic system for a specified TruthTable.
6. To convert a Boolean expression into logic circuit and design it is using logic gateICs.
7. To minimize a given logiccircuit.
8. Half Adder, Full Adder, and 4-bit binaryAdder.
9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full AdderI.C.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NANDgates.
11. To build JK Master-slave flip-flop using Flip-FlopICs
12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timingdiagram.
13. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-FlopICs.
14. To design an astable multivibrator of given specifications using 555Timer.
15. To design a monostable multivibrator of given specifications using 555Timer.

Reference Books:

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGrawHill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-GrawHill.

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PHYSICS-SEC -4	BSHP-226-21	ELECTRICAL CIRCUITS AND NETWORK SKILLS	L-0, T-1, P-2	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of this course is to enable the students to design, and trouble-shoot the electrical circuits, networks, and appliances through hands-on mode.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Familiarization with basic electronics devices such as, multimeter, voltmeter, and ammeter.
CO2	Understand the concept of generators and transformers.
CO3	Understand the DC Power sources, AC/DC generators, Inductance, capacitance, and impedance.
CO4	Apply the concept of operation of transformers.
CO5	Understand the concept of electric wiring and usage.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

PART-A

UNIT I

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter, and ammeter.

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary, and complex power components of AC source. Power factor. Saving energy and money.

(6 Lectures)

UNIT -II

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **(5 Lectures)**

PART-B

UNIT-III

Solid-State Devices: Resistors, inductors, and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) **(6 Lectures)**

UNIT-IV

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drops and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

(5 Lectures)

Reference Books:

1. A textbook in Electrical Technology - B L Theraja and A K Theraja - S Chand & Co.
2. Performance and design of AC machines - M G Say, CBS Publisher.
3. Electronic Principles (SIE)- Albert Malvino and David J. Bates 7th Edition,McGraw Hill Education.

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PHYSICS-SEC -5	BSHP-227-21	BASIC INSTRUMENTATION SKILLS	L-0, T-1, P-2	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply the fundamentals of instrumentation in measurements and calibration of instruments.
CO2	Make use of instrument with appropriate specifications and design of extension of range instrument.
CO3	Experiment with different bridge circuits for unknown parameter (Resistance, Capacitance) measurement.
CO4	Demonstrate the use of oscilloscopes for electrical parameter measurement.
CO5	Select the digital instrument for the measurement of given parameter and make use of recorder and function generator for the specified parameter

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

Detailed Syllabus:

PART-A

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

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Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance. **(6 Lectures)**

UNIT-II

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only-no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time-period, Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. **(6 Lectures)**

PART B

UNIT-III

Signal Generators and Analysis Instruments: Block diagram, explanation, and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters: Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges. **(6 Lectures)**

UNIT-IV

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time-base stability, accuracy, and resolution. **(5 Lectures)**

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment
6. Winding a coil / transformer
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

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Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q-meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.
9. Using a Dual Trace Oscilloscope
10. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books:

1. A Textbook in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, Ed., 2012, Tata Mc Graw Hill.
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

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PHYSICS-SEC -6	BSHP-228-21	SCIENTIFIC WORD PROCESSING	L-0, T-1, P-2	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of this course is not just to teach scientific documentation methods and numerical analysis but to emphasize its role in solving problems in Physics.*

- *Use of latex as a tool in writing scientific document in physics applications.*
- *Course will consist of hands-on training on the latex on Computers.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Explain, install, and use of TeX and LaTeX.
CO2	Describes the development process of TeX and LaTeX.
CO3	Explains the difference between TeX and LaTeX.
CO4	Tells the advantages of LaTeX over other more traditional software's.
CO5	Lists LaTeX compatible operating systems and use latex for scientific documentation purpose.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

PART-A

UNIT-I

Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type of style, Symbols from other languages.

