PROGRAMME BOOKLET

B.Sc.(Hons.) Physics (PHU01)
(Batch: 2022-2025)
(Syllabus: Scheme B)

Department of Physics
Faculty of Applied Sciences
Manav Rachna University

MANAV RACHNA UNIVERSITY

Vision

To educate students in frontier areas of knowledge enabling them to take up challenges as ethical and responsible global citizens

Mission

- **To impart outcome based holistic education**
- **To disseminate education in frontier areas**
- **To produce globally competitive, ethical and socially responsible human resources**
- **To produce human resources sensitive to issues of Environment and Sustainable Development**
- **To develop Environment and Sustainable development as a thrust area of research and development.**

Quality Policy

To continuously learn from the best practices, study role models and develop transparent procedures for empowerment of stakeholders.

Strategic Objectives

- **To facilitate, enhance & promote innovation in curriculum design and delivery and have Outcome-oriented Learning Culture.**
- **To promote Research Environment and Management Practices.**
- **To enhance the quality of the student learning experience.**
- **To provide Resources and Infrastructure for Academic Excellence.**

DEPARTMENT OF PHYSICS

Vision

- **To educate the students in frontier areas of Physics enabling them to take challenges to solve the problem of the society.**

Mission

- **To inculcate outcome based holistic education in frontier areas of Physics.**
- **To develop competent physicists who address future issues of the society.**
- **To conduct interdisciplinary research in thrust areas.**
- **To produce good quality human resources sensitive to environmental and sustainable development issues.**
- **To produce globally competitive, ethical and socially responsible young minds.**

B.Sc. (Hons.) Physics

Programme Educational Objectives (PEOs)

- The students are expected to understand the fundamentals, principles, concepts and recent developments in the Physics.
- The practical course is framed in relevance with the theory courses to improve the understanding of the various concepts in Physics.
- It is expected to inspire and boost interest of the students in Physics.
- To develop the power of appreciations, the achievements in science and role in nature and society.

ProgrammeOutcomes(POs)

- Fundamental understanding of the field
- Application of basic Physics concepts
- Linkages with related disciplines
- Procedural knowledge for professional subjects
- Skills in related field of specialization
- Ability to use in Physics problem
- Skills in Mathematical modeling
- Skills in performing analysis and interpretation of data
- Develop investigative Skills
- Skills in problem solving in Physics and related discipline
- Develop Technical Communication skills
- Developing analytical skills and popular communication
- Developing ICT skills
- Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self-reading, etc

Programme Structure (Complete Structure)

Semester -1

COURSE CODE	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective/ University Compulsory)	L	T	P	NO. OF CREDITS
PHH104B-T	Mathematical Physics-I	PH	CORE	3	1	0	4
PHH104B-P	Mathematical Physics-I Lab	PH	CORE	0	0	2	1
PHH105B-T	Mechanics	PH	CORE	3	1	0	4
PHH105B-P	Mechanics Lab	PH	CORE	0	0	2	1
CHH105B-T	Essential of chemistry	CH	CORE	3	1	0	4
CHH105B-P	Essential of chemistry Lab	CH	CORE	0	0	2	1
CSH105B - T	Programming for Problem Solving Using C	CS	CORE	3	1	0	4
CSH105B-P	Programming for Problem Solving Using C	CS	CORE			2	1
HLS102	Communicative English	HL	GE	1	0	2	2
	TOTAL (L-T-P-/CREDITS)			14	4	8	22

Semester-II

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
PHH107B-T	**Electricity and Magnetism**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH107B-P	**Electricity and Magnetism Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH108B-T	**Wave Optics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH108B-P	**Wave Optics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH109B-T	**Mathematical Physics II**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH109B-P	**Mathematical Physics II Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
CHH137	**Environmental Science**	**CH**	**UCC**	**2**	**0**	**2**	**4**
CDO111	**Professional Competency-I**	**CDC**		2	0	0	1
	TOTAL (L-T-P-/CREDITS)			**13**	**3**	**8**	**20**
PHO219B	**Post 2nd semValue added summer training course**						**02**

Semester-III

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT		L	T	P	NO. OF CREDITS
PHH201B-T	**Quantum Mechanics**	**PH**		**3**	**1**	**0**	**4**

PHH201B-P	**Quantum Mechanics Lab**	**PH**		**0**	**0**	**2**	**1**
PHH202B-T	**Mathematical Physics III**	**PH**		**3**	**1**	**0**	**4**
PHH202B-P	**Mathematical Physics III LAB**	**PH**		**0**	**0**	**2**	**1**
PHH203B-T	**Electromagnetic theory**	**PH**		**3**	**1**	**0**	**4**
PHH203B-P	**Electromagnetic theory Lab**	**PH**		**0**	**0**	**2**	**1**
CDO211	**Professional Competency-II**	**CDC**		2	0	0	1
FLS101	**Spanish I**	**CDC**		**1**	**1**	**0**	**2**
FLS102	**German I**						
FLS103	**French I**						
	Open elective Odd Semester Basket/mini project-1	**offered by different departments**		**1**	**0**	**2**	**2**
	TOTAL (L-T-P/CREDITS)			**13**	**4**	**8**	**20**

ELECTIVE BASKET										
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective/ University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
EDS288	**Applied Philosophy**	**Education**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
EDS289	**Applied Psychology**	**Education**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
EDS290	**Applied Sociology**	**Education**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
MCS231	**Basics of Economics**	**Management**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**

MCS232	**Introduction of Finance**	**Management**	**NTCC**	**ELECTIVE**	**0**	**0**	**2**	**0**	**2**	**2**
PHN204	**Mini Project-I**	**Physics**	**Soft**	**ELECTIVE**						**2**

Semester-IV

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
MAH411-T	**Numerical Analysis**	**MA**	**CORE**	**3**	**1**	**0**	**4**
MAH411-P	**Numerical Analysis Lab**	**MA**	**CORE**	**0**	**0**	**2**	**1**
PHH205B-T	**Thermodynamics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH205B-P	**Thermodynamics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH206B-T	**Solid State Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH206B-P	**Solid State Physics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
ECS306B	**E-Waste Environmental Problems & Management/**	**ECE**	**GE**	**1**	**0**	**2**	**2**
CHS234	**Environmental Ethics and Sustainable Development**	**CH**		**1**	**0**	**2**	**2**

LWS323	**Cybercrime and laws**	**Law**		**1**	**1**	**0**	**2**
PHN207	**Mini Project**	**PH**		**0**	**0**	**4**	**2**
CDO212	**Professional Competency-III**	**CDC**	AP/AF	2	0	0	1
	TOTAL (L-T-P-/CREDITS)			**12**	**3**	**8**	**18**

Semester-V

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
PHH301B-T	**Statistical Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH301B-P	**Statistical Physics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH302B-T	**Digital Electronics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH302B-P	**Digital Electronics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH303B-T	**Condensed Matter Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH304B-T	**Modern Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH304B-P	**Modern Physics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHN305	**Project Work (Minor)-3**	**PH**	**CORE**	**0**	**0**	**0**	**4**
CDO311	**Professional Competency-IV**	**CDC**	AP/AF	2	0	0	1
	TOTAL (L-T-P-/CREDITS)			**14**	**4**	**6**	**24**

Semester-VI

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
PHH306B-T	Electronic Devices	PH	CORE	3	1	0	4
PHH306B-P	Electronic Devices Lab	PH	CORE	0	0	2	1
PHH310B-T	Atmospheric Physics	PH	Elective (Any Two)	3	1	0	10
PHH310B-P	Atmospheric Physics Lab	PH		0	0	2	
PHH311B-T	Computational Condensed Matter Physics	PH		3	1	0	
PHH311B-P	Computational Condensed Matter Physics Lab	PH		0	0	2	
PHH312B-T	Laser Fundamentals and its Applications	PH		3	1	0	
PHH312B-P	Laser Fundamentals and its Applications Lab	PH		0	0	2	
PHH313B-T	Quantum Computing	PH		4	1	0	
PHH314B-T	Energy, Environment and Climate Change Concerns	PH		3	1	0	
PHH314B-P	Energy, Environment and Climate Change Concerns Lab	PH		0	0	2	

PHH315B-T	**Introduction to Astronomy and Astrophysics**	**PH**		**4**	**1**	**0**	
CDO312	**Professional Competency-V**	**CDC**		2	0	0	1
PHN307	**Major Project**	**PH**	**core**	**0**	**0**	**16**	**8**
	TOTAL (L-T-P/CREDITS)			**11**	**3**	**6**	**24**

Total Credits Scheme

S. No.	Semester	Contact Hours	Credits
1	**I**	**26**	**22**
2	**II**	**24**	**20**
3	**Summer Training (Post II Sem)**	**42**	**2**
4	**III**	**25**	**20**
5	**IV**	**23**	**18**
6	**V**	**24**	**24**
7	**VI**	**20**	**24**
Total		**184**	**130**

B.Sc. (Hons.) Physics - PHU01
Semester-I

COURSE CODE	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective/ University Compulsory)	L	T	P	NO. OF CREDITS
PHH104B-T	Mathematical Physics-I	PH	CORE	3	1	0	4
PHH104B-P	Mathematical Physics-I Lab	PH	CORE	0	0	2	1
PHH105B-T	Mechanics	PH	CORE	3	1	0	4
PHH105B-P	Mechanics Lab	PH	CORE	0	0	2	1
CHH105B-T	Essential of chemistry	CH	CORE	3	1	0	4
CHH105B-P	Essential of chemistry Lab	CH	CORE	0	0	2	1
CSH105 B - T	Programming for Problem Solving Using C	CS	CORE	3	1	0	4
CSH105 B – P	Programming for Problem Solving Using C	CS	CORE			2	1
HLS102	Communicative English	HL	GE	1	0	2	2
	TOTAL (L-T-P-/CREDITS)			14	4	8	22

Detailed Syllabus

SEMESTER I

Course Title/Code	Mathematical Physics I (PHH104B-T)	
Course Type	Core (Deptt./Allied)/Elective (Deptt./Allied)/Audit	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study differential equations of first and second order,vector and integral calculus, gradient, divergence, and Laplacian in different coordinate systems	
Course Outcomes (COs)		Mapping
CO1	Ability to solve the differential equations of first and second order and to apply them in order to model a known physical phenomenon mathematically	Skill Development
CO2	Ability to perform vector operations in Cartesian and Curvilinear coordinate systems and to develop an understanding of their applications in physical sciences.	Skill Development
CO3	Ability touse the fundamental theorem of calculus in order to calculate the definite integral of an integral function in one, two and three dimensions.	Skill Development
CO4	Ability to understand the orthogonal curvilinear coordinate system and to determine vector derivatives in Cartesian, spherical and cylindrical coordinate systems and to develop an understanding of their applications in physical sciences.	Employability
Prerequisites (if any)		

Section - A

Differential Calculus

Limits, Continuity, Average and Instantaneous Quantities, Differentiation, Functions and Plotting of Curves, First Order Differential Equations, Second Order Differential Equations, Homogeneous Equations with Constant Coefficients.

SECTION- B

Vector Calculus

Properties of Vectors under Rotations, Scalar Product and Its Invariance under Rotations, Vector Product, Scalar Triple Product and Their Interpretation in Terms of Area and Volume Respectively, Scalar and Vector Fields, Vector Differentiation: Directional Derivatives and Normal Derivative, Gradient of A Scalar Field and Its Geometrical Interpretation, Divergence and Curl of A Vector Field, Del and Laplacian Operators, Vector Identities,

Section - C

Integral Calculus

Surface and Volume Integrals of Vector Fields, Gauss' Divergence Theorem, Green's and Stokes Theorems and Their Applications (No Rigorous Proofs), Line, surface and volume integrals of Vector fields, Definition of Dirac Delta Function, Representation as Limit of a Gaussian Function and Rectangular Function. Properties of Dirac Delta Function.

Section- D

Orthogonal Curvilinear Coordinates

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Textbooks

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier (Text Book)

2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

CO-PO Mapping

Courses Code	Course	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH104B-T	Mathematical Physics-I	CO1	3	-	-	3	-	3	3	-	-	3	-	-	-	-
		CO2	3	-	-	3	-	3	3	-	-	3	-	-	-	-
		CO3	3	-	-	3	-	3	3	-	-	3	-	-	-	-
		CO4	3	-	-	3	-	3	3	-	-	3	-	-	-	-

Course Title/Code	Mathematical Physics-I Lab (PHH104B-P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To study differential equations of first and second order,vector and integral calculus, gradient, divergence, and Laplacian in different coordinate systems	
Course Outcomes (COs)		Mapping
CO	Ability to solve different mathematical and differential equations of first and second order using Scilab.	Skill Development
Prerequisites (if any)		

List of Experiments

1- Plotting of Different functions.

2- To solve the first order differential equations.

3- To solve second order differential equations.

4- To calculate gradient of a function.

5- To calculate divergence of a function.

6- To calculate curl of a function.

CO-PO MAPPING

Courses Code	Course	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH104B-P	Mathematical Physics-I Lab	CO	3	-	-	3	-	3	3	-	-	3	-	-	-	-

Course Title/Code	Mechanics (PHH105B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study mechanics of particles and system of particles in Galilean reference frames and study rotational dynamics, Oscillations and Motion under central forces using laws of mechanics	
Course Outcomes (COs)		Mapping
CO1	Ability to describe rotational behavior of particle and system of particles by applying the conservation laws	Skill Development
CO2	Describe Simple Harmonic Motion (SHM), damped and forced oscillations	Skill Development
CO3	Apply on problems of central forces in the radial coordinate system.	Skill Development
CO4	Explain different types frames of reference and apply them for specific problems	Skill Development
Prerequisites (if any)		

Section-A

Fundamental of Dynamics and Work & Energy

Review of Newton's Laws of Motions, Dynamics of a System of Particles, Centre of Mass, Principle Conservation of Momentum, Impulse, Momentum of Variable-Mass System: Motion of Rocket.

Work and Kinetic Energy Theorem, Conservative and Non-Conservative Forces, Potential Energy, Energy Diagram, Stable and Unstable Equilibrium, Force As Gradient of Potential Energy, Work and Potential Energy, Work Done By Non-Conservative Forces, Law of Conservation of Energy.

Section-B

Rotational Dynamics

Angular Momentum of a Particle and System of Particles, Torque, Principle of Conservation of Angular Momentum, Rotation about a Fixed Axis, Moment of Inertia, Calculation of Moment of

Inertia for Rectangular, Cylindrical, and Spherical Bodies, Kinetic Energy of Rotation, Motion of Flywheel

Section-C

Oscillations

Simple Harmonic Oscillations, Differential Equation of SHM and its Solution, Kinetic energy, Potential energy, and Total Energy and their Time Average Values, Damped oscillation, Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and quality Factor

Section-D

Motion under Central Forces

Concepts of Central Forces, Kepler's Laws of Planetary Motion, Gravitational Law, Gravitational Potential and Fields due to Spherical Shells and Solid Sphere, Gravitational Potential Energy and Escape Velocity, Two Particle Central Force Problem and Reduced Mass, Motion of Planets and Satellites.

Text and Reference Books

1. An introduction to mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973)

2. Mechanics Berkeley physics course, v.1: By Charles Kittel,Walter Knight, Malvin Ruderman,CarlHelmholz,Burton Moyer, (Tata McGraw-Hill, 2007)(Text Book)

3. Mechanics by D S Mathur (S. Chand & Company Limited, 2000)(Text Book)

4. Mechanics by Keith R. Symon (Addison Wesley; 3 edition, 1971)

5. University Physics by F W Sears, M W Zemansky and H D Young (NarosaPublishingHouse, 1982)

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH105B-T	Mechanics	CO1	3	3	3	-	-	1	1	-	2	3	-	2	2	2
		CO2	3	3	3	-	1	-	-	-	2	3	-	1	2	2
		CO3	3	3	3	1	1	-	-	3	-	3	1	-	2	2
		CO4	3	3	3	-	1	-	1	-	2	3	-	2	2	2

Course Title/Code	Mechanics Lab (PHH105B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To study mechanics of particles and system of particles in Galilean reference frames and study rotational dynamics, Oscillations and Motion under central forces using laws of mechanics	
Course Outcomes (COs)		Mapping
CO	Ability to describe and demonstrate rotational behavior of particle and system of particles by applying the conservation laws.	Skill Development
Prerequisites (if any)		

LIST OF EXPERIMENTS

1. To determine the acceleration due to gravity and velocity for a freely falling body, using Digital Timing Techniques
2. To determine the Moment of Inertia of a Flywheel
3. To determine the coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method)
4. To determine the Young's Modulus of a wire by Optical Lever Method
5. To determine the Modulus of Rigidity of a wire by Maxwell's needle
6. To determine the Electic Constants of a Wire by Searle's Method.
7. To study simple harmonic motion of mass spring system.
8. To study simple harmonic motion of compound pendulum.
9. To determine value of g using bar pendulum.
10. To determine the moment of inertia of a disc using Trosional pendulum.
11. To study damped oscillations of series LCR circuit.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH105B-P	Mechanics	CO1	3	3	3	-	-	1	1	-	2	3	-	2	2	2

Course Title/Code		Essentials of Chemistry (CHH105B-T)
Course Type		Core
L-T-P Structure		3-1-0
Credits		4
Course Objective		To integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems.
Course Outcomes (COs)		Mapping
CO1	Gain knowledge of concepts and phenomenon related to electronic structure of atom.	
CO2	Understand various types of titration and their applications.	
CO3	Analyze the concentration of solutions.	
CO4	Evaluate the pH of hydrolysis of salts.	
CO5	Remember the concept and application of colloids and catalysis.	
CO6	Synthesize and create adsorption isotherms.	
Prerequisites		

Section - A

ATOMIC STRUCTURE: Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Quantum numbers and their significance. 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.

Bonding: Valence-Bond Approach to Bonding in Complexes; Crystal Field Theory: Octahedral Crystal Fields; Tetrahedral Crystal Fields; Square-Planar Complexes; High-Spin Versus Low-Spin Octahedral Complexes; High-Spin Versus Low-Spin tetrahedral Complexes

Section -B

Analytical Chemistry: Titrations: Terminology- equivalence point and end point, primary and secondary standards, reactions used for titrations, molarity and normality, some examples of stoichiometric calculations.

Acid-base titration, Acid-base indicators, theory of acid base indicators, calculation of pH values at different stages of the acid base titration and titration curve.

Precipitation and Complexometric Titration: indicator theory, effect of complexing agents and their advantages, examples including EDTA based titration and titration curve,

Back and blank titration with examples, Gravimetric Method of Analysis with examples Electrochemistry in Analysis: Redox titrations, Redox indicators, their use in volumetric analysis, iodometry and iodimetry, example of titration from other redox systems.

Section - C

IONIC EQUILIBRIA: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids.

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Theory of acid–base indicators; selection of indicators and their limitations. Hydrolysis and hydrolysis constants.

Section - D

SURFACE AND COLLOIDS CHEMISTRY: Physical adsorption, chemisorption, nature of adsorbed state. Adsorption- Langmuir and Freundlich isotherms. Multilayer adsorption-BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), emulsions and emulsifiers, association colloids (micelles), gels. Applications of colloids

Catalysis: Types of catalysts, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis and mechanism.

Text and Reference Books

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University 12 Press (2014).
2. Qualitative Analysis Day and Underwood, 5th edition, Prentice-Hall (1986).
3. Fundamentals of Analytical Chemistry Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch, 9th Edition,Cengage Learning(2013).
4. F. A. Cotton, G. Wilkinson, P. G. Gauss, Basic Inorganic Chemistry, 3rd Edition, John Wiley, 1995
5. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

CO-PO MAPPING

Course Code	Course	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CHH105B-T	Essentials of Chemistry	CO1	1	-	3	3	-	-	-	-	-	-	-	-	-	1
		CO2		-	3	3	-	-	-	-	-	-	2	1		1
		CO3	2	-	3	3	-	-	-	-	-	-	-	-	-	1
		CO4		-	3	3	-	-	-	-	-	-	2	1		2
		CO5	1	-	3	3	-	-	-	-	-	-	-	-	-	2
		CO6	1	-	3	3	-	-	-	-	-	-	-	1	-	2

Course Title/Code		Essentials of Chemistry (CHH105B-P)
Course Type		Core
L-T-P Structure		0-0-2
Credits		1
Course Objective		To integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems.
Course Outcomes (COs)		Mapping
CO1	Understand various types of titration and their applications.	
CO2	Analyze the concentration of solutions.	
CO3	Evaluate the pH of hydrolysis of salts.	
Prerequisites		

LIST OF EXPERIMENTS

1. To determine strength of unknown HCl by titrating it against N/10 NaOH
2. To estimate the amount of Zinc present in a given solution by EDTA method.
3. To estimate the amount of Magnesium present in a given solution by EDTA method.
4. To estimate the amount of copper present in given solution by EDTA method.
5. To determine amount of Cu(II) in an unknown sample by iodometric titration.
6. To determine strength of given solution of ferrous ammonium sulphate (mohr salt) being provided with N/30 $KMnO_4$.
7. To estimate amount of Barium gravimetrically.
8. To find the Strength of an acid (Strong Acid -HCl OR weak acid- CH_3 COOH conductometrically.
9. To determine the adsorption of aqueous acetic acid by activated charcoal and study adsorption isotherm
10. To determine the solubility of a salt (KCl or NaCl) in water at room temperature
11. To determine the solubility of organic acid (oxalic acid) in water at room temperature
12. To determine the solubility product of calcium hydroxide using common ion effect of sodium hydroxide or any other strong alkali.

CO-PO MAPPING

Course Code	Course	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CHH10	Essential	CO1	1	-	-	-	-	-	-	-	3	-	2	3	-	-

5B-P	**s of Chemistry**	**CO2**	2	-	-	-	-	-	-	-	3	-	2	3	-	-
		CO3	2	-	-	-	-	-	-	-	3	-	2	3	-	-

Course Title/Code	Programming for Problem Solving Using C (CSH105B-T)	
Course Type	Core (Allied)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To construct a program of moderate complexity from a specification	
Course Outcomes (COs)		Mapping
CO1	Analyze and apply Test Driven Development approach to design programs.	Skill Development and Employability
CO2	Understand and apply programming language constructs as per given problems	Skill Development and Employability
CO3	Understand and apply C programming language constructs on open source platform	Skill Development and Employability
CO4	learn to work in a team using different online platform for program development	Skill Development and Employability
Prerequisites (if any)		

Section-A

Programming and UNIX

Students will learn the basics of programming using Scratch, they will learn to use statements, expressions, conditions, selection, iteration, variables, functions, arrays, threads and events. In addition, they will be introduced to basic UNIX commands under Bash.

Introduction to Programming, test driven development, Scratch: Introduction, statements, expressions, conditions, selection, iteration, variables, functions, arrays.UNIX: Basic commands-pwd, ls, cd, rm, cat, less, mkdir, rmdir; permissions, root. C language: statements, expressions, conditions, selection iteration, variables, functions, arrays.

Section-B

Applying programming constructs

Students will learn how to write programs that satisfy unit tests. The instructor will build the unit tests, demonstrating how to break a problem down into smaller components. In the labs and homework, students will construct programs that satisfy the unit tests. Students become familiar with the constructs of the C programming language.

Moving to C: Data Types, constants, and variables, Statements, Expressions, Conditions, Selection, iteration, Functions and recursion

Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming

Arrays; One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Null terminated strings as array of characters, Standard library string functions

Introduction to Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments .

Section-C

Practical programming:

During the third quarter of the class, students will begin building their own programs by decomposing problems into smaller tasks and writing unit tests that will check to see that the program accurately accomplishes the task using Test Driven Development. They will then write the program that satisfies their own unit tests. Students will learn to apply the constructs of the C programming language to create programs.

Students will learn to apply these programming techniques: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions, Break, Continue and Goto, Type Conversion; Enumerations; Macros. Students will be able to use these techniques to develop programs

Section-D

Memory Management and Abstraction

During the final quarter, students will be introduced to dynamic memory allocation and dynamic data structures including: dynamic arrays. They will consolidate their ability to use the C programming techniques they have learned in the earlier sections.

Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation, software configuration management, Modules, C Unit, GIT, SCRUM, MAKE. Dynamic Memory Allocation.

Text and Reference Books

1. The C Programming Language, Brian Kernighan and Dennis Ritchie
2. The Unix Programming Environment
3. Pro Git

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CSH105B-T	Programming for Problem solving using C	CO1	3	3	2	-	-	-	-	-	3	3	3
		CO2	3	3	3	-	-	-	-	-	2	2	2
		CO3	3	3	3	-	-	-	-	-	3	3	2
		CO4	3	3	3	-	-	-	-	-	2	2	3

Course Title/Code	Programming for Problem Solving Using C Lab (CSH105B-P)	
Course Type	Core (Allied)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To construct a program of moderate complexity from a specification	
Course Outcomes (COs)		Mapping
CO1	Analyze and apply Test Driven Development approach to design programs.	Skill Development and Employability
CO2	Understand and apply programming language constructs as per given problems	Skill Development and Employability
CO3	Understand and apply C programming language constructs on open source platform	Skill Development and Employability
CO4	learn to work in a team using different online platform for program development	Skill Development and Employability
Prerequisites (if any)		

LIST OF EXPERIMENTS

1. Scratch: Covering Concepts of
   I. Sequential Statements
   II. Variables
   III. Blocks
2. Unix Commands: pwd, mkdir, cd, ls, less, touch, cp,move, cat, rm, rmdir –r etc.
3. Moving to C Using nano and gcc.

4. Project on Calculator Using Agile Methodology, Nano, Cunit, Git, Scrum , Agile Methodology,

Nano, Gcc, Make. Covering Conepts :

- Statements
- Functions
- Arrays
- Structures
- Pointers
- File Handling

Suggested Books:

1. The C Programming Language, Brian Kernighan and Dennis Ritchie
2. The Unix Programming Environment
3. Pro Git

Help Pages

1. Eclipse C/C++ Development Guide

Wikipedia Pages

1. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
2. Unit testing, http://en.wikipedia.org/wiki/Unit_testing

Tool Web Sites

1. Eclipse, https://eclipse.org/users/
2. Git, http://git-scm.com/
3. GCC, https://gcc.gnu.org/onlinedocs/gcc-4.9.3/gcc/
4. Make
5. Unix

Web tutorials

1. Harvard's CS50, https://courses.edx.org/courses/HarvardX/CS50x3/2015/info

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CSH105B-P	Programming for Problem solving using C Lab	CO1	3	3	2	-	-	-	-	-	3	3	3
		CO2	3	3	3	-	-	-	-	-	2	2	2
		CO3	3	3	3	-	-	-	-	-	3	3	2

		CO4	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**

Course Title/Code	**Communicative English (HLS102)**	
Course Type	**Core (Allied)**	
L-T-P Structure	**(1-0-2)**	
Credits	**2**	
Course Objective	To imbibe students about the basics of communication skills & English Language by understanding the need of industry.	
Course Outcomes (COs)		**Mapping**
CO1	To know about all the words and phrases of English language.	**Skill Development**
CO2	To build the basic skills of effective communication	**Skill Development**
CO3	To know about the importance of Listening	**Skill Development**
CO4	To know about the importance of verbal and nonverbal movements.	**Skill Development**
Prerequisites (if any)		

Section – A

Lexis:

Homonyms, Homophones, Homographs, Words often confused, One word Substitutes, Synonyms and Antonyms, Foreign Words, Phrasal Verbs & Idioms and Phrases

Section – B

Oral Communication:
Importance of Speech Sounds, Organs of Speech, Vowel Sounds, Consonant Sounds, IPA Symbols, Phonetic Transcription, Phoneme and Syllables, Intonation, Word Stress, Sentence Stress.

Section – C

Presentation Skills:
Body Language and Paralanguage, Gestures and Postures, Kinesics, Proxemics, Importance of Body Language in Presentation, Etiquette of the Telephone Handling and Business Meetings, Professional Presentation, Hearing and Listening, Essentials of Effective Listening, Importance of Effective Listening, Visual Presentation – How to prepare slide presentation.

Section – D

Technical Writing-II:
Business Letters, Job Application and Resume Writing, Developing Outlines, Circular, Memos, Blog Writing and Comments on Media.

Suggested Text Reading:

1. A Practical Course for Developing Writing Skills in English. J K Gangal: PHI Learning Pvt.
2. A Textbook of English Phonetics for Indian Students. T.BalaSubhrmaniam: Macmillan
3. English Vocabulary in Use. MaCarthy: Foundation Books, OUP. Print.
4. English Grammar, Competition and Correspondence. M.A. Pink and A.C. Thomas: S. Chand and Co. Print.
5. Reading between the Lines: Students Book. MacRae: Foundation Books. CUP, New Delhi.

List of Practical:

1. **Extempore**
2. **Homonyms & Homophones**
3. **Foreign Words**
4. **Idioms & Phrases and Phrasal Words**
5. **Telephonic Conversation**
6. **Business Letter**
7. **Group Discussion**
8. **Organs of Speech**
9. **Phonetic Transcription**
10. **Job Application & CV Writing**
11. **Presentation**
12. **Circular & Memo**
13. **Mock Interview**
14. **Blog Writing**

CO-PO MAPPING

Course Code	Course	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
HLS102	Communicative English	CO1	-	-	-	1	-	-	-	3	-	-	1
		CO2	-	-	-	1	-	-	-	3	-	-	1
		CO3	-	-	-	1	-	-	-	3	-	-	1
		CO4	-	-	-	1	-	-	-	3	-	-	1

SEMESTER II

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
PHH107B-T	Electricity and Magnetism	PH	CORE	3	1	0	4
PHH107B-P	Electricity and Magnetism Lab	PH	CORE	0	0	2	1
PHH108B-T	Wave Optics	PH	CORE	3	1	0	4
PHH108B-P	Wave Optics Lab	PH	CORE	0	0	2	1
PHH109B-T	Mathematical Physics II	PH	CORE	3	1	0	4
PHH109B-P	Mathematical Physics II Lab	PH	CORE	0	0	2	1
CHH137	Environmental Science	CH	UCC	2	0	2	4
CDO111	Professional Competency-I	CDC		2	0	0	1
	TOTAL (L-T-P-/CREDITS)			13	3	8	20
PHO219B	Post 2nd semValue added summer training course						02

1

Detailed Syllabus

Course Title/Code	Electricity and Magnetism (PHH107B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To solve the problems on Electrostatic Energy and di-electric constant, loss etc. ; to distinguish and design the Ferro, ferry, anti-Ferro, para and dia magnetic material and their applications in real file.	
Course Outcomes (COs)		Mapping
CO1	Acquire the knowledge of vector calculus to be applied to electromagnetism	Skill Development
CO2	Apply vector calculus for the computation of various parameters of electrostatics	Skill Development
CO3	Analyze the variation of magnetic fields due to current flowing in different forms and due to dipole	Skill Development
CO4	Appreciate various characteristics and properties of magnetic field in electromagnetic applications.	Skill Development
Prerequisites (if any)		

Section-A

Electric Field and Electric Potential

Electric Field: Electric Field Lines, Electric Flux. Gauss' Law with Applications to Charge Distributions with Spherical, Cylindrical and Planar Symmetries, Conservative Nature of Electrostatic Field, Electrostatic Potential, Laplace's and Poisson Equation, The Uniqueness Theoremand Potential Electric Field of a Dipole, Force and Torque on a Dipole.

Section-B

Electrostatic Energy

Electrostatic Energy of System of Charges, Electrostatic Energy of a Charged Sphere, Conductors in an Electrostatic Field, Surface Charge and Force on a Conductor, Capacitance of a System of Charged Conductors, Parallel-Plate Capacitor, Capacitance of an Isolated Conductor, Method of Images and its Application

Dielectric Properties of Matter

Electric Field in Matter, Polarization, Electrical Susceptibility and Dielectric Constant, Capacitor (Parallel Plate, Spherical, Cylindrical) Filled with Dielectric, Displacement Vector **D**, Relations between **E**, **P** and **D**, Gauss' Law in Dielectrics

Section-C

Magnetic Field

Magnetic Force between Current Elements and Definition of Magnetic Field **B**; Biot-Savart's Law and its Simple Applications: Straight Wire and Circular Loop, Current, Loop as a Magnetic Dipole and its Dipole Moment, Ampere's Circuital Law and its Application to (1) Solenoid and (2) Toroid; Properties of **B**: Curl and Divergence, Vector Potential, Magnetic Force on (1) Point Charge (2) Current Carrying Wire (3) Between Current Elements, Torque on a Current Loop in a Uniform Magnetic Field.

Section-D

Magnetic Properties of Matter

Magnetization Vector (**M),** Magnetic Intensity (**H),** Magnetic Susceptibility and Permeability, Relation between **B, H, M**, Ferromagnetism,B-H Curve and Hysteresis.

Electromagnetic Induction

Faraday's Law, Lenz's Law, Self-Inductance and Mutual Inductance, Reciprocity Theorem, Energy Stored in a Magnetic Field, Charge Conservation and Displacement Current. Introduction to Maxwell's Equations

Text and Reference Books

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw (Text Book)
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education (Text Book)
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
6. Electricity and Magnetism, J.H.Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH107B-T	Electricity and Magnetism	CO1	3	3	2	1	2	2	-	-	2	2	2	2	2	2
		CO2	3	3	2	1	2	2	-	-	2	2	2	2	2	2
		CO3	2	3	2	1	2	2	-	-	2	3	3	3	2	2
		CO4	2	3	2	1	2	2	-	-	2	3	3	3	2	2

Course Title/Code	Electricity and Magnetism Lab (PHH107B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To solve the problems on Electrostatic Energy and di-electric constant, loss etc. ; to distinguish and design the Ferro, ferry, anti-Ferro, para and dia magnetic material and their applications in real life.	
Course Outcomes (COs)		Mapping
CO1	Demonstrate the characteristics of various electric circuits**.**	**Skill Development and Employability**
CO2	Demonstrate and analyze the variation of magnetic fields due to current flowing in different forms.	**Skill Development and Employability**
Prerequisites (if any)		

List of Experiments

1. Use of 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 characteristics of a series RC Circuit.

3. To determine an unknown Low Resistance using Potentiometer.

4. To determine an unknown Low Resistance using Carey Foster's Bridge.

5. To compare capacitances using De'Sauty's bridge.

6. Measurement of field strength B and its variation in a solenoid (determine dB/dl)

8. To verify the Superposition, and Maximum power transfer theorems.

9. To determine self-inductance of a coil by Anderson's bridge.

10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency,

(b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.

11. To study the response curve of a parallel LCR circuit

12. To determine self-inductance of a coil by Rayleigh's method.

13. To determine the mutual inductance of two coils by Absolute method.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH107B-P	Electricity and Magnetism Lab	CO1	3	3	2	1	2	2	-	-	2	2	2	2	2	2
		CO2	3	3	2	1	2	2	-	-	2	2	2	2	2	2

Course Title/Code	Wave Optics (PHH108B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To introduce to the concepts of physics and different optical phenomena by using devices based on these phenomena.	
Course Outcomes (COs)		Mapping
CO1	Ability to produce and analyze the interference pattern due to division of amplitude & wave front.	Skill Development
CO2	Ability to produce required quality Spectrum and analyze it using appropriate diffraction grating	Skill Development
CO3	Ability to measure the concentration/purity of optically active materials using optical devices.	Skill Development
CO4	Ability to explain the construction, working and applications of Lasers and Optical Fibers.	Skill Development
Prerequisites (if any)		

Section- A

INTERFERENCE

Interference of light, Young's Double Slit Experiment, analytical treatment of interference, Conditions for Sustained Interference, Coherent Sources and coherence, Interference based on the Division of Wave Front, Interference based upon Division of Amplitude, Fresnel Bi-Prism and its Applications, Interference in Thin Films, Newton's Ring and its Applications, Michelson Interferometer and its Applications.

Section - B

DIFFRACTION

Difference between interference and diffraction; Fraunhoffer and Fresnel diffraction; Fraunhoffer diffraction through a single slit; plane transmission diffraction grating (N-slits); absent spectra; Resolving power-Rayleigh's criterion of resolution; Dispersive power; Resolving power of a grating.

Section - C

POLARISATION

Polarized and Un-Polarized Light; Brewster's law, Malus Law; Uniaxial crystals, Double Refraction; Nicol Prism; Quarter and Half Wave Plates; Detection and Production of Different Types of Polarized Light; Polarimetry; Bi-Quartz and Laurent's Half Shade Polarimeter

Section - D

Laser: Stimulated absorption, Spontaneous and stimulated emission,Population inversion, Conditions for laser action, Types of laser: He-Ne laser, Ruby Laser, Semiconductor laser, Laser properties and applications;

Fiber Optics: Introduction; Propagation of light through a fiber; Numerical aperture; Types of fiber; Modes of propagation (simple idea); V-number, applications of optical fibers;

References/ Text and Reference Books

1. Textbook of Optics, Brijlal and Subramaniam
2. Optics- A K Ghatak
3. Fundamentals of Optics- Jenkins and White
4. Optics- Eugene Hecht
5. Fundamentals of Optics- Khanna and Gulati
6. Engineering Physics- SatyaParkash
7. Modern Physics- S P Taneja

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH108 B-T	Wave Optics	CO1	3	3	-	-	-	1	-	2	-	1	-	1	-	-
		CO2	3	3	2	-	-	2	-	3	-	2	-	-	-	-
		CO3	1	3	2		1	2		2	2	2	-	1	1	1
		CO4	-	-	3	2	2	2	-	3	-	3	-	1	1	1

Course Title/Code	Wave Optics Lab (PHH108B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To introduce to the concepts of physics and different optical phenomena by using devices based on these phenomena.	
Course Outcomes (COs)		Mapping
CO1	Ability to produce and analyze the interference pattern due to division of amplitude & wave front.	Skill Development
CO2	Ability to produce required quality Spectrum and analyze it using appropriate diffraction grating	Skill Development
CO3	Ability to measure the concentration/purity of optically active materials using optical devices.	Skill Development
CO4	Ability to explain the construction, working and applications of Lasers and Optical Fibers.	Skill Development
Prerequisites (if any)		

List of Experiments

1. To determine the wavelength of sodium light by Newton's rings experiment.
2. To determine the wavelength of sodium light by Fresnel's biprism experiment.
3. To determine the wavelength of various colors of white light with the help of a plane transmission diffraction grating.
4. Determination of dispersive power of the given grating.
5. To determine the refractive index and Cauchy's constants of a prism by using spectrometer.
6. To determine the wavelength of sodium light by Michelson interferometer.
7. To determine the resolving power of a telescope.
8. To determine the pitch of a screw using He-Ne laser
9. To determine the specific rotation of optically active solution by using Laurent’s half shade polarimeter.
10. To determine the numerical aperture of an optical fiber using laser light.

Text and Reference Books

1. Advanced Practical Physics- B. L. Worsnop and Flint.
2. Practical Physics- S. L. Gupta and V. Kumar
3. B. Sc. Practical Physics- Harnam Singh and P. S. Hemine
4. Advanced Practical Physics- Chauhan and Singh

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH108 B-P	Wave Optics Lab	CO1	3	3	-	-	-	1	-	2	-	1	-	1	-	-
		CO2	3	3	2	-	-	2	-	3	-	2	-	-	-	-
		CO3	1	3	2		1	2		2	2	2	-	1	1	1
		CO4	-	-	3	2	2	2	-	3	-	3	-	1	1	1

Course Title/Code	Mathematical Physics - II (PHH109B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study special functions (Beta ,Gamma function), Frobenius method, Fourier series and Laplace Transforms, partial differential equations and tensors	
Course Outcomes (COs)		Mapping
CO1	Ability to apply Beta, Gamma function and Frobenius method to solve different problems	Skill Development and Employability
CO2	Ability to apply Fourier series and Laplace Transforms.	Skill Development and Employability
CO3	Ability to apply partial differential equations for different problems	Skill Development and Employability
CO4	Ability to apply tensors in fluid flow and relativity	Skill Development and Employability
Prerequisites (if any)		

Section- A

Special Functions and second order differential equations

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions, Series solution of second order differential equations, Frobenius method and its applications.

Section – B

Fourier Series and Laplace transform

Periodic functions, Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only), Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients, Even and odd functions and their Fourier expansions, Laplace Transform (LT) of Elementary Functions, Properties of Laplace Transforms: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Inverse LT, Application of Laplace Transforms.

Section- C

Partial Differential Equations

Method of forming partial differential equations, solution of equations by direct integration, solutions of Partial Differential Equations Using Separation of Variables, Laplace's Equation, Wave Equationa and its Solution for Vibrating Membranes.

Section-D

Tensors

Transformation Properties of Vectors, Covariant and Contra Variant Vectors; Tensors: Definition, Algebraic Properties; Numerical Tensors (Kronecker Delta and Levi-Civita Symbols), Metric Tensor, Index Raising, Lowering, Contraction; Electromagnetic Field Tensor; Covariant Differential, Covariant Derivative, Metric Connection; Riemann Curvature Tensor, Bianchi Identity, Ricci Tensor, Einstein Equation and Curvature Tensor.