(6 Lectures)

UNIT-II

Equation representation: Formulae and equations, Figures and other floating bodies, lining in columns- Tabbing and tabular environment, generating table of contents, bibliography, and citation, making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

(8 Lectures)

PART-B

UNIT-III

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving, and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot.

(8 Lectures)

UNIT-IV

Exercises:

1. Write a 20 pages report in latex on any topic of your interest in Physics.
2. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an .eps file and as a .pdf file.

Reference Books:

1. LaTeX-A Document Preparation System", Leslie Lamport (Second Edition, Addison- Wesley, 1994).
2. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
3. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
4. Computational Physics: An Introduction, R. C. Verma et al. New Age International Publishers, New Delhi (1999).

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Fifth Semester

Coursetype	Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
			L	T	P	Internal	External		
PHYSICS-C-11	BSHP-311-21	Quantum Mechanics	5	1	-	40	60	100	6
PHYSICS-C-12	BSHP-312-21	Solid State Physics	3	1	-	40	60	100	4
PHYSICS-C	BSHP-313-21	Physics Lab-VII	-	-	4	30	20	50	2
PHYSICS-C-	BSHP-314-21	Computational Physics Lab-I	-	-	4	30	20	50	2
DSE-1 DSE-2	BSHP-315-21 BSHP-316-21	Department Specific Elective (DSE)-1	5	1	-	40	60	100	6
DSE-3 DSE-4 DSE-5	BSHP-317-21 BSHP-318-21 BSHP-319-21	Department Specific Elective (DSE)-2	5	1	-	40	60	100	6
	TOTAL		**18**	**4**	**8**	**220**	**280**	**500**	**26**

Department Specific Electives -1 and 2 (Any two from the following list)

S. No.	Name of the Subject	Code
1	Atomic and Molecular Physics	BSHP-315-21
2	Nuclear Physics	BSHP-316-21
3	Dissertation	BSHP-317-21
4	Communication Electronics	BSHP-318-21
5	Renewable Energy and Energy Harvesting	BSHP-319-21

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PHYSICS-DSE -2	**BSHP-316-21**	**Nuclear Physics**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The course contents cover general properties of nuclei, nuclear models, radioactive decays, nuclear reactions, fission and fusion processes and applications, interaction of gamma ray, charged particles and neutrons radiation with matter and respective detectors.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the ideas of basics of nucleus and their energy.
CO2	Understand the procedures for nuclear fission and fusion.
CO3	Understand the relationship between various types of couplings.
CO4	Ability to have insight into the interplay between theory, models, and data from modernexperiments and into how the major open questions are being addressed.
CO5	A basic understanding of nuclear properties and models that describe the quantum structure, decay, and reactions of nuclei.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

Detailed Syllabus

PART A

UNIT-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Radioactivity decay: (α) Alpha decay: basics of α-decay processes, radioactive series, tunnel theory of α emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: β-, β+, EC decays, beta energy spectrum, end point energy, Gamma decay: Gamma rays' emission & kinematics, internal conversion. **(16 Lectures)**

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UNIT-II

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force, Meson theory of nuclear forces. **(14 Lectures)**

PART B

UNIT-III

Nuclear Reactions: Types of Reactions, Coulomb scattering (Rutherford scattering), Coulomb barrier, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction.

Fission and Fusion: Nuclear reactors, Breeder reactors, nuclear fusion in stars, formation of heavier elements, nuclear reactor accidents – Chernobyl and Fukushima, nuclear weapons, Fusion reactors, International thermonuclear experimental reactor (ITER). **(15 Lectures)**

UNIT-IV

Interaction of radiation and charged particles with matter: Interaction of gamma rays with matter - photoelectric effect, Compton scattering, pair production, Energy loss of electrons and positrons, Positron annihilation in condensed media, Stopping power and range of heavier charged particles, derivation of Bethe-Bloch formula, neutron interaction with matter.