Text and Reference Books

1. A Text Book of Differential Equations By N. M. Kapoor (Pitambar Publishing, 2006)
2. Schaum's outline of theory and problems of differential equations By Richard Bronson (McGraw-Hill Professional, 1994)
3. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Limited,1985)
4. Higher Engineering Mathematics by B S Grewal, Khanna Publishers (2000)
5. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH109B-T	Mathematical Physics II	CO1	3	3	3	-	-	3	3	-	-	3	-	-	-	-
		CO2	3	3	3	-	-	3	3	-	-	3	-	-	-	-
		CO3	3	3	3	-	-	3	3	-	-	3	-	-	-	-
		CO4	3	3	3	-	-	3	3	-	-	3	-	-	-	-

Course Title/Code	Mathematical Physics –II Lab (PHH109B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To apply software packages for solving special functions (Beta ,Gamma function), Fourier series and Laplace Transforms, partial differential equations and tensors	
Course Outcomes (COs)		Mapping
CO	Ability to solve Beta, Gamma function and different special differential equations using software packages.	Skill Development and Employability
Prerequisites (if any)		

List of Experiments

1- To solve Legendre equation.

2- To solve Bessel equation.

3- Problems on Beta and Gamma functions.

4- Applications of Frobenius method

5-Problems on Fourier series.

6- To solve partial differential equations (atleast 4 problems).

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH109B-P	Mathematical Physics II Lab	CO	3	3	3	-	-	3	3	-	-	3	-	-	-	-

Course Title/Code	Environmental Science (CHH137)	
Course Type	Core	
L-T-P Structure	2-0-4	
Credits	0/4	
Course Objective	The students will be able to identify the areas of environmental degradation and suggest possible solutions.	
Course Outcomes (COs)		Mapping
CO1	Understand and explain the multidisciplinary dimensions of environmental issues	Skill Development
CO2	Understand the primary environmental problems and suggest potential solutions	Entrepreneurship
CO3	Discuss about the various types of organisms and draw inferences about their interactions in different environmental settings/habitats	Skill Development
CO4	Defend/criticize the consequences of the interactions between social and environmental factors	Skill Development
Prerequisite		

Section - A

Multidisciplinary nature of environmental studies
Definition, scope and importance, Need for public awareness

Renewable and non-renewable resources:
Natural resources and associated problems

. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

a. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

b. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

c. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

d. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

e. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
f. Role of an individual in conservation of natural resources.
g. Equitable use of resources for sustainable lifestyles.

Section - B

Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:
    - Forest ecosystem
    - Grassland ecosystem
    - Desert ecosystem
    - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels
- India as a mega-diversity nation
- Hot-sports of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Section - C

Environmental Pollution

- **Definition, Cause, effects and control measures of:-**
    a. Air pollution
    b. Water pollution
    c. Soil pollution
    d. Marine pollution
    e. Noise pollution
    f. Thermal pollution
    g. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns, Case Studies
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies
- Wasteland reclamation
- Consumerism and waste products
- Environment Protection Act
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

Section - D

Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme
- Environment and human health
- Human Rights
- Value Education
- HIV/AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and human health.
- **Case Studies.**

ENVIRONMENTAL SCIENCES–FIELD WORK

- Visit to a local area to document environmental assets- river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

Reference Books:

1. K.C. Agarwal, Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.
3. R.C. Brunner, Hazardous Waste Incineration, McGraw Hill Inc.1989.
4. R. S. Clark, Marine Pollution, Clanderson Press Oxford (TB)
5. W. P. Cunningham, T. H. Cooper, E. Gorhani, M. T. Hepworth, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 2001.
6. A. K. De, Environmental Chemistry, Wiley Eastern Ltd.
7. C. Baird and M. Cann, Environmental Chemistry, W.H. Freeman and Company, New York, 2012.
8. C.J-Gonzalez and D.J.C. Constable, Green Chemistry and engineering: A practical Design Approach A John Wiley & Sons, INC., publication, New Jersey, 2011
9. S. E. Manahan, Environmental Chemistry, CRC Press, 2005

10. Perspectives in Environmental Studies Kaushik&Kaushik New age international publishers Ltd.-New Delhi
11. John Grant, The Green marketing Manifesto, Wiley Publications

CO-PO MAPPING

Course Code	Course	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CHH 137	Environmental Science	CO1	-	-	-	-	-	-	2	3	1	3	-	-	-	-
		CO2	-	-	-	-	-	-	2	3	1	3	-	-	-	-
		CO3	-	-	-	-	-	-	2	3	1	3	-	-	-	-
		CO4	-	-	-	-	-	-	2	3	1	3	-	-	-	-

Course Title/Code	PROFESSIONAL COMPETENCY - I (CDO111)	
Course Type/ Semester	Core	
L-P-O Structure	2-0-0	
Credits	1	
Course Objective	To familiarize students with the basic knowledge of Quantitative Aptitude & Logical Reasoning	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to recognize problems based on arithmetic & number system.	
CO2	Students will be able to solve problems based on verbal reasoning	
CO3	Students will be able to apply short tricks on complex problems of the number system.	
Prerequisites (if any)	**N.A**	

Part A

Unit 1 Number System

1. Numbers
1.1 Types of numbers and number tree
1.2 Divisibility Rule
1.3 HCF & LCM
1.4 Factors and Multiples
1.5 Unit Digits &Cyclicity
1.6 Remainders
1.7 Factorials

Unit 2: Arithmetic I

2.1 Percentages

2.2 Profit & Loss

2.2.1 Basic terminology & Formulae
2.2.2 Error in Weights
2.2.3 Marked Price and Discounts

2.3 Interest

2.3.1 Simple Interest

2.3.2 Compound Interest

2.3.3 Relation between SI & CI

2.4 Ratio & Proportion

2.4.1 Proportionality

2.4.2 Variations

2.4.3 Partnership

2.4.4 Problem on Ages & Numbers

2.5 Mixtures & Allegations

2.6 Time, Speed & Distance

2.6.1 Basics Formulas & Proportionality

2.6.2 Average & Relative Speed

2.6.3 Trains and Boats & Streams

2.6.4 Circular Motion and Clocks

Unit 3: Logical Reasoning I

3.1 Direction Sense Test

3.2 Blood Relation Test

3.3 Coding and Decoding

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO 111	PROFESSIONAL COMPETENCY-I	CO1	2	--	1	2	2	1	2	--	--	--	1	2	3
		CO2	--	--	3	--	--	--	--	1	3	2	--	--	3
		CO3	2	1	2	1	1	1	1	--	--	--	1	2	3

Semester-III

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT		L	T	P	NO. OF CREDITS
PHH201B-T	**Quantum Mechanics**	**PH**		**3**	**1**	**0**	**4**
PHH201B-P	**Quantum Mechanics Lab**	**PH**		**0**	**0**	**2**	**1**
PHH202B-T	**Mathematical Physics III**	**PH**		**3**	**1**	**0**	**4**
PHH202B-P	**Mathematical Physics III LAB**	**PH**		**0**	**0**	**2**	**1**
PHH203B-T	**Electromagnetic theory**	**PH**		**3**	**1**	**0**	**4**
PHH203B-P	**Electromagnetic theory Lab**	**PH**		**0**	**0**	**2**	**1**
CDO211	**Professional Competency-II**	**CDC**	AP/AF	2	0	0	1
FLS101	**Spanish I**	**CDC**		**1**	**1**	**0**	**2**
FLS102	**German I**						
FLS103	**French I**						
	Open elective Odd Semester Basket/mini project-1	**offered by different departments**		**1**	**0**	**2**	**2**
	TOTAL (L-T-P/CREDITS)			**13**	**4**	**8**	**20**

ELECTIVE BASKET										
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective/ University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
EDS288	Applied Philosophy	**Education**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
EDS289	Applied Psychology	**Education**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
EDS290	Applied Sociology	**Education**	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
MCS231	Basics of Economics	Management	**Soft**	**ELECTIVE**	**1**	**0**	**2**	**0**	**3**	**2**
MCS232	Introduction of Finance	Management	**NTCC**	**ELECTIVE**	**0**	**0**	**2**	**0**	**2**	**2**
PHN204	Mini Project-I	Physics	**Soft**	**ELECTIVE**						**2**

Semester-III

Detailed Syllabus

Course Title/Code	Quantum Mechanics (PHH201B –T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To discuss Quantum phenomena in microscopic objects and Quantum Mechanics in one and three dimensional cases. .	
Course Outcomes (COs)		Mapping
CO1	Ability to acquire and demonstrate knowledge of quantum phenomena like Photoelectric Effect, Compton Effect and concept of wave packet.	Skill Development
CO2	Ability to discuss time dependent and independent form of Schrodinger wave equation and apply them for one dimensional potential.	Skill Development
CO3	Ability to apply Schrodinger equation to spherically symmetric potential of one electron atom	Skill Development
CO4	Ability to discuss tunnel effect to explain fundamental phenomena like alpha decay and working of electronic devices based on the phenomenon	Skill Development
Prerequisites (if any)		

Section-A

Particles and Waves

Inadequacies in Classical Physics, Blackbody Radiation: Quantum Theory of Light, Photoelectric Effect, Compton Effect; Wave Nature of Matter : de Broglie Hypothesis, Wave-Particle Duality, Davisson-Germer Experiment, Wave description of Particles by Wave Packets, Group and Phase Velocities and Relation between them, Heisenberg's Uncertainty Principle :Derivation from Wave Packets

Section-B

Quantum Mechanics

Basic Postulates and Formalism : Energy, Momentum and Hamiltonian Operators, Time dependent and Time-independent Schrödinger Wave Equation, Properties of Wave Function. Interpretation of Wave Function, Probability Density and Probability, Normalization, Linearity and Superposition Principles, Eigenvalues and Eigenfunction, Expectation Values, Wave Function of a Free Particle, Particle in a one Dimensional Box

Section-C

Bound State Problems

General Features of a Bound Particle System, One Dimensional Simple Harmonic Oscillator : Energy Levels and Wave Functions, Zero Point Energy; Quantum Theory of Hydrogen Atom : Particle in a Spherically Symmetric Potential, Separation of Variables, Radial Solutions and Principal Quantum Number, Orbital and Magnetic Quantum Numbers, Quantization of Energy and Angular Momentum, Space Quantization, Electron Probability Density .

Section-D

Finite Potential

Radiative Transitions, Selection Rules, Scattering Problems in one Dimension: Finite Potential Step: Reflection and Transmission, Stationary Solutions, Probability Current, Attractive and Repulsive Potential Barriers,Quantum Phenomenon of Tunneling: Tunnel Effect, Finite Potential Well.

Text and Reference Books

1 L. I. Schiff, Quantum Mechanics, 3rd edition, (McGraw Hill Book Co., New York 1968).

2 A. Beiser, Concepts of Modern Physics (Text Book)

3 E. Merzbacher, Quantum Mechanics, 3rd edition, (John Wiley & Sons, Inc1997)

4 J.L. Powell & B. Crasemann, Quantum Mechanics, (Addison-Wesley Pubs.Co.,1965)

5 A. Ghatak& S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India , 2004)

6 E. M. Lifshitz and L. D. Landau, Quantum Mechanics: Non-Relativistic Theory (Course of Theoretical Physics, Vol 3), 3rd Edition, Butterworth-Heinemann (1981).

7 Quantum Mechanics: Foundations and Applications by Arno Bohm.-3rd ed.(New York: Springer-Verlag, 2003).

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH201B-T	Quantum Mechanics	CO1	3	3	-	-	-	2	-	1	-	2	-	2	-	2
		CO2	2	2	2	-	3	3	-	2	-	3	-	-	-	1
		CO3	2	2	3	-	2	3	-	3	3	3	-	2	1	2
		CO4	-	-	-	3	3	3	-	2	-	3	-	2	2	2

Course Title/Code	Quantum Mechanics Lab (PHH201B –P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To demonstrate Quantum phenomena in microscopic objects and Quantum Mechanics in one and three dimensional cases. .	
Course Outcomes (COs)		Mapping
CO1	Ability to acquire and demonstrate knowledge of quantum phenomena like Photoelectric Effect, Compton Effect and concept of wave packet.	Skill Development
CO2	Ability to solve Schrodinger wave equation for different physical systems using software packages.	Skill Development
Prerequisites (if any)		

List of Experiments

Use Mathematica/Matlab for solving the following problems based on Quantum Mechanics

1. Solve the Schrodinger equation for 1D particle in a box problem to obtain the energy eigenvalues and the plot of corresponding wavefunctions.
2. Calculation of normalization constants, probabilities and expectation values of position and momentum for different simple quantum mechanical problems.
3. Solve the Schrodinger equation for 3D particle in a box problem to obtain the energy eigenvalues. Also plot the corresponding wavefunctions.
4. Solve the Schrodinger equation for the ground state and the higher excited state of the hydrogen atom to obtain the energy eigenvalues and the plot of corresponding wavefunctions.
5. Solve the Schrodinger equation for 1D harmonic oscillator problem in order to obtain energy eigenvalues and the plot of corresponding wavefunctions.

Laboratory based experiments:

6. Determination of Rydberg constant.
7. Determination of excitation potential of Argon.
8. Study of Electron spin resonance
9. Study of Zeeman effect: with external magnetic field; Hyperfine splitting

Text/ Reference Books:

1. Mathematica Programming: An Advanced Introduction by Leonid Shifrin
2. Software Mathematica
3. Lab manuals

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH201B-P	Quantum Mechanics Lab	CO1	3	3	-	-	-	2	-	1	-	2	-	2	1	2
		CO2	2	2	2	-	3	3	-	2	-	3	-	-	2	1

Course Title/Code	Mathematical Physics - III (PHH202B-T)	
Course Type	Core	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study complex analysis, Fourier transform, probability, Group Theory, Non Linear Method and Chaos applicable to different problems in physics.	
Course Outcomes (COs)		Mapping
CO1	Ability to apply the concept of complex analysis and evaluate the different problem problems based on complex analysis.	Skill Development
CO2	Ability to apply Fourier transform to differential equations.	Skill Development
CO3	Ability to apply the concept of Probability to some physics problems.	Skill Development
CO4	Ability to apply the theory of bifurcation and fractals to natural patterns	Skill Development
Prerequisites (if any)		

Section- A

Complex Analysis

Review of Complex Arithmetic; Complex Differentiation: Analyticity of Complex Functions,

Examples of analytic functions. Singular functions: poles and branch points Cauchy Riemann

Conditions; Complex Integration: Cauchy Integral Theorem, Cauchy Integral Formula, Derivative as Integral; Complex Series: Taylor and Laurent Series; Residues and Residue Theorem, application in solving Definite Integrals.

Section - B

Fourier Transforms

Fourier Transforms: Fourier Integral theorem, Fourier Transform, Fourier Transform of Derivatives, Properties of Fourier Transforms (Translation, Change of Scale, Complex Conjugation, etc.), Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations

Section - C

Introduction to probability

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.

Section- D

Introduction to Group Theory, Non Linear Method and Chaos

Abstract group, subgroups, classes, cosets, factor group, normal subgroups, direct product of groups, lie groups, rotation and unitary groups, representation of SO(3), SU(2), SU(3) tensors. Introduction to nonlinear method and chaos, nonlinear differential equations, Introduction to bifurcation and fractals

Text and Reference Books

1. A Text Book of Differential Equations By N. M. Kapoor (Pitambar Publishing, 2006)

2. Schaum's outline of theory and problems of differential equations By Richard Bronson (McGraw-Hill Professional, 1994)

3. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Limited,1985)

4. Higher Engineering Mathematics by B S Grewal, Khanna Publishers (2000)

5. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.(Text Book)

6. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH202B-T	Mathematical Physics - III	CO1	3	3	3	-	-	3	2	-	-	3	-	-	-	-
		CO2	3	3	3	-	-	3	2	-	-	3	-	-	-	-
		CO3	3	3	3	-	-	3	3	-	-	3	-	-	-	-
		CO4	3	2	3	-	-	3	3	-	-	2	-	-	-	-

Course Title/Code	Mathematical Physics - III Lab (PHH202B-P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To study complex analysis, Fourier transform, probability, Group Theory, Non Linear Method and Chaos applicable to different problems in physics.	
Course Outcomes (COs)		Mapping
CO	Ability to solve problems using Scilab.	Skill Development
Prerequisites (if any)		

List of Experiments

1- Integral solution by residue method.

2- Solution of Definite integrals.

3- To find the poles of a functions.

4- Problems on Fourier Transform.

5-Solution of one dimensional Wave Equation.

6-Solution of Diffusion Equation.

7-Solution of Heat Flow Equation.

8- Problems on probability.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH202B-P	Mathematical Physics - III Lab	CO	3	3	3	-	-	3	2	-	-	3	-	-	-	-

Course Title/Code	Electromagnetic Theory (PHH203B-T)	
Course Type	Core	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study formulation of Maxwell's Equations and transmission of E-M waves in different media and in transmission lines	
Course Outcomes (COs)		Mapping
CO1	Ability to convert to different coordinate system	Skill Development
CO2	Ability to explain the properties of Maxwell equations and apply to simple systems	Skill Development
CO3	Ability to explain transmission of E M waves in transmission lines	Skill Development
CO4	Ability to explain the smith chart in transmission line	Skill Development
Prerequisites (if any)		

Section - A

Elements of Vector Calculus

Spherical, Cylindrical and CartesianCoordinate Systems and Transformation, Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stoke's theorem, Laplacian of a scalar.

Section -B

Maxwell's Equations

Maxwell Equations in differential form, Displacement Current, Vector and Scalar Potentials, Boundary Conditions at Interface between Different Media, Wave Equations, Time-varying potentials, Time-Harmonic Fields, Waves in general, Plane waves in free space

Section -C

Time Dependent Fields & Waves

Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, plane waves in good conductors, power and the pointing vector Electromagnetic Energy Density., Reflection of a plain wave in a normal incidence, Reflection of a Plane Wave at Oblique Incidence.

Section - D

Transmission Lines: Transmission Line Parameters, Transmission Line Equations, Smith chart; Input Impedance, SWR and Power, S-parameters, Some Applications of Transmission Lines, Transients on Transmission Lines, EM spectrum.

Text and Reference Books

1. Introduction to Electrodynamics by A.Z.Capri&P.V.Panat.(New Delhi: NarosaPub.House, 2002)
2. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata McGraw Hill, 2006).
3. Fundamentals of electromagnetics by M.A.W.Miah.(Tata McGraw Hill,1992)
4. Applied electromagnetism By Liang Chi Shen, Jin Au Kong (PWS Pub. Co., 1995)
5. David J. Griffiths, Introduction to Electrodynamics, 3rd edition, (Benjamin Cummings 1998).
6. J. D. Jackson, Classical Electrodynamics, 3rd edition, (Wiley, New York 1998)

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH203B-T	Electromagnetic theory	CO1	3	3	2	1	2	2	2	2	2	2	-	-	-	-
		CO2	3	2	3	2	2	3	3	2	1	3	-	-	-	-
		CO3	2	3	2	1	2	3	3	3	2	3	-	-	-	-
		CO4	3	3	2	2	2	3	2	3	2	2	-	-	-	-

Course Title/Code	Electromagnetic Theory Lab (PHH203B-P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To study formulation of Maxwell's Equations and transmission of E-M waves in different media and in transmission lines	
Course Outcomes (COs)		Mapping
CO	Ability to demonstrate different phenomena related to electromagnetic waves.	Skill Development
Prerequisites (if any)		

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.
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 diodes.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH203B-P	Electromagnetic theory Lab	CO	3	3	2	1	2	2	2	2	2	2	-	-	-	-

Course Title/Code	PROFESSIONAL COMPETENCY - II (CDO211)	
Course Type/ Semester	Core	
L-P-O Structure	2-0-0	
Credits	1	
Course Objective	To familiarize students with the knowledge of Quantitative Aptitude & Logical Reasoning	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to analyze various forms of data.	
CO2	Students will be able to solve complex problems based on arithmetic reasoning.	
CO3	Recognize problem based on Modern Mathematics and Algebra	
CO4	Students will be able to solve problems based on verbal reasoning	
Prerequisites (if any)	**N.A**	

Section A

Unit I: Arithmetic, Averages, Time & Work, Time and Work, Chain Rule, Work & Wages, Pipes & Cisterns

Section B

Unit II: Data Interpretation, Table and Bar graph, Line and Pie Charts, Mixed Charts and Caselets

Section C

Unit III: Modern Mathematics, Permutation and Combination, Principal of counting and basic formulas, Arrangements, Selection and Selection + Arrangement, Linear/Circular arrangements, Digits and Alphabetic Problems and Applications, Probability, Events and Sample Space, Basic

Formulas., Problems on Coins, Cards and Dices, Conditional Probability, Bayes' Theorem and their Applications.

Section D

Unit IV: Logical Reasoning II, Data Sufficiency, Syllogism

TEXTBOOKS

1. R.S Agarwal Quantitative Aptitiude& logical Reasoning

REFERENCE BOOKS

1 Arun Sharma Aptitude & Logical Reasoning

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO 211	PROFESSIONAL COMPETENCY-II	CO1	2	1	--	2	1	1	1	--	--	1	1	2	3
		CO2	1	--	2	2	1	--	1	--	2	1	--	--	2
		CO3	2	1	2	2	1	1	1	--	--	1	--	2	2
		CO4	--	--	3	--	--	--	--	1	3	2	--	--	3

Course Title/Code	French I/Spanish I/German I (FLS103/FLS101/FLS102)	
Course Type	**Allied Elective**	
L-T-P Structure	**1-1-0**	
Credits	**2**	
Course Objective	To describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary	
Course Outcomes (COs)		**Mapping**
CO1	Ability to exchange greetings and do introductions using formal and informal expressions	**Skill Development**
CO2	Ability to Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary	**Skill Development**
CO3	Ability toexpress their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed	**Skill Development**
CO4	Ability toidentify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed.	**Skill Development**
Prerequisites (if any)		

French I

Section-A

- Les Salutations & forms of politeness
- Alphabets
- Taking leave expressions

Section-B

- Les pronomssujets

- Les verbes ER
- Self introduction

Section-C

- Les noms
- VerbesAvoir, Etre, Aller& Faire
- Les articles define et indefini

Section-D

- Les moin de l'annee
- les jours de la semaine

- Repondez aux questions

Spanish I

Section-A

- Presentation on Spanish language
- Greetings and goodbye's
- Spanish letter
- Introduction of VerboSER

Section-B

- Uses of Verbo SER
- Introduction of Nationality
- Professions and vocabulary related to professions.
- Adjectives related to Verbo SER.
- Counting till number 20.

Section-C

- Introduction of Articles and Indefinite articles
- Interrogatives
- Adjectives to describe things and place and Counting till number 90
-

Section-D

- Introduction of Verbo ESTAR
- Uses of Verbo ESTAR with respect to positioning of objects
- Prepositions related to the positioning of an object

German I

Section-A

- Salutations/Greetings
- Introduction

Section-B

- Introduction cntd.
- Alphabets
- Numbers 1-20

Section-C

- Personal pronouns
- Hobbies and professions

Section-D

- Café related vocabulary and dialogues
- Revision personal pronouns

Section-E

- Café related vocabulary and dialogues cntd.

Common verbs and their conjugations

CO-PO MAPPING

Course Code	Course	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
FLS103/FLS101/ FLS102	French I/Spanish I/German I	CO1	1	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO4	1	1	-	-	1	-	1	-	1	1	1	-	1	-

Course Title/Code	Applied Philosophy (EDS288)	
Course Type	Allied Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To confront the philosophical problems implicit in the experience of self, others and the society.	
Course Outcomes (COs)		Mapping
CO1	Ability to read critically the philosophy of influential philosophers with respect to society, Science and success in life	
CO2	Ability to understand and apply concepts and theories of moral philosophy.	
CO3	Ability to reflect philosophically and ethically on their own personal, professional and civic lives.	
CO4	Ability to formulate for himself or herself a philosophy of life or world-view consistent with the objectives of liberal society.	
Prerequisites (if any)		

SECTION - A

INTRODUCTION TO PHILOSOPHY: Philosophy: Meaning, Nature and Scope**,** Practical uses of Philosophy**,** Branches of Philosophy.

SECTION - B

THOUGHTS OF PHILOSOPHERS AND THEIR IMPLICATIONS: General Philosophy of John Dewey, Swami Vivekananda and RabindraNath Tagore**,** Philosophy of life and success: Steve Jobs, N.R. NarayanaMurthi, Dr. A.P.J. Abdul Kalam and Muhammad Yunus, Philosophy of Science and technology- Francis Bacon and Martin Heidegger.

SECTION - C

PHILOSOPHICAL PERSPECTIVES OF SOCIO-POLITICAL SCENARIO IN INDIA: Nature of Democracy and its implications, Meaning and requirements of National Integration, Universal Human Rights

SECTION - D

PHILOSOPHICAL PERSPECTIVES OF RELIGIOUS SCENARIO IN INDIA: Secularism—its nature and implications, Moral Philosophy of religion with special reference to Hinduism, Jainism, Buddhism, Islam, Christianity, Sikhism. Religious pluralism and Religious tolerance.

Text and Reference Books

1. Bhatia, K. & Bhatia, B. (1974) The Philosophical and Sociological Foundations of Education. Delhi: Doaba House.
2. Brubacher, John. S. (1969). Modern Philosophies of Education, New Delhi: Tata McGraw-Hill
3. Dewey, J. (1966). Democracy in Education, New York: Macmillan.
4. Ferre, F.(1995). Philosophy of Technology. University of Georgia Press.
5. Gandhi, M. K. (1956). Basic Education. Ahmedabad, Navajivan.
6. Goel, A. &Goel S. L. (2005). Human values and Education. New Delhi: Deep and Deep Publications Pvt. Ltd.
7. Palmer, Joy A. et.al. (2001). Fifty major thinkers on education from confucious to Dewey. New Delhi: Rutledge.
8. Rajput, J.S. (2006). Human Values and Education. New Delhi: Paragon Publications.
9. Walia, J.S. (2011). Philosophical, Sociological and Economic Bases of Education.

List of Experiments

1. Prepare and present a report on 'philosophy of life' from the perspective of a young adult.
2. Quiz and interactive sessions on various philosophical perspectives of contemporary philosophers.
3. Organization of and participation in street plays /dramas/ declamation/ debates/ any other suitable activity on any theme of Philosophical perspectives of Socio-Political scenario in India.
4. Group discussions on any suitable topics concerning contemporary society like aggression among youth, Over-ambitiousness in young generation, misuse of democracy, implications of secularism etc. and to reflect upon different viewpoints.
5. Preparation of quotation boards to display quotes of great philosophers in the college premises.
6. Picture interpretation and philosophical reflection on social themes like juvenile crime, begging in India, Social networking etc.
7. Readings from the autobiographies and other publications of great philosophers e.g. 'Wings of Fire' followed by discussion session.
8. Showing Videos on Unique personalities: life and philosophies followed by reflection exercises.
9. Any other suitable activity.

CO-PO Mapping

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
EDS288	APPLIED PHILOSOPHY	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-

Course Title/Code	Applied Psychology (EDS289)	
Course Type	Allied Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To define psychology and its applications in various fields.	
Course Outcomes (COs)		Mapping
CO1	Ability to understand the conceptual framework of attitude along with cherishing out their attitude development	
CO2	Ability to conceptualize psychology in social and organizational settings.	
CO3	Ability to maintain and reform group dynamics.	
CO4	Ability to understand the conceptual framework of personality along with cherishing out their personality development.	
Prerequisites (if any)		

Section -A

PSYCHOLOGY: ATTITUDE FORMATION

Psychology: Meaning, nature, and scope, Role of psychology across multi-disciplinary aspects, Introduction: Attitude, Stereotypes, Prejudice, and Discrimination, Formation of attitude and attitude change.

Section- B

PERSONALITY AND PERSONALITY DEVELOPMENT

Definition of personality and personality development, State/ Trait approach to personality, Bandura's Social- Cognitive theory of personality

Section -C

SOCIAL PSYCHOLOGY

Introduction to social identity, social cognition, and social influence, social conflicts and its resolutions, Group dynamics: Introduction, formation, types of groups, cooperation, competition, and conflict in groups

Section - D

ORGANIZATIONAL PSYCHOLOGY

Organizational Psychology: Definition, fundamental concepts and importance, Introduction to job satisfaction, work motivation, and organizational commitment. Introduction to participation, empowerment, and team work

Text and Reference Books

1. Arrow, K. J. (1995). Barrier to Conflict Resolution. NY: W. W. Norton.
2. Bandra, A., & Walters, R. H. (1963). Social Learning and Personality Development. New York: Holt, Rinehart, & Winston.
3. Bandra, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice- Hall, Inc.
4. Baron, R. A., Byrne, D. (1997). Social Psychology (8th Ed.). Boston, MA: Allyn& Bacon.
5. Baron, R. A. (2001). Psychology (5th ed.). London: Pearson.
6. Cialdini, R. B. (2001). Influence: Science and Practice (4th Ed.). Boston, MA: Allyn& Bacon.
7. Feldman, R. S. (2008). Essentials of Understanding Psychology. New Delhi: Tata McGraw Hill.
8. Friedkin, N. (1998). A structural theory of social influence. Cambridge: Cambridge University Press.
9. Gage, N. L., & Berliner, D. C. (1992). Educational Psychology (5th Ed.). Boston, MA: Houghton Mifflin Co.
10. Hall, C. S., Lindzey, G. & Campbell, J. B. (2004). Theories of Personality (4th Ed.). New York: Wiley.
11. Hunt, R. R., & Ellis, H. C. (2006). Fundamentals of Cognitive Psychology. New Delhi: Tata McGraw Hill.
12. McDavid, J. M., &Harari, H. (1994). Social Psychology: Individuals, Groups, and Societies. New Delhi: CBS Publishers.
13. Millward, L. (2005). Understanding Occupational and Organizational Psychology. London: Sage Publications.

List of Experiments

1. Prepare a story using different pictures in order to understand the personality
2. Prepare a SWOT Chart to identify strength and weakness of oneself
3. Role of psychology be proved as an asset in professional development
4. Give a brief account of your personality before and after the transaction of course content.
5. Identify different stereotype present in our Society and present your views on it.
6. Collect any five articles on discrimination prevalent in Society
7. List out Company incentives provided to their employee for work motivation.
8. Prepare a street play on social issues to understand the group dynamics
9. Reflection activities to understand the emotions and personality
10. List out the Do's and Don'ts of the Interview

11. Role of body language in attitude formation.
12. Situational Activities: Suppose you are captain of your football team. Draw out inputs to motivate your team, and maintain the team- spirit.
13. Write a brief note on any one attitude you want to change in yourself and the strategies to accomplish it.
14. The psychometric tests to be conducted by learners:
15. Sociometry test
16. Personality testing (16PF)
17. Vineland Social Maturity Scale
18. Rorschach inkblot test
19. Thematic Appreciation Test
20. Color personality Test
21. Any other suitable activities.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
EDS289	Applied Psychology	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-

Course Title/Code	Applied Sociology (EDS290)	
Course Type	Allied Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To study the various contemporary issues of society and develop basic research skills in area of sociology.	
Course Outcomes (COs)		Mapping
CO1	Ability to discuss the fundamental concepts of sociology and its applications.	
CO2	Development of the analytical skills of students about ways in which social processes affect our everyday lives.	
CO3	Ability to understand the impact of various processes of social change and assess their impact on society.	
CO4	Ability to analyze the social cultural dynamics that contribute to transformation of Indian reality	
Prerequisites (if any)		

Section - A

Introduction and Applications of Sociology:

- Society, Community, Social Institutions, Social Groups, Introduction to Applied Sociology
- Sociology and Social Processes
- Sociology and Social Change
- Sociology and Social Problems
- Clinical Sociology

Section - B

Sociological Processes:

- Social Stratification, Social Mobility and their impact on society
- Socialization, Agents of Socialization, Assessing the effects of Socialization
- Social Movements: Concept, Impact of Environmental Movements in India: Chipko Movement, Narmada BachaoAndolan

Section - C

Processes and Issues of Social Change:

- Social Change: Westernization, Urbanization, Privatization, Globalization, Sustainable development
- Issues in urban development-Population, poverty, unplanned growth and ecological issues
- Conflict management:

- Intergroup: Causes, Resolutions
- Organizational Conflict, Conflict Management and Grievance Handling

Section - D

Field Survey & Report Writing:

- Need, Meaning of Survey
- Types of Survey
- Steps in Conducting Survey
- Data Collection Methods
- Salient Features of Report Writing

Text and Reference Books

1. Andrew, W. (1997) Introduction to the Sociology of Development. New Jersey, Palgrave Macmillan.
2. Berg, L.B. (2001). Qualitative Research Methods for the Social Sciences (4th edition). Boston: Allyn and Bacon
3. Bhatia, H.(1970). Elements of Social Psychology. Bombay: Somaiyya Publications Pvt Ltd.
4. Bhattacharyya D.K (2009). *Organizational Behavior*, Oxford University Press, UK.
5. DastuptaDriskle(2007) : Discourse on Applied Sociology Volume-II, 2007
6. Desai, B Sonalde et al. (2010). Human Development in India: Challenges for a Society in Transition. OUP
7. Deshpande, S.(2003). Contemporary India: A Sociological View. New Delhi: Viking.
8. Hall R.H (2009). *Organizational Structures, Processes & outcomes, Asia*: Pearson Education Publications.
9. Hodegetts R M. (2009). *Organizational Behavior*, Macmillan.
10. McMichael.P. (1996). Development and Social change: A global perspective. California Thousand Oaks.
11. Merton, R and Nisbet, (1976) Contemporary Social Problems, New York: Harcourt, Brace and World.
12. Metha, S. (2009). Women and Social Change, Jaipur: Sage.
13. Michael Edwards (2011). Civil Society in India, edited The Oxford Handbook of Civil Society, Oxford, Oxford University Press
14. Mitra et.al. (2009). Democracy, Agency and Social Change in India, New Delhi: Sage
15. Pratt henry Fairchild(2009) : Outline of Applied Sociology, 2009
16. Sirclaus Moser & G. Kalton: Survey Methods in Social Investigation, Heinemann Educational Books, London.
17. Sanderson. (2010). Social Psychology, New York: John Wiley.
18. Tepperman, L. & Curtis, J. (Eds.) (2009). Principles of Sociology: Canadian perspectives. Don Mills, ON: Oxford University Press.
19. Young, K. (2001). Handbook of Social Psychology, London: Routledge and Kegal Paul Ltd.

List of Experiments

1. Showing Videos on the life and philosophies of Famous sociologists and to acquaint the students about their different theories
2. Preparation of quotation board with the help of displaying the pictures and quotes of famous sociologists
3. Choose a theme of your interest- for e.g., crime, technology environmental concerns or any other and look through the Sunday editorials of any national daily of the last 3 months to locate related articles.
4. Role Play: Gender issues in everyday life, students will form small groups and present skits to address this issue creatively; this will be followed by discussions.
5. Students may be given the assignment of taking pro-active role in initiating social change in a local field
6. Visit a shopping mall and observe the interaction between employees and customers/visitors. Identify themes based on your observation and prepare a questionnaire based on this experience.
7. Look at a set of published letters of Gandhi, Nehru, C.F. Andrews and Tagore etc. and identify key social issues that are discussed in the contents of the letters and prepare a report on it.
8. Students will be asked to write a short essay on the pressures they feel of the experience in performing masculinity or femininity, Presentations and discussions based around the essays.
9. Debate or discussion on "Is the family the site of love and care" or "Is the family democratic?"
10. Discuss the impact of modernization, industrialization and globalization on the day-today life.
11. Students may be asked to apply any applied research technique
12. Design a survey on factors effecting marriage choices of young people.
    Any other suitable activity

CO-PO Mapping

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
EDS290	APPLIED SOCIOLOGY	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-

Course Title/Code	Basics of Economics (MCS231)	
Course Type	Allied Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective		
Course Outcomes (COs)		Mapping
CO1	Acquaint the students with the fundamental knowledge Economics and its basic laws and principles.	
CO2	Understand the theories of demand and supply and practically identify the different factors that affect demand and supply.	
CO3	Analyze the different types of costs that form part of a production process and relate it with the laws of production.	
CO4	Understand and evaluate the different types of markets operating in an industry.	
Prerequisites (if any)		

Section-A

Definition of Economics - various definitions, Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical application and importance.

Section-B

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, degrees of Price elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Section-C

Meaning of production and factors of production, laws of production, various concepts of cost - Fixed cost, variable cost, average cost, marginal cost, money cost, real cost and opportunity cost. Shape of short run cost curves.

Section-D

Meaning of Market, Types of Market -Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets).Supply and Law of Supply, Role of Demand & Supply in Price Determination and effect of changes in demand and supply on prices.

Text and Reference Books

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Economics for Engineers- T R Jain & O P Khanna
3. Micro Economic Theory – M.L. Jhingan (S.Chand).
4. Micro Economic Theory - H.L. Ahuja (S.Chand).
5. Modern Micro Economics: S.K. Mishra (Pragati Publications).
6. Economic Theory - A.B.N. Kulkarni& A.B. Kalkundrikar (R.Chand& Co.).
7. Indian Economy: RudarDutt& K.P.M. Sundhram

CO-PO Mapping

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PO13	PO14
MCS231	Basics of Economics MCS231	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-

Course Title/Code	Fundamentals of Finance (MCS232)	
Course Type	Allied Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective		
Course Outcomes (COs)		Mapping
CO1	Acquaint the students with the fundamental concepts of Financial Management& time Value of Money.	
CO2	Enable students to take decisions using Capital Budgeting techniques	
CO3	Enable students to understand and apply concepts of working capital management.	
CO4	Enable students to analyze and apply the concepts of firm's value, capital structure theories, and dividend policy decisions.	
Prerequisites (if any)		

Section-A

Introduction to Finance ; Forms of Business Organization ; Overview to financial statements , Balance Sheet, Profit and Loss Account , Cash Flow Statement.

Section-B

Financial Analysis and Planning; Financial Ratios, Break Even Analysis Sources of Long term Finance – Equity Capital, Preference Capital, Terms Loans, Debentures; Raising Long term Finance.

Section-C

Time Value of Money, Capital Budgeting- Techniques of Capital Budgeting, Net Present Value and Payback Period; Capital Structure and Cost of Capital.

Section-D

Working Capital: Introduction, Components of Current Assets and Current Liabilities, Operating Cycle, Estimation of Working Capital; Operating Income , Earning Before Interest and Tax (EBIT).

Text and Reference Books

1. Pandy, I.M., Financial Management, Vikas Publishing House, New Delhi
2. Khan M.Y, and Jain P.K., Financial Management, Tata McGraw Hill, New Delhi

1. Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, Financial Management, Pearson Education
2. Chandra, Prasanna, Financial Management, TMH, New Delhi
3. Van Horne, James C., Financial Management and Policy, Prentice Hall of India
4. Brigham & Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.
5. Kishore, R., Financial Management, Taxman's Publishing House, New Delhi

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
MCS232	Fundamentals of Finance	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-

Semester-IV

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
MAH411-T	Numerical Analysis	MA	CORE	3	1	0	4
MAH411-P	Numerical Analysis Lab	MA	CORE	0	0	2	1
PHH205B-T	Thermodynamics	PH	CORE	3	1	0	4
PHH205B-P	Thermodynamics Lab	PH	CORE	0	0	2	1
PHH206B-T	Solid State Physics	PH	CORE	3	1	0	4
PHH206B-P	Solid State Physics Lab	PH	CORE	0	0	2	1
ECS306B	E-Waste Environmental Problems & Management/	ECE	GE	1	0	2	2
CHS234	Environmental Ethics and Sustainable Development	CH		1	0	2	2
LWS323	Cybercrime and laws	Law		1	1	0	2
PHN207	Mini Project	PH		0	0	4	2
CDO212	Professional Competency-III	CDC	AP/AF	2	0	0	1

	TOTAL (L-T-P-/CREDITS)			**12**	**3**	**8**	**18**

Detailed Syllabus

Course Title/Code	**Numerical Analysis (MAH411-T)**	
Course Type	**Core**	
L-T-P Structure	**3-1-0**	
Credits	**4**	
Course Objective	To apply the concepts of numerical techniques required for solving the mathematical problems and their applications.	
Course Outcomes (COs)		**Mapping**
CO1	Ability to identify and compute the interpolating polynomial for equispaced and unequispaced intervals.	**Skill Development**
CO2	Ability to find roots of nonlinear and transcendental equation. and fit a curve to the given data	**Skill Development**
CO3	Ability to solve & analyze the Mathematical problems related to Numerical Analysis and its applications using software	**Skill Development**
CO4	Ability to Solve system of linear equation by using direct and iterative methods and Compute Eigen values and Eigen vectors for symmetric and non-symmetric matrices	**Skill Development**
Prerequisites (if any)		

Section - A

Solution of nonlinear & transcendental equations: Bracketing methods for locating a root, initial approximations and convergence criteria, bisection method, RegulaFalsi, Newton-Raphson and secant method.

Interpolation and curve fitting: Introduction to interpolation, Lagrange approximation, Newton's formula for equispaced& non equispaced points (forward, backward and divided difference), Hermite interpolation. Curve fitting by a straight line and a second degree curve and laws reducible to linear law.

Section- B

Numerical differentiation and integration: Approximating the derivatives, numerical differentiation formulas (forward, backward and central), introduction to numerical quadrature, Newton- cotes formula, Gaussian quadrature - Gauss Legendre & Gauss Chebyshev's.