Nuclear Detectors: Gas-filled detectors: ionization chamber, proportional counter and GM Counter. Basic principle of Organic and Inorganic scintillation detectors for gamma and electron radiation, photo-multiplier tube, Semiconductor detectors, Solid state nuclear track detectors, Neutron detector, Cherenkov detector, radiation monitoring devices. **(15 Lectures)**

Reference Books:

1. Introductory Nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of Nuclear Physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Concepts of Modern Physics by Arthur Beiser, Shobit Mahajan and S. Rai Choudhury (Tata Mcgraw Hill, 2006).
4. Modern Physics by J. Bernstein, Paul M. Fishbane, S. G. Gasiorowicz (Pearson, 2000).
5. Introduction to the physics of Nuclei & Particles, R.A. Dunlap. (Thomson Asia, 2004).
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
7. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
8. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
9. Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991).

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PHYSICS-DSE -3	**BSHP-317-21**	**DISSERTATION**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Understanding of Physics and Mathematics

Course Objectives:

Course Outcomes: At the end of the course, the student will be able to

CO1	Explain the significance and value of problem in physics, both scientifically and in the wider community.
CO2	Design and carry out experiments as well as accurately record the results of experiments.
CO3	Critically analyse and evaluate experimental strategies and decide which is most appropriate for answering specific questions.
CO4	Research and communicate scientific knowledge in the context of a topic related to physics.
CO5	Explore new areas of research in physics and allied fields of science and technology.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

Guidelines:

- The aim of project work in B.Sc. (H.S.) 5th semester is to expose the students to Instrumentation, Power Electronics, Microcontroller, Digital communication.
- It may include development of pulse processing electronic modules, power supplies, software-controlled equipment in a research laboratory, or fabrication of a device. Project work based on participation in some ongoing research activity or analysis of data or review of some research papers is included.
- A student will work under the guidance of a faculty member from the department before the end of the 5th semester.
- A report of nearly 40 pages about the work done in the project (typed on both the sides of the paper and properly bound) will be submitted by a date to be announced by the Department.
- Assessment of the work done under the project will be carried out by a committee based on grasp of the problem assigned, efforts put in the execution of the project, degree of interest shown in learning the methodology, report prepared, and viva-voce/seminar, etc., as per guidelines.

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PHYSICS-DSE-4	**BSHP-318-21**	**COMMUNICATION ELECTRONICS**	**L-5, T-1, P-0**	**Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The fundamental objectives of this course are to make the student understand and use the basic concepts of the circuits found in radiocommunications, be able to interpret and analyze the characteristics of the main components of communication electronics and be able to design the simplest devices and transmitting the signals.*

Course Outcomes: At the end of the course, students will be able to

CO1	Introduced to the communicationmethods means and modes.
CO2	Compare the performance of AM, FM and PM schemes with reference to SNR
CO3	Understand noise as a random process and its effect on communication receivers
CO4	Evaluate the performance of PCM, DPCM and DM in a digital communication system
CO5	Identify source coding and channel coding schemes for a given communication link

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

PART A

UNIT-I

Electronic communication: Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system. Basic principles of propagation of e. m. waves through atmosphere and ionosphere, Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base-band signals. Concept of Noise, signal-to- noise (S/N) ratio.

(10 Lectures)

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UNIT-II

AM Transmission and Reception: Mathematical analysis of AM, Power content of sidebands and carrier, Generation of AM signals, switching modulator, square law modulation, double sideband suppressed carrier modulation, Ring modulator, Coherent detection, Costas receiver, Receiver Parameters; Selectivity, Sensitivity, Fidelity, Super heterodyne Receiver. Generation of SSB signals; Filter method, Phase-shift Method, Demodulation of SSB-SC signals. Transmission and reception of vestigial side band signals.

FM Transmission and Reception: Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, FM allocation standards, generation of FM signals, Direct and Indirect FM, Diode reactance modulator, Phase-Locked-Loop, Armstrong method, RC phase shift method, Frequency stabilized reactance FM transmitter. Frequency demodulators tuned circuit frequency discriminators; FM stereo multiplexing, FM detection using PLL.
(16 Lectures)

PART B

UNIT-III

Analog Pulse Modulation: Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.

Digital transmission – Need for digital transmission, Pulse code modulation, Sampling, Aliasing, quatisation error, Digital carrier modulation and demodulation techniques: Information capacity, Shannon limit of information capacity, ASK, FSK, PSK, Differential encoder and decoder, Differential PSK, modulators and detectors, Scrambling and descrambling.

Advanced communication: Overview of picture and sound transmission and reception, channel band width, television standards, Block diagram of T.V. receivers, Concept of colour picture transmission. **(15 Lectures)**

UNIT-IV

Satellite Communication: Introduction, need, Geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink. FDMA, TDMA, CDMA, SDMA.

Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, simplified block diagram of mobile phone handset, 2G, 3G 4G and 5G concepts (qualitative only). GPS navigation system (qualitative idea only) **(14 Lectures)**

TUTORIALS: Relevant problems on the topics covered in the course.

Reference Books:

1. Communication Systems: B.P. Lathi, Wiley Eastern Limited.
2. Communication Systems, S. Haykin, 2006, Wiley India
3. Principles of Communication Systems: Taub and Schilling, John Wiley and Sons.

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4. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
5. Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
6. Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill.
7. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
8. Electronic Communication system, Blake, Cengage, 5th edition.
9. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press
10. Digital Computer Electronics: Albert P. Malvino, Jerald A Brown Tata-McGraw Hill.
11. Digital signal Transmission: C.C. Bissell and D.A. Chapman, Cambridge University Press.

PHYSICS-DSE -5	**BSHP-319-21**	**RENEWABLE ENERGY AND ENERGY HARVESTING**	**L-5, T-1, P-0**	**6 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible*

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the energy demand of world & distinguish between traditional and alternative form of energy.
CO2	Describe the concept of solar energy radiation and thermal applications.
CO3	Analyze making of solar cell and its types.
CO4	Identify hydrogen as energy source, its storage and transportation methods.
CO5	Compare wind energy, wave energy and ocean thermal energy conversion.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

PART A

UNIT-I

Introduction to alternate sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. Renewable energy source, Types of

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renewable energy, zero-carbon or low-carbon energy, Working of renewable energy sources: Solar energy, Wind energy, Hydro energy, Tidal energy, Geothermal energy, Biomass energy,biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. Scope and future of renewable energy.

(11 Lectures)

Unit II

Solar energy and solar cell: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

(13 Lectures)

PART B

UNIT-III

Hydrogen Energy: Solar hydrogen through photo electrolysis and photocatalytic process, Physics of material characteristics for production of solar hydrogen.

Production storage and transportation: Storage processes, solid state hydrogen storage materials, structural and electronic properties of storage materials, new storage modes, safety factors, use of hydrogen as fuel; use in vehicles and electric generation, fuel cells, hydride batteries. **(15 Lectures)**

UNIT-IV

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices, Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass, Geothermal Energy: Geothermal Resources, Geothermal Technologies. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials, and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications.

(15 Lectures)

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

Reference Books:

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PHYSICS-C	**BSHP-313-21**	**PHYSICS LAB-VII**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: The aim and objective of the lab course is to introduce the students to the formal structure of solid state physics so that they can use these as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Detailed Syllabus:

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

List of Experiments:

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150 oC) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
12. To study of Zeeman effect: with external magnetic field; Hyperfine splitting
13. To show the tunneling effect in tunnel diode using I-V characteristics.
14. Quantum efficiency of CCDs

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson, and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

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PHYSICS-C	**BSHP-314-21**	**COMPUTATIONAL PHYSICS LAB**	**L-0, T-0, P-4**	**2 Credits**

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: The aim and objective of the lab course is to introduce the students to the formal structure of computational physics so that they can use these essential to solve the physics problems.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

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Note: Students are expected to perform atleast 10 experiments out of following list using C++ and Gnuplot.