Section - C

Solution of linear systems: Direct methods, Gaussian elimination, matrix inversion, iterative methods for linear systems (Gauss Seidel & Gauss Jacobi), LU decomposition. Eigen value problems: Jacobi, Given's and Householder's methods for symmetric matrices, power and inverse power methods.

Section -D

Solution of differential equations: Introduction to differential equations, Initial value problems, Picard's method, Taylor series method , Euler's methods, classical method of Runge-Kutta method of order IV , Predictor-Corrector methods(Milne's & Adam's Bashforth).

Text and Reference Books

1. M.K. Jain, S.R.K. Iyengar and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", New Age international Publishers.
2. Laurene V, Fausett, "Applied Numerical Analysis using MATLAB", Pearson.
3. S.S. Sastry, "Introductory Methods of Numerical Analysis", Published by Prentice Hall of India.

CO-PO Mapping

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
MAH411 –T	Numerical Analysis	CO1	3	-	3	-	-	2	-	3	-	-	-	3	-	-
		CO2	3	-	3	-	-	2	-	3	-	-	-	3	-	-
		CO3	3	-	3	-	-	3	-	3	-	-	-	2	-	-
		CO4	3	-	3	-	-	3	-	2	-	-	-	3	-	-

Course Title/Code	Numerical Analysis Lab (MAH411 –P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To apply the concepts of numerical techniques required for solving the mathematical problems and their applications.	
Course Outcomes (COs)		Mapping
CO1	Ability to solve & analyze the Mathematical problems related to Numerical Analysis and its applications using software	Skill Development
CO2	Ability to solve system of linear equation by using direct and iterative methods and Compute Eigen values and Eigen vectors for symmetric and non-symmetric matrices	Skill Development
Prerequisites (if any)		

LIST OF EXPERIMENTS

1. To find roots of an equation using Bisection method.
2. To find roots of an equation using RegulaFalsi method.
3. To find roots of an equation using Newton Raphson method.
4. To find roots of an equation using Secant method.
5. To find the value of a dependent variable for a given value of an independent variable using Lagrange's interpolation method for a given set of data.
6. To find the value of a dependent variable for a given value of an independent variable using Newton divided difference interpolation for a given set of data.
7. To find the value of a definite integral using Trapezoidal rule of integration.
8. To find the value of a definite integral using Simpson's 1/3 rule of integration.
9. To find the value of a definite integral using Simpson's 3/8 rule of integration.
10. To find the solution of an ordinary differential equation of first order by R-K method

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
MAH411 –P	Numerical Analysis Lab	CO1	3	-	3	-	-	2	-	3	-	-	-	3	-	-
		CO2	3	-	3	-	-	2	-	3	-	-	-	3	-	-

Course Title/Code	THERMODYNAMICS (PHH205B-T)	
Course Type	Core	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study laws of thermodynamics and thermodynamic relations	
Course Outcomes (COs)		Mapping
CO1	Ability to demonstrate and apply first law of thermodynamics. Compare different thermodynamic processes	Skill Development
CO2	Ability to demonstrate a clear understanding of second and third law of thermodynamics. Apply basic concept of heat and entropy in real life problems	Skill Development
CO3	Ability to explain various thermodynamical potentials and second order phase transitions in daily life scenario	Skill Development
CO4	Ability to compare different distribution of velocities in gases and compare the concepts of ideal and real gas	Skill Development
Prerequisites (if any)		

Section-A

Zeroth and First Law of Thermodynamics: Extensive and Intensive Thermodynamic Variables, Thermodynamic Equilibrium, Concept of Work and Heat, State Functions, First Law of Thermodynamics and its Differential Form, Internal Energy, General Relation between C_P and C_V, Work Done During Isothermal and Adiabatic Processes, Reversible and Irreversible Process withExamples

Section-B

2^{nd} Law of Thermodynamics: Kelvin-Planck and Clausius Statements and Their Equivalence, Carnot Engine & Efficiency Carnot's Theorem, Concept of Entropy, Second Law of Thermodynamics in Terms of Entropy, Principle of Increase of Entropy, Entropy and Disorder, Entropy Changes in Reversible and Irreversible Processes with Examples, Third Law of Thermodynamics, Unattainability of Absolute Zero

Section-C

Derivations and Applications of Maxwell's Relations, Expressions for (C_P–C_V) and C_P/C_V, Tds Equations, Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Cooling due to Adiabatic Demagnetization, First and Second Order Phase Transitions with Examples, Claussius - Clapeyron Equation

Section-D

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas, Mean, RMS & Most Probable Speeds, Mean Free Path (Zeroth Order), Transport Phenomenon in Ideal Gases: Viscosity, Thermal Conductivity, Deviations from the Ideal Gas Behavior, Van der Waal's Equation of State for Real Gases, Free Adiabatic Expansion of a Perfect Gas, Joule-Thomson Coefficient

Text and Reference Books

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH205B-T	Thermodynamics	CO1	3	3	2	2	2	3	-	2	-	2	2	2	2	-
		CO2	3	3	3	3	2	3	-	3	-	2	2	3	2	-
		CO3	3	3	2	2	2	3	-	2	-	2	1	2	1	-
		CO4	3	3	2	1	2	3	-	2	-	2	1	2	1	-

Course Title/Code	THERMODYNAMICS LAB (PHH205B-P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To demonstrate laws of thermodynamics	
Course Outcomes (COs)		Mapping
CO	Ability to demonstrate thermodynamic processes and determine important thermodynamic parameters	Skill Development
Prerequisites (if any)		

List of Experiments

1. To determine J by Callender and Barne's constant flow method
2. To determine the Coefficient of Thermal Conductivity of Copper by Searle's Apparatus
3. To determine the Coefficient of Thermal Conductivity of Copper by Angstrom's Method
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT)
6. To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement
7. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions
8. To Calibrate a Thermocouple to measure Temperature in a Specified Range using (1) Null Method (2) Direct Measurement using an Op-Amp Difference Amplifier and to determine Neutral Temperature
9. To determine the viscosity of a fluid.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH205B-P	Thermodynamics Lab	CO1	3	3	2	2	2	3	-	2	-	2	2	2	2	-

Course Title/Code	Solid State Physics (PHH206B-T)	
Course Type	Core	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study and analyze different types of crystal structures, electrical, magnetic, dielectric and superconducting properties of materials	
Course Outcomes (COs)		Mapping
CO1	Ability to analyze the XRD pattern and determine the crystal structure of a material	Skill Development
CO2	Ability to describe and measure the electrical and magnetic properties of materials.	Skill Development
CO3	Ability to describe and measure dielectric properties of materials.	Skill Development
CO4	Ability to describe the properties of materials in a superconducting state.	Skill Development
Prerequisites (if any)		

Section-A

Crystal Structure

Crystalline Solids – Polycrystalline and Single Crystal Form, Amorphous Solids, Lattice and Basis, Unit Cell, Crystal Systems, Crystal Symmetry, Space Groups, Bravais Space Lattices, Miller Indices, Lattice Planes, Inter-planar Spacing, Some Simple Crystal Structures (SC, BCC, FCC, HCP and Diamond), X-ray Diffraction, Bragg's Law, Determination of Crystal Structure with X-rays Using Powder Method.

Section-B

Electrical Properties of Solids

Classical Free Electron Theory of Metals, Wiedeman-Franz's Law, Quantum Theory of Free Electrons, Band Theory of Solids: Periodic Potential and Bloch Theorem, Kronig-Penney Model, E-k Curves, Brillouin Zones, Effective Mass, Band Structure in Conductors, Semiconductors and Insulators, Direct & Indirect Band gap Semiconductors, Drift Current, Mobility and Conductivity , Hall Effect

Section-C

Magnetic properties of materials

Review of Basic Concepts (origin of magnetism, magnetic moment, Magnetization and Magnetic susceptibility) Dia, Para and Ferro-magnetic Properties of Solids, Langevin's Theory of Diamagnetism and Paramagnetism, Quantum Theory of Paramagnetism, Curie's Law, Ferromagnetism : Spontaneous Magnetization and Domain Structure; Temperature Dependence of Spontaneous Magnetization; Curie-Weiss Law, Hysteresis Curve, Antiferromagnetism, Ferrimagnetism

Section-D

Dielectric properties of materials and superconductivity

Review of Basic Concepts, Classification ofDielectric Materials, Concept of Polarization, Three Electric Vectors, Local Field, Electronic, Ionic and Dipolar Polarization, Behavior of Dielectrics in A.C. Field, Concept of Local Field, Polarizability, Claussius-Mosotti Relation, Ferroelectricity, Piezoelectricity, Applications.

Introduction (Kamerlingh-Onnes experiment), Effect of Magnetic Field, Type-I and Type-II Superconductors, Isotope Effect, Meissner Effect, Heat Capacity, Energy Gap, London Equations and Explanation of Persistent Current and Meissner Effect, BCS Theory, Applications of Superconductivity.

Text and Reference Books

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
3. Solid State Physics, S.O. Pillai
4. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
5. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
6. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
7. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
8. Solid State Physics, M.A. Wahab, 2011, Narosa Publication

CO – PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH206 B-T	Solid State Physics	CO1	2	3	-	-	2	3	-	2	-	-	3	-	-	-
		CO2	3	3	3	-	3	2	-	2	-	2	-	1	2	-
		CO3	3	3	3	-	2	2	-	2	-	2	-	2	3	1
		CO4	3	3	3	-	3	3	-	3	-	2	-	1	1	1

Course Title/Code	Solid State Physics Lab (PHH206B-P)	
Course Type	Core	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To study and analyze different types of crystal structures, electrical, magnetic, dielectric properties of materials	
Course Outcomes (COs)		Mapping
CO1	Ability to analyze the XRD pattern and determine the crystal structure of a material.	Skill Development
CO2	Ability to describe and measure the electrical and magnetic properties of materials.	Skill Development
CO3	Ability to describe and measure dielectric properties of materials.	Skill Development
Prerequisites (if any)		

LIST OF EXPERIMENTS

1. To verify Richardson – Dushmann equation and to determine work function of the cathode material.
2. To determine carrier concentration of a semiconductor using Hall Effect setup.
3. Determination of retentivity and coercivity of a ferromagnetic substance by plotting B-H curve.
4. To determine crystal structure and lattice parameters of a material by analyzing XRD Data.
5. To determine dielectric constant of a material using De-Sauty Bridge.
6. To determine energy band gap using reverse biased P-N junction diode.
7. To determine energy band gap of a semiconductor using four probe method.
8. To measure the Dielectric Constant of a dielectric Materials with frequency.
9. To determine the susceptibility of a paramagnetic material.

CO – PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH206 B-P	Solid State Physics Lab	CO1	2	3	-	-	2	3	-	2	-	-	3	-	-	-
		CO2	3	3	3	-	3	2	-	2	-	2	-	1	2	-
		CO3	3	3	3	-	2	2	-	2	-	2	-	2	3	1

Course Title/Code	Environmental Ethics & Sustainable Development (CHS234)	
Course Type	Allied Elective	
L-T-P Structure	2-0-0	
Credits	2	
Course Objective	To describe, explain and analyze the sustainable development concerns and challenges.	
Course Outcomes (COs)		Mapping
CO1	Ability to develop an inter-disciplinary understanding of sustainable development concerns;	
CO2	Ability to recognize the challenges of sustainable development; the opportunities and limits in meeting these challenges	
CO3	Ability to defend or criticize the sustainability initiatives adopted by different enterprises.	
Prerequisites (if any)		

Section - A

Introduction to Sustainable Development

Definition of Sustainable Development; Triple Bottom Line, Components of TBL, Changing Perspective & Debates in Sustainable Development - Need for Sustainable Development, Evolution of the concept of Sustainable Development: Stockholm Conference, The Brundtland Commission, Earth Summit, Agenda 21; Millennium Development Goals

Section - B

Challenges to Sustainable Development and Sustainable Development Goals (SDGs)

Challenges to Sustainable Development - Agriculture, Population & Food Security, Public Health and Nutrition, Education, Natural Resources (Forests, Energy, Water), Climate Change Sustainable Development Goals (SDGs) - Introduction, Challenges to SDGs, Indian Scenario.

Section - C

Sustainability Strategies & Reporting

Sustainability Strategies & Reporting - Introduction, Rationale and Mechanisms, Key Principles, Sustainability Strategies Adopted by Different Enterprises – Case Studies

Section - D

Sustainable Development and Contemporary Issues

Sustainable Consumption, Indigenous Knowledge, Gender Issues, Population & Sustainable Agriculture, Sustainable Tourism

List of Experiments/Activities

1. Survey - Business and non-business students' perception towards TBL (based on the readings listed above); inferences on the basis of survey; http://www.aabri.com/manuscripts/121249.pdf
2. Workshop based - Sustainable agriculture- Mushroom farming
3. Workshop based - Back to nature - DIY composting bin
4. Review - Sustainable Consumption in India: Challenges and Opportunities; Divesh Kumar, Praveen Goyal, ZillurRahman, Ishwar Kumar; IJMBs Vol. 1, Issue 3, September 2011; http; ://www.ijmbs.com/13/devesh.pdf
5. Calculate Carbon Footprint/Ecological footprint
6. Stimulus Activity (Piece of writing) - Sustainable Consumption
7. CSR - Workshop for Village school children
8. Simulation Activity - Challenges to Sustainable Development
   Case Studies - Sustainability initiatives @ TATA Motors, CAIRN INDIA, Mahindra & Mahindra, Subaru Isuzu, Disney, Novo Nordisk, etc

Text and Reference Books

1. Environmental Management for Sustainable Development; C.J. Barrow; Routledge Publishers
2. Roberts, J.T., and Hite, A., 2000, From Modernization to Globalization - Perspectives on Development and Social Change, Blackwell Publishing
3. Sachs, J., 2004, Stages of Development, Speech at the Chinese Academy of Arts and Sciences
4. Giddings, B., Hopwood, B., and Geoff O'Brien, 2002, Environment, Economy and Society: Fitting Them Together into Sustainable Development, Published online in Wiley Inter Science (www.interscience.wiley.com). DOI: 10.1002/sd.199

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CHS234	Environmental Ethics &Sustainable Development	CO1	-	-	3	-	-	-	-	-	-	-	3	2	-	3
		CO2	-	-	3	-	-	-	-	-	-	-	2	3	-	2
		CO3	-	-	3	-	-	-	-	-	-	-	3	3	-	3

Course Title/Code	**CYBER CRIMES & LAWS(LWS323)**	
Course Type	Elective(Allied)	
L-T-P Structure	1-1-0	
Credits	2	
Course Objective	To make students understand the concept of Cyber Crimes & Cyber Law and various aspects relating to it, enhance their understanding of problems arising out of online transactions and stimulate them to find solutions, clarify the Intellectual Property issues in the cyber space and the growth and development of the law in this regard, help them understand Information Technology Act, 2000.and Information Technology Amendment Act 2008.	
Course Outcomes (COs)		**Mapping**
CO1	UnderstandtheconceptofCyber-crimesandcyberLaw	
CO2	Criticallyanalyzetheproblemsarisingoutofonlinetransactionsandfindsolutions	
CO3	AnalyzeIntellectualPropertyissuesinthecyberspaceandapplyrelevantlaws toprotectorfightinfigment	
CO4	UnderstandInformationTechnologyAct2000andcriticallyanalyzevariousse ctionstoapplysuchlawsappropriately	
Prerequisites (if any)	**N.A**	

Section –A

Unit 1: Cyber Crimes: Meaning, Categories & Kinds

A. Cyber Crime: Meaning & Categories
B. Nature of Cyber Crime, Cyber Crimes v. Conventional Crimes
C. Kinds of Cyber Crime- hacking, spamming, phishing, cyber stalking, cyber pornography,

malware etc.

Section - B

Unit 2: Privacy Issues & Access Rights

A. Freedom of speech and expression in Cyberspace.
B. Right to Privacy and Right to Data Protection.
C. Access Rights

Section - C

Unit 3: Cyber Space & Legal framework

A. Cyber Security
B. Cyber Space , Concept of Property in Cyber Space
C. Jurisdiction in Cyber Space

Section - D

Unit 4: Information and Technology Act 2000 &IT Amendment Act 2008 (Contact Hours - 3)

A. Need of Cyber Law in India
B. Enactment & Scheme of the IT Act
C. Objectives of the IT Act 2000, Amendments to the Act
D. Justice Dispensation System for Cyber Crimes under IT Act

TEXT& REFERENCE BOOKS

1. Sushma Arora & Raman Arora, Cyber Crimes & Laws, Taxmann's
2. PavanDuggal, Cyber Law.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
LWS 323	Cyber crimes& laws	CO1	2	1	-	-	-	-	2	-	-	1	-	3	-	-
		CO2	3	2	-	-	-	-	-	-	2	-	-	1	1	-
		CO3	3	1	2	-	-	-	-	1	-	-	-	2	1	-
		CO4	3	1	-	-	-	-	-	-	-	-	-	3	1	-

Course Title/Code	E-Waste: Environmental Problems and Management (ECS306B)	
Course Type	Allied Elective	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To describe, explain and analyze the environmental concerns and challenges.	
Course Outcomes (COs)		Mapping
CO1	Gain a better understanding and appreciation for the challenges related to waste management.	
CO2	Create awareness about environmental impacts of e-waste.	
CO3	Identify various components of e-waste	
Prerequisites (if any)		

Section - A

INTRODUCTION: E-Waste, Indian and global scenario of e-Waste, Growth of Electrical and Electronics industry in India, E-waste generation in India, Composition of e-waste, Possible hazardous substances present in e-waste, Environmental and Health implications.

Section - B

E-WASTE LEGISLATION: Regulatory regime for e-waste in India, The hazardous waste(Management and Handling) rules 2003, E- waste management rules 2015, Regulatory compliance including roles and responsibility of different stakeholders – producer, manufacturer, consumer etc., Proposed reduction in the use of hazardous substances (RoHS) & REACH, Extended producer responsibility (EPR).

Section - C

END OF LIFE MANAGEMENT OF E-WASTE: Historic methods of waste disposal – dumping, burning, landfill; Recycling and recovery technologies – sorting, crushing, separation; Life cycle assessment of a product – introduction; Case study – optimal planning for electronic waste.

Section - D

ENVIRONMENTALLY SOUND E-WASTE MANAGEMENT: Emerging recycling and recovery technologies, Guidelines for environmentally sound management of e-waste, environmentally sound treatment technology for e-waste, Guidelines for establishment of

integrated e-waste recycling and treatment facility, Case studies and unique initiatives from around the world.

List ofExperiments:

1. Identify the hazardous materials present in printed circuit boards.
2. Extraction of copper of printed circuit boards in etching solution.
3. Demo of recycling process through videos.
4. Extraction of precious metal from e Waste.
5. Invited guest lecture.
6. Field visit to a waste management initiative in NCR.
7. Activity based learning: survey of the household practice of e-waste disposal and awareness.
8. Case study – presentation and group discussion.

Text and Reference Books

Electronic Waste Management, R E Hester, R M Harrison, RSC publishing.
E Waste: Implications, Regulations and Management in India and current global practices, RakeshJohri, TERI PRESS.