List of experiments:

1. To find the standard deviation, mean, variance, moments etc. of at least 15 entries.
2. To compile a frequency distribution and evaluate mean, standard deviation etc.
3. To evaluate sum of finite series and the area under a curve.
4. To find the product of two matrices
5. To find a set of prime numbers and Fibonacci series.
6. To write program to open a file and generate data for plotting using Gnuplot.
7. To choose a set of 10 values and find the least squared fitted curve.
8. Plotting trajectory of a projectile projected horizontally.
9. Plotting trajectory of a projectile projected making an angle with the horizontally.
10. To find the roots of a quadratic equation.
11. Motion of a projectile using simulation and plot the output for visualization.
12. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
13. Motion of particle in a central force field and plot the output for visualization.
14. To find the determinant of a matrix and its eigenvalues and eigenvectors.
15. To generate random numbers between (i) 1 and 0, (ii) 1 and 100.

Text and Reference Books:

1. Numerical Mathematical Analysis, J.B. Scarborough (Oxford & IBH Book Co.) 6th ed., 1979.
2. A first course in Computational Physics: P.L. DeVries (Wiley) 2nd edition, 2011.
3. Computer Applications in Physics: S. Chandra (Narosa) 2nd edition, 2005.
4. Computational Physics: R.C. Verma, P.K. Ahluwalia and K.C. Sharma (New Age) 2000.
5. Object Oriented Programming with C++: Balagurusamy, (Tata McGrawHill) 4th edition 2008.

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1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

SEMESTER-VI

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Sixth Semester

Coursetype	Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Cr
			L	T	P	Internal	External		
PHYSICS-C-13	BSHP-321-21	Electromagnetic Theory	5	1	-	40	60	100	6
PHYSICS-C-14	BSHP-322-21	Statistical Mechanics	3	1	-	40	60	100	4
PHYSICS-C-	BSHP-323-21	Physics Lab -VIII	-	-	4	30	20	50	2
DSE-6 DSE-7 DSE-8 DSE-9 DSE-10	BSHP-324-21 BSHP-325-21 BSHP-326-21 BSHP-327-21 BSHP-328-21	Department Specific Elective (DSE)-3 Department Specific Elective (DSE)-4	5 5	1 1	- -	40 40	60 60	100 100	6 6
	TOTAL		**18**	**4**	**4**	**190**	**260**	**450**	**24**

Department Specific Electives- 3 and 4 (Any two from the following list)

S. No.	Name of the Subject	Code
1	Particle Physics	BSHP-324-21
2	Advanced Mathematical Physics	BSHP-325-21
3	Advanced Condensed Matter Physics	BSHP-326-21
4	Experimental Techniques	BSHP-327-21
5	Radiation Safety	BSHP-328-21

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PHYSICS-C	BSHP-323-21	PHYSICS LAB-VIII	L-0, T-0, P-4	2 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The laboratory should help the student develop a broad array of basic skills and tools of experimental physics and data analysis.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

Note: Students are expected to perform 8-10 experiments from the list taking at least 2-3 from the virtual lab.

List of Experiments:

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves.

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7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

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PHYSICS-DSE -9	BSHP-327-21	EXPERIMENTAL TECHNIQUES	L-5, T-1, P-0	6 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of course is to introduce students to basic experimental techniques, measurement theory and experiment design. The primary goal is to develop an appreciation of the role and significance of experimentation in the field of science. Students will be exposed to some widely employed experimental techniques and be introduced to some of the instrumentation that is used in experimental physics research.*

Course Outcomes: At the end of the course, the student will be able to

CO1	mastered the use of digital multimeters and oscilloscopes to measure DC and AC voltages and currents.
CO2	mastered the assessment of reasonable experimental uncertainty in a variety of different measurements and understood how to minimize that uncertainty.
CO3	rigorously analyzed experimental data using accepted error analysis methodologies to verify theoretical predictions.
CO4	Use the tools, methodologies, language and conventions of physics to test andcommunicate ideas and explanations.
CO5	learned to efficiently search the scientific literature and critically assess the scientific merit of what they read.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	2	1	2	3	2	2
CO2	2	2	1	2	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	2	1	1	3	1	1
CO4	2	2	2	2	1	1	2	1	1	3	1	1
CO5	2	2	2	2	1	1	2	1	1	3	1	1

PART A

UNIT-I

Measurements: Accuracy and precision. Significant figures. Error and uncertainty analysis. Types of errors: Gross error, systematic error, random error. Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution.

(10 Lectures)

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UNIT-II

Signals and Systems: Periodic and aperiodic signals. Impulse response, transfer function and frequency response of first and second order systems. Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise, 1/f noise.

Shielding and Grounding: Methods of safety grounding. Energy coupling. Grounding. Shielding: Electrostatic shielding. Electromagnetic Interference. **(14 Lectures)**

PART B

UNIT-III

Transducers & industrial instrumentation (working principle, efficiency, applications): Static and dynamic characteristics of measurement Systems. Generalized performance of systems, Zero order first order, second order and higher order systems. Electrical, Thermal and Mechanical systems. Calibration. Transducers and sensors. Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75) and signal conditioning. Linear Position transducer: Strain gauge, Piezoelectric. Inductance change transducer: Linear variable differential transformer (LVDT), Capacitance change transducers. Radiation Sensors: Principle of Gas filled detector, ionization chamber, scintillation detector.

(16 Lectures)

UNIT-IV

Digital Multimeter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy, and resolution of measurement.

Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge. Q-meter and its working operation. Digital LCR bridge.

Vacuum Systems: Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization). **(12 Lectures)**

Reference Books:

1. Measurement, Instrumentation and Experiment Design in Physics and Engineering,
2. M. Sayer and A. Mansingh, PHI Learning Pvt. Ltd.
3. Experimental Methods for Engineers, J.P. Holman, McGraw Hill
4. Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd.
5. Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.
6. Instrumentation Devices and Systems, C.S. Rangan, G.R. Sharma, V.S.V. Mani, Tata McGraw Hill
7. Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd.
8. Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk, Springer

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PHYSICS-DSE-10	BSHP-328-21	RADIATION SAFETY	L-5, T-1, P-0	6 Credits

Pre-requisite: Understanding of senior secondary level Physics and Mathematics

Course Objectives: *The aim of this course is for awareness and understanding regarding radiation hazards and safety. The list of laboratory skills and experiments listed below the course are to be done in continuation of the topics.*

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basics of nuclear and particle physics.
CO2	Students will demonstrate knowledge of radiation safety.
CO3	Students will use critical thinking and problem-solving skills to understand the impact of radiation hazardous.
CO4	Compare the effects of radiation has on a variety of biological and non-biological materials.
CO5	account for the role of radiation physics in a societal context, including climate and environmental challenges.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	3	2	1	2	3	2	2
CO2	2	2	1	2	1	3	1	1	1	3	3	2
CO3	3	2	2	2	1	3	2	1	1	3	3	1
CO4	2	2	2	2	1	3	2	1	1	3	3	1
CO5	2	2	2	2	1	3	2	1	1	3	2	1

Detailed Syllabus:

PART A

UNIT-I

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half-life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission. **(15 Lectures)**

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UNIT-II

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, Interaction of Photons - Photo- electric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and Moderation. **(15 Lectures)**

PART B

UNIT-III

Radiation detection and monitoring devices: Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). Radiation detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry. **(15 lectures)**

UNIT-IV

Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management.

Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, and Food preservation. **(15 Lectures)**

Reference Books:

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F. Knoll, Radiation detection and measurements
3. Thermoluninescense Dosimetry, Mcknlay A.F., Bristol, Adam Hilger (Medical Physics Handbook)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand-Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
6. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowental and P.L. Airey, Cambridge University Press, U.K., 2001
7. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.
8. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publishers Inc. London, 1981.

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