CO-PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
ECS306B	E-Waste: Environmental Problems and Management	CO1	-	-	3	-	-	-	-	-	-	-	3	2	-	3
		CO2	-	-	3	-	-	-	-	-	-	-	2	3	-	2
		CO3	-	-	3	-	-	-	-	-	-	-	3	3	-	3

Course Title/Code	PROFESSIONAL COMPETENCY - III (CDO212)	
Course Type/ Semester	Core / Sem - 4	
L-P-O Structure	2-0-0	
Credits	1	
Course Objective	To familiarize students with mental wellbeing, Communication & Leadership Skills	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to construct simple and complex sentences accurately	
CO2	Students will be able to enhance and expand word knowledge by fostering word consciousness and develop reading skills & build verbal reasoning skills.	
CO3	Students will be able to demonstrate problem solving and leadership skills required to participate in a simulated environment.	
CO4	Students will be able to enhance effectiveness and display better management of self.	
Prerequisites (if any)	**N.A**	

Section A

Unit I: Health & Safety, Mental Wellbeing, Life Skills: Mental toughness, Self-regulation, Work life balance, Work life in Covid era, Positivity

Section B

Unit II: Communication Accuracy, Relevance of Verbal Ability and preparatory guidelines, Functional Grammar – Subject Verb Agreement, Tenses – Perfect, Simple, Continuous, Common Errors and rectification, Idioms and Phrases

Word Power Building Skills, Words: Antonyms, Synonyms, Verbal Analogies, Root Word Technique for Prefixes & Suffixes, Word Power: 7 Tips for Learning New Words, Practice Vocabulary Exercises

Section C

Unit III: Leadership Skills, Defining Leadership – John Adair's Action Centered Leadership Theory, Ethics & Values, Emotional Intelligence, Change Management: Change and How to Deal with It, Self-Leadership

Section D

Unit IV: Personal Effectiveness, Building Your Self Esteem and Assertiveness Skills, Accountability, Adaptability/ Flexibility for Success, Building Relationships for Success – interpersonal skills, Boosting Your Confidence, Public Speaking and Performance, How to Set Goals When Everything Feels Like a Priority

TEXTBOOKS

1. The 7 Habits of Highly Effective People: Stephen R. Covey
2. Personal Effectiveness: Alexander Murdock, Carol N. Scutt, 3rd Edition

REFERENCE BOOKS

1. Verbal Ability and Reasoning for Competitive Examinations: P.A. Anand, Wiley
2. Great Work, Great Career: How to Create your ultimate job and make extraordinary contribution by Stephen R. Covey, Jennifer Colosimo

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO 212	PROFESSIONAL COMPETENCY III	CO1	--	--	--	--	--	--	--	--	1	1	--	--	2
		CO2	--	--	1	--	--	--	1	--	1	1	--	--	2
		CO3	--	--	--	--	--	--	--	--	2	1	1	--	1
		CO4	--	--	--	--	--	--	--	--	2	1	--	--	1

Semester-V

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
PHH301B-T	**Statistical Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH301B-P	**Statistical Physics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH302B-T	**Digital Electronics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH302B-P	**Digital Electronics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHH303B-T	**Condensed Matter Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH304B-T	**Modern Physics**	**PH**	**CORE**	**3**	**1**	**0**	**4**
PHH304B-P	**Modern Physics Lab**	**PH**	**CORE**	**0**	**0**	**2**	**1**
PHN305	**Project Work (Minor)-3**	**PH**	**CORE**	**0**	**0**	**0**	**4**
CDO311	**Professional Competency-IV**	**CDC**	AP/AF	2	0	0	1
	TOTAL (L-T-P-/CREDITS)			**14**	**4**	**6**	**24**

SEMESTER V

Detailed Syllabus

Course Title/Code	Statistical Physics (PHH301B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To discuss basic concepts of Statistical Physics and apply them to solve real problems	
Course Outcomes (COs)		Mapping
CO1	Discuss and interpret experiments that reveal the properties of matter at microscopic and macroscopic levels as well as how this motivates in generating thermodynamic function for gasses with their limitations.	Skill Development
CO2	Understand the central concepts and principles in statistical mechanics including the classical and quantum theory of radiation, such as the Wien's Displacement laws, Rayleigh-Jeans Laws, Stefan-Boltzmann Laws and apply these laws in solving problems and analyzing the relationships/missing information in solving the real time applications.	Skill Development
CO3	Apply the statistics for discussing Bose-Einstein Distribution Laws, with evaluating the applications and properties of Liquid He, Photon Gas and analyses of Planck's Law.	Skill Development
CO4	Apply the statistics for discussing Fermi-Dirac Distribution Laws, with evaluating the applications and properties of degenerate Fermi gasses, Fermi Energy.	Skill Development
Prerequisites (if any)		

Section - A

Classical Statistics

Concept of Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Ensemble Concept, Partition Function, Thermodynamic Functions of Finite

Number of Energy Levels, Negative Temperature, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Law of Equipartition of Energy-Applications to Specific Heat and its Limitations.

Section - B

Classical and Quantum Theory of Radiation

Properties of Thermal Radiation, Blackbody Radiation, Pure temperature dependence, Radiation Pressure, Kirchhoff's law, Stefan-Boltzmann law: Thermodynamic proof, Wien's Displacement law, Wien's Distribution Law, Saha's Ionization Formula, Rayleigh-Jeans Law, Spectral Distribution of Black Body Radiation, Planck's Quantum Postulates, Planck's Law of Blackbody Radiation: Deduction of Wien's Distribution Law, Rayleigh-Jeans Law, Stefan-Boltzmann Law and Wien's Displacement Law from Planck's Radiation Law.

Section - C

Bose-Einstein Statistics

B-E Distribution Law, Thermodynamic Functions of a Strongly Degenerate Bose Gas, Bose Einstein Condensation, Properties of Liquid He (Qualitative Description), Radiation as a Photon Gas and Thermodynamic Functions of Photon Gas, Bose Derivation of Planck's Law.

Section - D

Fermi-Dirac Statistics

Fermi-Dirac Distribution Law, Thermodynamic Functions of a Completely and Strongly Degenerate Fermi Gas, Fermi Energy, Electron Gas in a Metal, Specific Heat of Metals, Relativistic Fermi Gas, White Dwarf Stars, Chandrasekhar Mass Limit

Text and Reference Books

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press.
3. Statistical and Thermal Physics by S. Loknathan and R.S. Gambhir.

4. Statistical Mechanics by AvijitLahiri.
5. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.

CO – PO Mapping

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH301 B-T	Statistical Physics	CO1	3	3	3	-	3	3	3	-	-	2	-	-	1	1
		CO2	3	3	3	-	3	3	3	-	-	2	-	-	1	1
		CO3	3	3	3	-	3	3	3	-	-	2	-	-	1	1
		CO4	3	3	3	-	3	3	2	-	-	2	-	-	1	1

Course Title/Code	Statistical Physics Lab(PHH301B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To apply the basic concepts of Statistical Physics and apply them to solve real problems	
Course Outcomes (COs)		Mapping
CO	Ability to apply the basic ideas of Programming and create new program based on the given facts and/or related knowledge using the theory of Statistical Mechanics and evaluate the results of open end problem on Programmable languages such as Matlab App/Octave	Skill Development
Prerequisites (if any)		

List of Experiments

Use C/C++/Scilab for solving the problems based on Statistical Mechanics like

1. Plot Planck's law for Black Body radiation and compare it with Wein's Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.

2. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases.

   6133459274

3. Plot Maxwell-Boltzmann distribution function versus temperature.

4. Plot Fermi-Dirac distribution function versus temperature.

5. Plot Bose-Einstein distribution function versus temperature.

Text and Reference Books

1. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444

2. Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub.

CO – PO MAPPING

Course Code	Course	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH301 B-P	Statistical Physics Lab	CO	3	3	3	-	3	3	2	-	-	2	-	-	1	1

Course Title/Code	Digital Electronics (PHH302B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To outline the formal procedures for the analysis and design of combinational and sequential circuits	
Course Outcomes (COs)		Mapping
CO1	Ability to discussthe application of number system and digital logic design in real life applications.	Skill Development
CO2	Ability to design the combinational circuits using MSI.	Skill Development
CO3	Ability to design and analyze synchronous and asynchronous sequential circuits	Skill Development
CO4	Ability to discuss the various types of memory devices	Skill Development
Prerequisites (if any)		

Section- A

Basic Digital Circuits and Operational Amplifier

Difference between Analog and 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, Basic Characteristics of Op-Amps, Characteristics of an Ideal Op-Amp, Feedback in Amplifiers, Open-loop and Closed loop Gain, Frequency Response, CMRR, Virtual ground, Applications of Op-Amps

Section – B

Boolean algebra and Data processing circuits

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 Sum of Products Method and Karnaugh Map, Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders

Section – C

Arithmetic and Sequential Circuits

Binary Addition, Binary Subtraction using 2's Complement, Half and Full Adders, Half & Full Subtractors, 4-bit binary Adder/Subtractor, SR, D, and JK Flip-Flops, Clocked (Level and Edge Triggered) Flip-Flops, Preset and Clear operations, Race-around conditions in JK Flip-Flop, Master Slave JK Flip-Flop

Section – D

Shift registers and Computer Organization

Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits),Ring Counter, Asynchronous Counters, Decade Counter, Synchronous Counter Input/Output Devices, Data storage (idea of RAM and ROM), Computer Memory, Memory organization & addressing, Memory interfacing Memory Map, Main features and Components of 8085 Microprocessor, Block diagram.

Text and Reference Books

1. Digital principles and applications By Donald P. Leach & Albert Paul Malvino, (Glencoe, 1995).(Text Book)
2. Digital Fundamentals, 3rd Edition by Thomas L. Floyd (Universal Book Stall, India, 1998).
1. Digital Electronics by R.P. Jain,
2. Operational Amplifiers and Linear Integrated Circuits, 4th Edition by Robert F Coughlin and Frederick F Driscoll (P.H.I. 1992)
3. Op-Amps and Linear Integrated Circuits by R. A. Gayakwad (Pearson Education

Asia, 2000)

CO-PO MAPPING

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH302B-T	Digital Electronics	CO1	3	3	3	3	-	2	3	2	3	3	2	2	2	2
		CO2	3	3	3	3	-	3	3	3	3	3	2	2	2	2
		CO3	3	3	3	3	-	3	3	3	3	3	2	2	3	2
		CO4	3	3	2	2	-	3	3	3	3	3	3	3	3	3
		CO5	3	3	3	3	-	3	3	3	3	2	2	2	2	2

Course Title/Code	Digital Electronics Lab (PHH302B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To design the combinational and sequential circuits.	
Course Outcomes (COs)		Mapping
CO	Ability to interpret the design and working of a basic microprocessor.	Skill Development
Prerequisites (if any)		

LIST OF EXPERIMENTS:

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To design a combinational logic system for a specified Truth Table.
3. To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.
4. To minimize a given Logic Circuit.
5. To design a Seven segment display driver
6. Half Adder, Full Adder and 4-bit Binary Adder.
7. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
8. To build Flip-Flop Circuits using elementary gates (RS, Clocked RS, D-type, and JK Flip-Flop).
9. To build a 4-bit Counter using D-type/JK Flip-Flop.
10. To make a Shift Register from D-type/JK Flip-Flop.
11. Serial and parallel shifting of data.
12. To design an Inverting Amplifier of given gain using Op-amp 741 and to study its Frequency Response.
13. To design a Non-Inverting Amplifier of given gain using Op-amp 741 and to study its Frequency Response.
14. To design and study a precision Differential Amplifier of given I/O specification using Op-amp 741.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH 302B-P	Digital Electronics Lab	**CO**	**3**	3	3	3	**-**	3	3	3	3	2	2	2	2	2

Course Title/Code	Condensed Matter Physics (PHH303B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To discuss structural, electrical, thermal and characterization techniques.	
Course Outcomes (COs)		Mapping
CO1	Ability to learn, understand, assimilate and demonstrate the knowledge about crystalline and amorphous substances, correlation of characteristic properties of solid with the nature of bonding, lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones and diffraction of X-rays by crystalline materials.	Skill Development
CO2	.Ability to learn, understand, assimilate and demonstrate the knowledge about behavior of free electrons in crystals.	Skill Development
CO3	Ability to learn, understand, assimilate and demonstrate the knowledge about lattice vibrations, phonons and in depth knowledge of Einstein and Debye theory of specific heat of solids.	Skill Development
CO4	Ability to learn, understand, assimilate and demonstrate the knowledge about structure unfolding Characterization techniques.	Skill Development
Prerequisites (if any)		

Section - A

Amorphous and crystalline state of matter. Crystal systems, bonding in crystals: covalent, ionic, metallic, hydrogen bond, vander Waal's bond and the Madelung constant. Crystalline solids, unit cell, primitive cell, Bravis lattices, Miller indices, closed packed structures. Atomic radius, lattice constant and density. Liquid crystals. X-ray diffraction-Bragg equation.

Section - B

Free electrons in solids, density of states, Fermi surface, Fermi gas at T=0 K, Fermi statistics, specific heat capacity of electrons in metals, thermionic emission of electrons from metals.

Section - C

Lattice dynamics of atoms in crystals, vibrations of monoatomic and diatomic linear chains, acoustic and optical phonon modes, density of states, thermal properties of crystal lattices, thermal energy of the harmonic Oscillator

Section - D

Basic of characterization techniques: FTIR, NMR, Powder XRD, UV-Vis.

Text and Reference Books

1. Wahab, M. A., "Solid state Physics: structure & properties of materials", 2nd Ed., Narora publishing house, New Delhi, 1999
2. Pillai, S. O., "Solid state Physics", 6th Ed., New Age Science, 2009
3. Singhal, R. L., "Solid state physics", 6th Ed., Kedarnath Ram Nath& co, Meerut,1997
4. Banwell, C. N., "Fundamentals of molecular spectroscopy" 4th Ed., Tata McGraw -Hill Education., 1994
5. Cullity, B. D.,"Elements of X-ray diffraction" Addision-Wesley Publishing Company, Inc., U.S.A, 1956
6. Kittel, C., "Introduction to solid state physics",7th Ed., Jhon Wiley & sons, Inc, New York,1996

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH303B-T	Condensed Matter Physics	CO1	3	3	3	-	3	3	-	-	-	3	-	-	-	-
		CO2	3	3	3	-	3	3	-	-	-	3	-	-	-	-
		CO3	3	3	3	-	3	3	-	-	-	3	-	-	-	-
		CO4	3	3	3	-	3	3	-	-	-	3	-	-	-	-

Course Title/Code	Modern Physics (PHH304B-T)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To study and analyze different types of spectra, nuclear models and detectors	
Course Outcomes (COs)		Mapping
CO1	Ability to apply concept of Length Contraction, Time Dilation, Velocity addition, Energy mass conversion, variation of mass with velocity.	Skill Development
CO2	Ability to calculate wavelength of different series of hydrogen atom and explain fine structure of the spectrum	Skill Development
CO3	Ability to explain spectrum of many electron systems.	Skill Development
CO4	Ability to explain nuclear properties and nuclear radiation detectors.	Skill Development
Prerequisites (if any)		

Section - A

Inertial and Non inertial frame of references, Michelson-Morley Experiment (Qualitative), Einstein's Postulates of Special Theory of Relativity, Lorentz Transformations, Length Contraction, Time dilation, velocity Addition Theorem, Variation of mass with velocity, Mass – Energy Equivalence Relation

Section - B

Bohr's Model of Hydrogen Atom, Spectral Series, Schrodinger Equation in Spherical Polar Coordinates, Hydrogen Atom (Qualitatively), Quantum Numbers and Selection Rules (Qualitative). Stern-Gerlach Experiment, Spin as an Intrinsic Quantum Number, Fine Structure

Section - C

Magnetic Moment of the Electron, Lande g-Factor, Vector Model – Space Quantization, Zeeman Effect, Pauli Exclusion Principle, Shell Structure. Hund's Rule, Spectroscopic Terms of Many Electron Atoms in the Ground State Diatomic Molecules–Rotational and Vibrational Energy Levels, Basic Ideas About Molecular Spectra, Raman Effect and Its Application to Molecular Spectroscopy (Qualitatively).

Section - D

Structure of nuclei

Basic Properties of Nuclei: Mass, Radii, Charge, Angular Momentum, Spin, Magnetic Moment (μ), Stability and Binding Energy.

Nuclear Models

Liquid Drop Model, Mass formula, Shell Model, Meson Theory of Nuclear Forces

Detectors of Nuclear Radiations

Interaction of Energetic particles with matter, Ionization chamber, GM Counter, Cloud Chambers, Wilson Cloud Chamber, Bubble Chamber, Scintillation Detectors, Semiconductor Detectors (Qualitative Discussion Only)

Text and Reference Books

1. Concepts of modern Physics A Beiser, S Mahajan & S R Chaudhary (Text Book)
2. Modern Physics-R A Serway, C J Moses & C A Moyer
3. Atomic and Molecular Spectra: Laser-R Kumar (Text Book)
4. Fundamentals of Molecular Spectroscopy-C N Banwell& E M Mccash
5. Introduction to Molecular Spectra – H E White

CO-PO MAPPING

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH304 B-T	Modern Physics	CO1	3	3	3	-	2	2	-	-	-	1	-	1	1	-
		CO2	3	3	2	-	2	2	-	-	-	1	-	1	1	-
		CO3	3	3	3	-	2	2	-	-	-	2	-	1	1	-
		CO4	3	3	3	-	2	2	-	-	-	1	-	1	1	-

Course Title/Code	Modern Physics Lab(PHH304B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To study and analyze different types of spectra, nuclear models and detectors	
Course Outcomes (COs)		Mapping
CO	Ability to demonstrate the various phenomena of Modern Physics	Skill Development
Prerequisites (if any)		

List of Experiments

1. Verification of Stefan's Law and Wien's displacement law by constructing Black Body Spectrum
2. Measurement of sodium doublet using Michelson Interferometer
3. Construction of Wave Packet by superposition of waves
4. Hydrogen spectra using Transmission Grating
5. Measurement of e/m of an electron
6. Measurement of Charge of an electron using Millikan Oil Drop method.
7. Measurement of energy Band Gap of intrinsic semiconductor by Four Probe Method
8. Measurement of Hall Effect.
9. Thermionic emission of electron
10. Energy band measurement for semiconductor diode/ diode laser.
11. To determine the wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg's Constant.

11. To determine the value of Boltzmann Constant by studying Forward Characteristics of a diode.

12. To determine the value of Planck's constant by using a Photoelectric Cell.

13. To determine the value of Planck's constant by using LEDs of at least different Wavelengths.

CO-PO MAPPING

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH304 B-P	**Modern Physics LAB**	**CO**	3	3	3	-	2	2	-	-	-	1	-	1	1	-

Course Title/Code	PROFESSIONAL COMPETENCY-IV(CDO311)	
Course Type/ Semester	Core / Sem - 5	
L-P-O Structure	2-0-0	
Credits	1	
Course Objective	To familiarize students with the problem solving, develop leadership ability	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to demonstrate problem solving and leadership skills required to participate in a stimulated environment.	
CO2	Students will be able to plan their career meticulously by setting their time oriented goals	
CO3	Students will be able to face real life challenges using critical reasoning skills.	
CO4	Enhance their ability to write, read, comprehend and communicate effectively to increase the productivity of business.	
Prerequisites (if any)	**N.A**	

Section A

Unit I: Problem Solving and Critical Thinking, Problem Solving skills: Defining Problem, Generating alternative solutions and root cause analysis, Critical thinking: Determine the

importance and relevance of arguments and ideas, Critical thinking process and components, Decision-making and productivity

Section B

Unit II: Personal Effectiveness, Accountability, Adaptability for Success, Building Your Self Esteem and Assertiveness Skills, Building Relationships for Success, Self Mastery – A Plan for Personal Success, Boosting Your Confidence, Public Speaking and Performance, How to Set Goals When Everything Feels Like a Priority

Section C

Unit III: Leadership Skills, Ethics & Values, Code of conduct, Social Emotional Learning, Change Management: Change and How to Deal with It, Self Leadership

Section D

Unit IV: Advanced Vocabulary Synonym & Antonym, One Word Substitution, Ordering of Words Sentence Construction & Syntax, Sentence Improvement, Spotting Errors, Ordering of Sentences, Change of Voice/ Direct & Indirect speech, Completing Statements/Sentences

Reading Comprehension & Reasoning-II, Strategic Reading, Eliminating Poor Reading Habits, Techniques to increase speed reading, comprehension and recall, Solving Sample RC Passages, Para Jumbles

TEXTBOOKS

3. The 7 Habits of Highly Effective People: Stephen R. Covey
4. Personal Effectiveness: Alexander Murdock, Carol N. Scutt, 3rd Edition

REFERENCE BOOKS

3. Verbal Ability and Reasoning for Competitive Examinations: P.A. Anand, Wiley
4. Great Work, Great Career: How to Create your ultimate job and make extraordinary contribution by Stephen R. Covey, Jennifer Colosimo

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CDO 311	Professional Competency IV	CO1	--	--	--	--	--	--	--	--	2	1	1	--	1
		CO2	--	--	--	--	--	--	--	--	1	--	1	--	2
		CO3	--	--	2	2	--	--	--	1	2	1	--	--	--
		CO4	--	--	--	--	--	--	--	--	2	--	1	--	1

Semester-VI

COURSE CODES	COURSE NAME	OFFERING DEPARTMENT	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	NO. OF CREDITS
PHH306B-T	Electronic Devices	PH	CORE	3	1	0	4
PHH306B-P	Electronic Devices Lab	PH	CORE	0	0	2	1
PHH310B-T	Atmospheric Physics	PH	Elective (Any Two)	3	1	0	10
PHH310B-P	Atmospheric Physics Lab	PH		0	0	2	
PHH311B-T	Computational Condensed Matter Physics	PH		3	1	0	
PHH311B-P	Computational Condensed Matter Physics Lab	PH		0	0	2	
PHH312B-T	Laser Fundamentals and its Applications	PH		3	1	0	
PHH312B-P	Laser Fundamentals and its Applications Lab	PH		0	0	2	
PHH313B-T	Quantum Computing	PH		4	1	0	

PHH314B-T	**Energy, Environment and Climate Change Concerns**	**PH**		**3**	**1**	**0**	
PHH315B-T	**Introduction to Astronomy and Astrophysics**	**PH**		**4**	**1**	**0**	
CDO312	**Professional Competency-V**	**CDC**	AP/AF	2	0	0	1
PHN307	**Major Project**	**PH**	**CORE**	**0**	**0**	**16**	**8**
	TOTAL (L-T-P/CREDITS)			**11/13**	**3**	**6**	**24**

Detailed Syllabus

Course Title/Code	**Electronic Devices(PHH306B-T)**	
Course Type	**Core (Deptt.)**	
L-T-P Structure	**3-1-0**	
Credits	**4**	
Course Objective	To discuss the working of diodes, transistors, electronic devices and simple circuits	
Course Outcomes (COs)		**Mapping**
CO1	Ability to understand, explain and demonstrate about semiconductors, various types of diodes and its applications in elctronics with problems and circuit diagram**.**	**Skill Development**
CO2	Ability to understand, construction and working of power handling devices such as SCR, UJT. Ability to understand construction and working of BJT with circuit diagram.	**Skill Development**
CO3	Ability to understand construction and working of JFET and MOSFET with circuit diagram.	**Skill Development**
CO4	Ability to understand about methods and steps for	**Skill Development**

	IC fabrication technology**.**	
Prerequisites (if any)		

Section-A

Semiconductor Basics: Energy Bands in Solids, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Majority Carriers (electrons and holes), Dependence of Fermi Level on Temperature and Doping Concentration, Diode: P-N Junction Diode, Formation of Depletion Layer, and Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of Abrupt p-n Junction, Diode Equations and the I-V Characteristic, Zener Diode and Avalanche mechanism, Diode as rectifier

Section – B

Metal Semiconductor Junctions and Bipolar Junction Transistors (BJT):

Ohmic& Rectifying Contacts, PNP and NPN Transistors, Basic Transistor Action, Energy Band Diagram of Transistor in Thermal Equilibrium, Early Effect, Input and Output Characteristics of CB, CE and CC Configurations, CE Transistor as an Amplifier, Uni-Junction Transistor (UJT): Construction, Working and I-V Characteristics of UJT, Thyristor Devices: Basic Construction and Characteristics of Thyristor, Semiconductor Controlled Device (SCR), Characteristics and Two Transistor Model Of SCR

Section – C

Field Effect Transistors (FET)

Construction and Working of JFET, Idea of Channel Formation, Pinch-off Voltage, Transfer and Output Characteristics, MOSFET: MOS Diode, Basic Construction of MOSFET and Working, IV Characteristics, Enhancement and Depletion Modes, Complimentary MOS(CMOS).

Section-D

Semiconductor Fabrication Technology

Introduction to Semiconductor Technology, Basic Fabrication Steps: Wafer, Epitaxial Growth, Oxidation, Photolithography, Etching, Diffusion, Ion Implantation, Film Deposition and Metallization, Moore's Law, Medium Scale Integration (MSI), Large Scale Integration (LSI), Very Large Scale Integration (VLSI), Ultra Large Scale Integration (ULSI), Giant Scale Integration(GSI)

Text and Reference Books

1. S. M. Sze, Semiconductor Devices: Physics and Technology, John Wiley & Sons (2002)

2. Ben Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)

3. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)

4. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)

CO-PO MAPPING

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH306 B-T	Electronic Devices	CO1	3	3	-	-	3	3	-	-	-	3	-	1	-	2
		CO2	3	3	2	-	2	2	-	-	-	2	-	-	-	2
		CO3	3	2	2	-	**3**	2	-	-	2	2	-	-	-	2
		CO4	3	2	-	1	2	1	-	-	-	1	-	-	-	2

Course Title/Code	Electronic Devices Lab(PHH306B-P)	
Course Type	Core (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To discuss the working of diodes, transistors, electronic devices and simple circuits	
Course Outcomes (COs)		Mapping
CO	Ability to demonstrate working of various electronic devices.	Skill Development
Prerequisites (if any)		

LIST OF EXPERIMENTS

1. To study (a) Half-wave Rectifier and (b) Full-wave Bridge Rectifier.
2. To investigate the effect of C, L and π filters.
3. To study the forward and reverse characteristics of a Zener Diode and to study its use as a Voltage Regulator.
4. To study the V-I Characteristics of p-n junction diode and hence to determine static and dynamic resistance.
5. To study the Characteristics of a Photo-diode.
6. To study the CE Characteristics of a Transistor.
7. To study the various Transistor Biasing Configurations as an amplifier
8. To design a CE Amplifier of a given gain (mid-gain) using Voltage Divider Bias.
9. To study the Frequency Response of Voltage Gain of a RC-Coupled Amplifier.
10. To study the Characteristics of a FET and design a common source amplifier.

CO-PO MAPPING

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH306 B-P	**Electronic Devices LAB**	**CO**	3	3	-	-	3	3	-	-	-	3	-	1	-	2

Course Title/Code	Atmospheric Physics (**PHH310B-T**)	
Course Type	**Elective (Deptt.)**	
L-T-P Structure	**3-1-0**	
Credits	**4**	
Course Objective	To understand, explain and demonstrate various laws and concepts of essentials of Atmospheric Physics.	
Course Outcomes (COs)		**Mapping**
CO1	Ability to understand, explain and demonstrate various laws and concepts of essentials of Atmospheric Physics and further analyze and solve related problems.	**Skill Development**
CO2	Ability to compare and explain various laws and concepts of atmospheric thermodynamics and solve related problems. They would further be able to formulate new problems related to atmospheric physics.	**Skill Development**
CO3	Ability to understand, compare and analyze the concepts cloud microphysics of warm and cold clouds, their formation and solve various related problems. They would be able to hypothesize new related problems	**Skill Development**
CO4	Ability to understand, explain and demonstrate concepts of ionosphere, its structure, formation, importance and analyze and solve problems related to various navigation and communication systems via ionosphere. They would be able to hypothesize new related problems	**Skill Development**
Prerequisites (if any)		

Section-A

Essentials of Atmospheric Physics

Structure of the atmosphere: troposhere, stratopshere, mesosphere, thermosphere, Composition of air, Greenhouse effect and enhanced greenhouse effect, Transport of matter, energy and momentum in nature, Stratification and stability of atmosphere, Elements of weather and climate of India.

Section-B

Solar and Terrestrial Radiation

Physics of radiation, Interaction of light with matter, Rayleigh- and Mie-scattering, Laws of radiation (Kirchoffs law, Planck's law, Wien's displacement law, etc.), Solar and terrestrial spectra, UV radiation, Ozone depletion problem, IR absorption energy balance of the earth atmosphere system.

Section-C

Atmospheric Pollution and Degradation

Elementry fluid dynamics, Diffusion. Turbulence and turbulent diffusion, Factors governing air, water and noise pollution air, Gaseous and particulate matters, Wet and dry deposition, Residence time and reaction rates of pollutants, sulphur compounds, nitrogen compounds, carbon compounds, organic compounds, aerosols, toxic gases and radio active particles trace gases.

Section-D

Global and Regional Climate

Stability and vertical motion of air, Horizontal motion of air and water, General circulation & climate, Pressure gradient forces, Viscous forces, Energy balance-a zero-dimensional Greenhouse model, Global climate models.

Text/ Reference Books:

1. Meteorology for Scientists & Engineers: Ronald B. Still, Brooks/ Cole Cengage Learning 1995.

2. Environmental Physics : Edbert B and Reink V Groundelle, John Wiley

3. The Physics of Atmosphere : J.T. Hougtion, Cambridge Univ. Press, 1977.

4. Atmospheric Science: John M. Wallace & Peter V. Hobbs, Academic Press (2006)

5. Dynamic Meteorology : Holton, J.R., 3rd edition,Academic PressN.Yf. (1992).

6. The Physics of Monsoons : R.N. Keshvamurthy ans M. Shanker Rao, Allied Publishers, 1992

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH310B-T	Atmospheric Physics	CO1	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2

Course Title/Code	Atmospheric Physics Lab (PHH310B-P)	
Course Type	Elective (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To demonstrate various laws and concepts of essentials of Atmospheric Physics.	
Course Outcomes (COs)		Mapping
CO	Ability to demonstrate various laws and concepts of essentials of Atmospheric Physics and further analyze and solve related problems.	Skill Development
Prerequisites (if any)		

LIST OF EXPERIMENTS

1. To study and analyze the diurnal features of Aerosols (PM10, PM2.5, SOx , NOx etc.,) using Central Pollution control board (CPCB) data.

2. To analyze the Air Quality Index (AQI) of different regions using Central Pollution control board (CPCB) data.

3. To determine the coefficient of viscosity and critical velocity of water using Poiseulle's method

4. To analyze the variations in PM10, PM2.5, CO_2, humidity, temperature with changing spatial locations using Airveda High Accuracy Smart Air Quality Monitoring instrument

5. To study the change in concentration of PM10, PM2.5, CO_2 during the burning of fragrance sticks/smoke using Airveda High Accuracy Smart Air Quality Monitoring instrument

6. Heat transfer by radiation.
    a) Compare heat transfer between different material surface and the black body surface by radiation.
    b) To find the emissivity of different material surface.

7. Heat transfer by conduction.
    a) To find the thermal conductivity of a material by the two slabs guarded hot plate method.
    b) To find the thermal resistance of the sample.

8. Heat transfer by natural convection.
    a) To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.
    b) To determine the value of Nusselt number.

9. Photoelectric effect.

    a) To understand the phenomenon Photoelectric effect as a whole.
    b) To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
    c) To determine the Planck's constant from kinetic energy versus frequency graph.
    d) To plot a graph connecting photocurrent and applied potential.
    e) To determine the stopping potential from the photocurrent versus applied potential graph.

10. The study of phase change.
    a) To study the phase change of a substance from liquid to solid by plotting the cooling curve.
    b) To determine the melting point of the given substance and to find out the transition time.

11. Determination of Stefan- Boltzmann constant σ.

12. To verify inverse square law of radiation using a photoelectric cell.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH310B-P	**Atmospheric Physics LAB**	**CO**	3	3	3	-	1	3	1	3	-	3	1	-	2	2

Course Title/Code	Computational Condensed Matter Physics (PHH311B-T)	
Course Type	Elective (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To handle the tools of classical mechanics, quantum mechanics, statistical mechanics and computers in order to develop the understanding of condensed materials in terms of structure and dynamics of the molecular system under consideration.	
Course Outcomes (COs)		Mapping
CO1	Ability toperform structural and dynamics calculations for various molecular systems based on molecular mechanics.	
CO2	Ability toderive the macroscopic properties of any physical system that has a large number of degrees of freedom from microscopic constituents on the basis of statistical ensembles.	
CO3	Ability tounderstand the development of different quantum mechanical theories and their role in understanding computational physics.	
CO4	Ability toperform various molecular dynamics simulations.	
Prerequisites (if any)		

Section - A

MOLECULAR MECHANICS

Perspective, the basic principles of molecular mechanics, examples of the use of molecular mechanics, geometries calculated by molecular mechanics, frequencies calculated by molecular mechanics, strength and weakness of molecular mechanics. The application of the Schrödinger equation to chemistry by Hückel, The Extended Hückel Method.

Section - B

STATISTICAL ENSEMBLES

Introduction to Ensembles: microcanonical ensemble; Canonical ensemble, canonical distribution, Mean values and fluctuations; Grand Canonical Ensemble, Grand Canonical distribution, Fluctuation in the number of particles of a system in a Grand Canonical ensemble; Reduction of Gibb's distribution to Maxwell and Boltzmann distributions, Boltzmann distribution and its experimental verification.

Section - C

SEMIEMPIRICAL AND MOLECULAR-MECHANICS TREATMENTS OF MOLECULES

ab initio calculations: Perspective, the basic principles of the ab initio method, basis sets, Post-HF calculations: electron correlation, applications of the ab initio method, strengths and weaknesses of ab initio calculations; **Semi empirical calculations**: Perspective, the basic principles of SCF SE methods, applications of SE methods, strengths and weaknesses of SE methods.**DFT**: Perspective, the basic principles of density functional theory, applications of density functional theory, strengths and weaknesses of DFT.

Section - D

MOLECULAR DYNAMICS SIMULATIONS

Introduction to linux, Installation and running a program, Preparation of input for different open source codes, calculation of various properties of molecules, clusters, crystals and surfaces, visualization of output.

Text and Reference Books

1. J.M. Ziman, Principles of the Theory of Solids, Cambridge University Press
2. M. Marder, Condensed Matter Physics, Wiley
3. P.M. Chaikin and T.C. Lubensky, Principles of Condensed Matter Physics, Cambridge University Press
4. Errol lewars, Introduction to the theory and applications of molecular and quantum mechanics.
5. Ira N. Levine, Quantum chemistry
6. B. B. Laud, Fundamentals of statistical mechanics
7. S. Raimes: Many Electron Theory
8. N. H. March and M. Parrinello: Collective Effects in Solids and Liquids
9. C. Kittel: Quantum Theory of Solids

10. P. Fazekas, Lecture Notes on Electron Correlation & Magnetism, World Scientific

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH311B-T	Computational Condensed Matter Physics	CO1	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2

Course Title/Code	Computational Condensed Matter PhysicsLab (PHH311B-P)	
Course Type	Elective (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To apply the tools of classical mechanics, quantum mechanics, statistical mechanics and computers in order to develop the understanding of condensed materials in terms of structure and dynamics of the molecular system under consideration.	
Course Outcomes (COs)		Mapping
CO	Ability to apply the computational package to determine different properties of materials.	
Prerequisites (if any)		

List of Experiments

1. Introduction to ghemical: input, output
2. Preparation of input of molecules, cluster for GAMESS (detail description of different keywords)
3. Structural, vibrational study of water using DFT.
4. Vibrational study of water using DFT.
5. Structural, vibrational study of benzene using DFT.
6. Vibrational study of benzene using DFT.
7. Study of structural change in quartz under pressure, by classical molecular dynamics.
8. UV-vis spectrum of dye by DFT

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH311B-P	Computational Condensed Matter Physics LAB	CO	3	3	3	-	1	3	1	3	-	3	1	-	2	2

Course Title/Code	**Laser: Fundamentals and Its Applications (PHH312B-T)**	
Course Type	**Elective (Deptt.)**	
L-T-P Structure	**3-1-0**	
Credits	**4**	
Course Objective	To understand the basic principles of how lasers work and their main properties. On successful completion of this course, a student should be able to understand the basics of lasers, the techniques behind different lasers' design, and applications of lasers in spectroscopy, chemistry, medicine, biology, military and other areas.	
Course Outcomes (COs)		**Mapping**
CO1	Ability to discuss and explain the basic principles of laser.	
CO2	Ability to discuss and explain different types of lasers.	
CO3	Ability to discuss and explain different types of laser systems	
CO4	Ability to discuss basic and technological applications of lasers.	
Prerequisites (if any)		

Section-A

Basic Laser Characteristics

Introduction; Importance: Why laser? Unique properties of lasers; Brief history of laser development; Laser basics; concept of coherence, absorption, spontaneous emission and stimulated emission processes, relation between Einstein's A and B coefficients, population inversion, Amplification of stimulated emission; pumping, gain, optical cavities.

Section-B

Basic Laser Principle

Coherent radiation, standing waves and modes; the kinetics of laser emission; Rate equations; Threshold conditions; Pulsed and continuous wave laser emission; various pulsing techniques: cavity dumping, Q-switching and mode-locking, Transitions, lifetimes and line widths: Three level laser, Four-level laser, emission linewidth;

Section-C

Laser Systems

Properties of laser light: monochromaticity, spatial and temporal coherence, intensity, beam-width Similarity transforms. Introduction to general lasers and their types. CW & Pulsed Lasers, atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement.

Section-D

Laser Applications

Applications of lasers in spectroscopy, chemistry, biology, medical sciences and other fields. Ultrafast Phenomenon: Principle of generation of ultrafast pulses (mode locking), basic concepts for measurement of fast processes, Streak technique, Stroboscopy, sampling technique, nonlinear optical methods for measuring ultrashort pulses.

Text and Reference Books

1. P.W. Milonni and J.H. Eberly, **Laser Physics**, John Wiley & Sons, 2010.
2. O. Svelto, **Principles of Lasers**, Springer, 3rd Edition 2007.
3. A.E Siegman, **Lasers**, University Science Books, 1986.
4. B.E.A. Saleh and M.C. Teich, **Fundamentals of Photonics**, Wiley Interscience, New York 1991.
5. K.R. Nambiar, “Laser Principles, Types and Application” New Age International.
6. S. A. Ahmad, “Laser concepts and Applications” New Age International.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH312B-T	Laser: Fundamentals and Its Applications	CO1	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2

Course Title/Code	Laser: Fundamentals and Its ApplicationsLab (PHH312B-P)	
Course Type	Elective (Deptt.)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To use lasers for different applications.	
Course Outcomes (COs)		Mapping
CO	Ability to use lasers for various basic and technical applications.	
Prerequisites (if any)		

List of Experiments

1. Measuring the slit-width using Diffraction experiment.
2. Measuring the diffraction pattern using single slit.
3. Measuring the diffraction pattern using the double slit.
4. Measuring the diffraction pattern using the Mesh.
5. Optical fiber losses experiment.
6. Optical fiber experiment; measuring the numerical aperture
7. Optical fiber experiment; measuring the bending loss.
8. Energy band measurement for semiconductor diode/ diode laser

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH312B-P	Laser: Fundamentals and Its Applications LAB	CO	3	3	3	-	1	3	1	3	-	3	1	-	2	2

Course Title/Code	Quantum Computing (PHH313B-T)	
Course Type	Elective (Deptt.)	
L-T-P Structure	4-1-0	
Credits	5	
Course Objective		
Course Outcomes (COs)		Mapping
CO1	Recall basic physics and mathematics behind computation	
CO2	Explain computation as a physical process	
CO3	Apply laws of quantum mechanics to perform computation tasks	
CO4	Analyze complex problems related to quantum computing	
Prerequisites (if any)		

Section - A

Introduction to quantum computing

History of computation, status and future prospects; limitations of traditional semiconductor-based computers, Why Quantum computing, Quantum computing roadmap, Q mission in India, Essential linear algebra and notation of quantum bits or qubits.

Section - B

Quantum mechanics and quantum circuits

A brief introduction to application of quantum computing, Quantum computing basics, Postulates of quantum mechanics, Quantum measurement, Quantum gates and circuits.

Section - C

Quantum computing concepts and quantum search algorithms

Entanglement and Interference, Quantum Algorithms: Deutsch Jozsa Algorithm, Bernstein Vazirani Algorithm, Grover search algorithm.

Section - D

Quantum Error Correction

NISQ era quantum algorithm, Variational quantum Algorithm (VQE), Quantum generative Adversial networks (QGANs), Fixing quantum error with quantum tricks: Brief introduction to Quantum Error Correction.

Suggested Books:

1. Quantum computation & Quantum Information. Text book by M.A. Nielson and I Chuang, Cambridge University Press
2. R P Feynman, Feynman's Lectures on Computing, CRC Press, Boca Raton, 2018
3. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press, 2015

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH313B-T	Quantum Computing	CO1	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2

Course Title/Code	Energy, Environment and Climate Change Concerns (PHH314B-T)	
Course Type	Elective (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	Apply the concepts of energy production on physical systems through environmental conductions.	
Course Outcomes (COs)		Mapping
CO1	Explain the physical laws governing the structure and evolution of environmental phenomena spanning a broad range of spatial and temporal scales	
CO2	Describe the various types of environmental pollutants, their sources and remedial process.	
CO3	Describe solar energy spectrum distribution and their utilizations by using various solar devices.	
CO4	Demonstrate critical and analytical skills to interpret and predict weather systems using weather products.	
Prerequisites (if any)		

SECTION-A

Chemistry of the Environment

Environment, atmosphere: composition and structure, heat budget and lapse rate, cloud formation and classification, Thunderstorms, lightning/sprites and effects, aerosols, aerosols sources and their effect on climate.

SECTION-B

Environmental pollution and energy concerns

Overview of global environmental problems, Environmental pollution sources and classification, air pollution, noise pollution, water pollutions, soil pollution, marine pollution, Pollution due to thermal power stations, energy scenario, Elementary ideas of renewable energy sources, Fossil fuels.

SECTION-C

Solar Energy

Sun as a source of energy, solar-terrestrial relationship, Solar energy spectrum, Extraterrestrial and Terrestrial radiations, spectral energy distribution of solar radiation, depletion of solar radiation, measurement of solar radiation, Solar radiation geometry, solar day length, solar collector, solar water heater.

SECTION-D

Climate change concerns

Green House Gas Emissions, Depletion of ozone layer, Global warming, Climate change concerns, Climate change in India, Kyoto protocol, Clean development mechanism, Impact of climate change on glaciers, Rivers and water resources, Climate change issues in Himalayas, International status of climate change, Indian action plan on climate change.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH314B-T	Energy, Environment and Climate Change Concerns	CO1	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2

Course Title/Code	**Energy, Environment and Climate Change Concerns LAB (PHH314B-P)**	
Course Type	**Elective (Deptt.)**	
L-T-P Structure	**0-0-2**	
Credits	**1**	
Course Objective	To use the different devices to study various parameters of environment.	
Course Outcomes (COs)		**Mapping**
CO	Ability to handle the instrument which are used to study climate	
Prerequisites (if any)		

List of Experiments:

1) To study and analyze the diurnal features of Aerosols (PM10, PM2.5, SOx ,NOx etc.,) using Central Pollution control board (CPCB) data.

2)To analyze the Air Quality Index (AQI) of different regions using Central Pollution control board (CPCB) data.

3)To determine the coefficient of viscosity and critical velocity of water using Poiseulle's method

4)To analyze the variations in PM10, PM2.5, CO_2, humidity, temperature with changing spatial locations using Airveda High Accuracy Smart Air Quality Monitoring instrument

5)To study the change in concentration of PM10, PM2.5, CO_2 during the burning of fragrance sticks/smoke using Airveda High Accuracy Smart Air Quality Monitoring instrument

6)Heat transfer by radiation.

a)Compare heat transfer between different material surface and the black body surface by radiation.

b)To find the emissivity of different material surface.

7)Heat transfer by conduction.

a)To find the thermal conductivity of a material by the two slabs guarded hot plate method.

b)To find the thermal resistance of the sample.

8) Heat transfer by natural convection.

a)To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.

b)To determine the value of the Nusselt number.

9) Photoelectric effect.

a)To understand the phenomenon of the Photoelectric effect as a whole.

b)To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.

c)To determine Planck's constant from kinetic energy versus frequency graph.

d)To plot a graph connecting photocurrent and applied potential.

e)To determine the stopping potential from the photocurrent versus applied potential graph.

10) The study of phase change.

a)To study the phase change of a substance from liquid to solid by plotting the cooling curve.

b)To determine the melting point of the given substance and to find out the transition time.

11)Determination of Stefan- Boltzmann constant σ.

12)To verify the inverse square law of radiation using a photoelectric cell.

Reference and Text Books:

1. Meteorology for Scientists & Engineers: Ronald B. Still, Brooks/ Cole Cengage Learning 1995.

2. Environmental Physics: Edbert B and Reink V Groundelle, John Wiley

3. The Physics of Atmosphere: J.T. Hougtion, Cambridge Univ. Press, 1977.

4. Atmospheric Science: John M. Wallace & Peter V. Hobbs, Academic Press (2006)

5. Dynamic Meteorology: Holton, J.R., 3rd edition, Academic PressN.Yf. (1992).

6. The Physics of Monsoons: R.N. Keshvamurthy and M. Shanker Rao, Allied Publishers, 1992

7. Photovoltaic's Fundamentals, Technology and Application, Roger Messenger, D. Yogi Goswami, 2nd Edition, CRC Press

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH314B-P	**Energy, Environment and Climate Change Concerns LAB**	**CO**	3	3	3	-	1	3	1	3	-	3	1	-	2	2

Course Title/Code	Introduction to Astronomy and Astrophysics (PHH315B-T)	
Course Type	Elective (Deptt.)	
L-T-P Structure	4-1-0	
Credits	5	
Course Objective	To study astronomical objects using basic laws of physics	
Course Outcomes (COs)		Mapping
CO1	Interpret and explain the astronomical units, and the observation	
CO2	Understand the coordinate transformations	
CO3	Analyze different radiation process and its measurement	
CO4	Interpret different astrophysical sources	
Prerequisites (if any)		

SECTION - A

Observations

Scales and dimensions, Constellations, Earth, Sun, and the Solar System, Astronomical Catalogs and Software, Electromagnetic Waves, Electromagnetic Spectrum, Telescopes, Observations at Visible Frequencies, Mounting of Telescope, Observations at Other Wavelengths (12 L)

SECTION - B

Astrometry

Coordinate Systems: The Horizontal System, Equatorial Coordinate System, Ecliptic System, Galactic Coordinate System, Super galactic Coordinate System, Space Velocity and Proper Motion of Stars, Doppler Effect, Parallax, Aberration, Coordinate Transformations, Coordinate Transformations (12 L)

SECTION - C

Photometry

Flux Density and Intensify, Blackbody Radiation, Solid Angle, Energy Density in an Isotropic Radiation Field, Magnitude Scale, Stellar Temperatures, Gravitation and Kepler's Laws, Stars, Stellar Spectra, and Classification, Radiation from Astronomical Sources (qualitatively)

SECTION - D

Classification of Astrophysical Sources

Star Formation and Stellar Evolution, Stellar Nuclear Reactions, Solar System, Binary Stars, Milky Way, Galaxies, Cosmology, Active Galaxies

List of Simulation Experiment

1. Basic understanding of Magnetohydrodynamic plasma model

2. Modeling of Cosmic rays particle acceleration, Astrophysical shocks

Suggested Books:

• An introduction to Astrophysics (second edition), BaidyanathBasu, (PHI Publishing)

• An introduction to Astronomy and Astrophysics, Pankaj Jain (CRC press)

• An introduction to Astrophysics, Joshua N. Winn, Princeton Univ. (The great Course Pub.)

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH315B-T	Introduction to Astronomy and Astrophy	CO1	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2

	sics														

Course Title/Code	PROFESSIONAL COMPETENCY - V (CDO312)	
Course Type/ Semester	Core	
L-P-O Structure	2-0-0	
Credits	1	
Course Objective	To familiarize students with the Group discussion and managing Interviews	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to become proficient in resume building and drafting effective cover letters.	
CO2	Students will be able to enhance their ability to ace interviews, participate effectively and confidently in a Group Discussion	
CO3	Students will be able to enhance their ability to write, read, comprehend and communicate effectively	
CO4	Students will be able to prepare for placements and manage interviews effectively.	
Prerequisites (if any)	**N.A**	

Section - A

Unit I: Professional Writing, Profiling on Social Sites: LinkedIn, Facebook, Instagram, Cover Letter/Emails, Resume Writing

Section - B

Unit II: Group Discussions, Do's and Don'ts of a Group Discussion, Roles played in a Group Discussion, Tips for Cracking a Group Discussion

Section - C

Unit III: Professional Communication, Corporate lingo, Navigating through company social media sites, Networking: LinkedIn etc, Mock Interviews

Section - D

Unit IV: Managing Interviews, Developing the employability mindset, Preparing for Self – Introduction, Researching the employer, Portfolio Management, Types of Interviews & Interview etiquette, Professional Attire, Dressing, Body Language in interviews, Resume Check, Answering Difficult Questions in an Interview, Mock Interviews

TEXTBOOKS

5. The 7 Habits of Highly Effective People: Stephen R. Covey
6. Personal Effectiveness: Alexander Murdock, Carol N. Scutt, 3rd Edition

REFERENCE BOOKS

5. Verbal Ability and Reasoning for Competitive Examinations: P.A. Anand, Wiley
6. Great Work, Great Career: How to Create your ultimate job and make extraordinary contribution by Stephen R. Covey, Jennifer Colosimo

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO 312	Professional Competency V	CO1	--	--	--	--	--	--	--	--	1	--	--	--	2
		CO2	--	--	--	--	--	--	--	--	--	1	--	--	--
		CO3	--	--	--	--	--	--	--	--	2	--	1	--	1
		CO4	--	--	--	--	--	--	--	--	1	1	--	--	1

Course Title/Code	Major Project (PHN307)	
Course Type	Core	
L-T-P Structure	0-0-16	
Credits	8	
Course Objective	To make the students familiar with the cutting edge research.	
Course Outcomes (COs)		Mapping
CO	Ability to apply characterization and analysis tools in different areas of Physics	Employability and Skill Development
Prerequisites (if any)		

Course Code	Course Name	Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH307	Major Project	CO	3	3	3	3	1	3	1	3	3	3	3	3	3	3

CO-PO Mapping

Courses Code	Course	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
PHH104B-T	Mathematical Physics-I	CO1	3	-	-	3	-	3	3	-	-	3	-	-	-	-
		CO2	3	-	-	3	-	3	3	-	-	3	-	-	-	-
		CO3	3	-	-	3	-	3	3	-	-	3	-	-	-	-
		CO4	3	-	-	3	-	3	3	-	-	3	-	-	-	-
PHH104B-P	Mathematical Physics-I Lab	CO	3	-	-	3	-	3	3	-	-	3	-	-	-	-
PHH105B-T	Mechanics	CO1	3	3	3	-	-	1	1	-	2	3	-	2	2	2
		CO2	3	3	3	-	1	-	-	-	2	3	-	1	2	2
		CO3	3	3	3	1	1	-	-	3	-	3	1	-	2	2
		CO4	3	3	3	-	1	-	1	-	2	3	-	2	2	2
PHH105B-P	Mechanics	CO1	3	3	3	-	-	1	1	-	2	3	-	2	2	2
CHH105B-T	Essential of chemistry	CO1	2	-	-	1	1	-	-	-	-	-	-	-	-	-
		CO2	2	-	-	1	1	-	-	-	-	-	-	2	1	-
		CO3	2	-	-	1	1	-	-	-	-	-	-	2	1	-
		CO4	2	-	-	1	1	-	-	-	-	-	-	2	1	-
CHH105B-P	Essential of chemistry Lab	CO	2	-	-	1	1	-	-	-	-	-	-	2	1	-
CSH105B-T	Programming for Problem solving using C	CO1	3	3	2	-	-	-	-	-	3	3	3	3	3	3
		CO2	3	3	3	-	-	-	-	-	2	2	2	2	2	2
		CO3	3	3	3	-	-	-	-	-	3	3	2	2	2	2
		CO4	3	3	3	-	-	-	-	-	2	2	3	2	2	2
CSH105B-P	Programming for Problem solving using C	CO1	3	3	2	-	-	-	-	-	3	3	3	3	3	3
		CO2	3	3	3	-	-	-	-	-	2	2	2	2	2	2
		CO3	3	3	3	-	-	-	-	-	3	3	2	2	2	2
		CO4	3	3	3	-	-	-	-	-	2	2	3	2	2	2
HLS102	Communicative English	CO1	1	-	-	-	-	-	-	-	-	-	3	2	-	1
		CO2	-	-	-	-	-	-	-	-	-	-	3	2	-	1
		CO3	-	-	-	-	-	-	-	-	-	-	3	2	-	1
		CO4	-	-	-	-	-	-	-	-	-	-	3	2	-	1
PHH107B-T	Electricity and Magnetism	CO1	3	3	2	1	2	2	-	-	2	2	2	2	2	2
		CO2	3	3	2	1	2	2	-	-	2	2	2	2	2	2
		CO3	2	3	2	1	2	2	-	-	2	3	3	3	2	2
		CO4	2	3	2	1	2	2	-	-	2	3	3	3	2	2

PHH107B-P	**Electricity and Magnetism Lab**	**CO1**	**3**	**3**	**2**	**1**	**2**	**2**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**
		CO2	**3**	**3**	**2**	**1**	**2**	**2**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**
PHH108B-T	**Wave Optics**	**CO1**	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**1**	**-**	**1**	**-**	**-**
		CO2	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**
		CO3	**1**	**3**	**2**		**1**	**2**		**2**	**2**	**2**	**-**	**1**	**1**	**1**
		CO4	**-**	**-**	**3**	**2**	**2**	**2**	**-**	**3**	**-**	**3**	**-**	**1**	**1**	**1**
PHH108B-P	**Wave Optics Lab**	**CO1**	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**1**	**-**	**1**	**-**	**-**
		CO2	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**
		CO3	**1**	**3**	**2**		**1**	**2**		**2**	**2**	**2**	**-**	**1**	**1**	**1**
		CO4	**-**	**-**	**3**	**2**	**2**	**2**	**-**	**3**	**-**	**3**	**-**	**1**	**1**	**1**
PHH109B-T	**Mathematical Physics II**	**CO1**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
		CO2	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
		CO3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
		CO4	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
PHH109B-P	**Mathematical Physics II Lab**	**CO**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
CHH137	**Environmental Science**	**CO1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**3**
		CO2	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**2**
		CO3	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**
CDO111	**Professional Competency-I**	**CO1**	**2**	**--**	**1**	**2**	**2**	**1**	**2**	**--**	**--**	**--**	**1**	**2**	**3**	
		CO2	**--**	**--**	**3**	**--**	**--**	**--**	**--**	**1**	**3**	**2**	**--**	**--**	**3**	
		CO3	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**--**	**--**	**--**	**1**	**2**	**3**	
PHH201B-T	**Quantum Mechanics**	**CO1**	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**2**	**-**	**2**	**-**	**2**
		CO2	**2**	**2**	**2**	**-**	**3**	**3**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**1**
		CO3	**2**	**2**	**3**	**-**	**2**	**3**	**-**	**3**	**3**	**3**	**-**	**2**	**1**	**2**
		CO4	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**2**	**-**	**3**	**-**	**2**	**2**	**2**
PHH201B-P	**Quantum Mechanics Lab**	**CO1**	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**2**	**-**	**2**	**1**	**2**
		CO2	**2**	**2**	**2**	**-**	**3**	**3**	**-**	**2**	**-**	**3**	**-**	**-**	**2**	**1**
PHH202B-T	**Mathematical Physics III**	**CO1**	**3**	**3**	**3**	**-**	**-**	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
		CO2	**3**	**3**	**3**	**-**	**-**	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
		CO3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
		CO4	**3**	**2**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**
PHH202B-P	**Mathematical Physics III Lab**	**CO**	**3**	**3**	**3**	**-**	**-**	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
PHH203B-T	**Electromag**	**CO1**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**

	netic theory	CO2	3	2	3	2	2	3	3	2	1	3	-	-	-	-
		CO3	2	3	2	1	2	3	3	3	2	3	-	-	-	-
		CO4	3	3	2	2	2	3	2	3	2	2	-	-	-	-
PHH203B-P	Electromagnetic theory Lab	CO	3	3	2	1	2	2	2	2	2	2	-	-	-	-
CDO211	Professional Competency-II	CO1	2	1	--	2	1	1	1	--	--	1	1	2	3	
		CO2	1	--	2	2	1	--	1	--	2	1	--	--	2	
		CO3	2	1	2	2	1	1	1	--	--	1	--	2	2	
		CO4	--	--	3	--	--	--	--	1	3	2	--	--	3	
FLS103/FLS101/FLS102	French I/Spanish I/German I	CO1	1	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO4	1	1	-	-	1	-	1	-	1	1	1	-	1	-
EDS288	APPLIED PHILOSOPHY	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-
EDS289	Applied Psychology	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-
EDS290	APPLIED SOCIOLOGY	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-
MCS231	Basics of Economics MCS231	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-
MCS232	Fundamentals of Finance	CO1	2	1	-	-	1	-	1	-	1	1	1	-	1	-
		CO2	1	2	-	-	1	-	1	-	1	1	1	-	1	-
		CO3	1	1	-	-	2	-	1	-	1	1	1	-	2	-
		CO4	1	1	-	-	1	-	1	-	1	1	2	-	1	-
		CO1	1	-	-	-	-	1	-	-	-	-	-	1	-	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	-	1

		CO4	1	-	-	1	-	-	-	-	1	3	-	2	1	2
MAH411 –T	**Numerical Analysis**	**CO1**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**
		CO2	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**
		CO3	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**2**	**-**	**-**
		CO4	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**-**
MAH411 –P	**Numerical Analysis Lab**	**CO1**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**
		CO2	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**
PHH205B-T	**Thermodynamics**	**CO1**	**3**	**3**	**2**	**2**	**2**	**3**	**-**	**2**	**-**	**2**	**2**	**2**	**2**	**-**
		CO2	**3**	**3**	**3**	**3**	**2**	**3**	**-**	**3**	**-**	**2**	**2**	**3**	**2**	**-**
		CO3	**3**	**3**	**2**	**2**	**2**	**3**	**-**	**2**	**-**	**2**	**1**	**2**	**1**	**-**
		CO4	**3**	**3**	**2**	**1**	**2**	**3**	**-**	**2**	**-**	**2**	**1**	**2**	**1**	**-**
PHH205B-P	**Thermodynamics Lab**	**CO1**	**3**	**3**	**2**	**2**	**2**	**3**	**-**	**2**	**-**	**2**	**2**	**2**	**2**	**-**
PHH206B-T	**Solid State Physics**	**CO1**	**2**	**3**	**-**	**-**	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
		CO2	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**1**	**2**	**-**
		CO3	**3**	**3**	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**	**-**	**2**	**3**	**1**
		CO4	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**2**	**-**	**1**	**1**	**1**
PHH206B-P	**Solid State Physics Lab**	**CO1**	**2**	**3**	**-**	**-**	**2**	**3**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**
		CO2	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**1**	**2**	**-**
		CO3	**3**	**3**	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**	**-**	**2**	**3**	**1**
CHS234	**Environmental Ethics &Sustainable Development**	**CO1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**3**
		CO2	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**2**
		CO3	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**
LWS323	**Cyber crime and laws**	**CO1**	2	1	-	-	-	-	2	-	-	1	-	3	-	-
		CO2	3	2	-	-	-	-	-	-	2	-	-	1	1	-
		CO3	3	1	2	-	-	-	-	1	-	-	-	2	1	-
		CO4	3	1	-	-	-	-	-	-	-	-	-	3	1	-
CDO212	**Professiona**	**CO1**	--	--	--	--	--	--	--	--	1	1	--	--	2	1

	l Competency-III	**CO2**	--	--	1	--	--	--	1	--	1	1	--	--	2	1
		CO3	--	--	--	--	--	--	--	--	2	1	1	--	1	1
		CO4	--	--	--	--	--	--	--	--	2	1	--	--	1	2
PHH301B-T	**Statistical Physics**	**CO1**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**1**	**1**
		CO2	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**1**	**1**
		CO3	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**1**	**1**
		CO4	**3**	**3**	**3**	**-**	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**1**	**1**
PHH301B-P	**Statistical Physics Lab**	**CO**	**3**	**3**	**3**	**-**	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**1**	**1**
PHH302B-T	**Digital Electronics**	**CO1**	**3**	3	3	3	**-**	2	3	2	3	3	2	2	2	2
		CO2	**3**	3	3	3	**-**	3	3	3	3	3	2	2	2	2
		CO3	**3**	3	3	3	**-**	3	3	3	3	3	2	2	3	2
		CO4	**3**	3	2	2	**-**	3	3	3	3	3	3	3	3	3
		CO5	**3**	3	3	3	**-**	3	3	3	3	2	2	2	2	2
PHH302B-P	**Digital Electronics LAB**	**CO**	**3**	3	3	3	**-**	3	3	3	3	2	2	2	2	2
PHH303B-T	**Condensed Matter Physics**	**CO1**	3	3	3	-	3	3	-	-	-	3	-	-	-	-
		CO2	3	3	3	-	3	3	-	-	-	3	-	-	-	-
		CO3	3	3	3	-	3	3	-	-	-	3	-	-	-	-
		CO4	3	3	3	-	3	3	-	-	-	3	-	-	-	-
PHH304B-T	**Modern Physics**	**CO1**	3	3	3	-	2	2	-	-	-	1	-	1	1	-
		CO2	3	3	2	-	2	2	-	-	-	1	-	1	1	-
		CO3	3	3	3	-	2	2	-	-	-	2	-	1	1	-
		CO4	3	3	3	-	2	2	-	-	-	1	-	1	1	-
PHH304B-P	**Modern Physics LAB**	**CO**	3	3	3	-	2	2	-	-	-	1	-	1	1	-
CDO311	**Professional Competency IV**	**CO1**	--	--	--	--	--	--	--	--	**2**	**1**	**1**	--	**1**	**1**
		CO2	--	--	--	--	--	--	--	--	**1**	--	**1**	--	**2**	**1**
		CO3	--	--	**2**	**2**	--	--	--	**1**	**2**	**1**	--	--	--	**1**
		CO4	--	--	--	--	--	--	--	--	**2**	--	**1**	--	**1**	**2**
		CO5	1	-	-	1	-	1	-	-	1	3	-	2	1	2
		CO6	1	2	-	1	1	1	1	1	1	3	1	2	1	2
PHH306B-T	**Electronic**	**CO1**	3	3	-	-	3	3	-	-	-	3	-	1	-	2

	Devices	**CO2**	3	3	2	-	2	2	-	-	-	2	-	-	-	2
		CO3	3	2	2	-	**3**	2	-	-	2	2	-	-	-	2
		CO4	3	2	-	1	2	1	-	-	-	1	-	-	-	2
PHH306B-P	**Electronic Devices Lab**	**CO**	3	3	-	-	3	3	-	-	-	3	-	1	-	2
PHH310B-T	**Atmospheric Physics**	**CO1**	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2
PHH310B-P	**Atmospheric Physics LAB**	**CO**	3	3	3	-	1	3	1	3	-	3	1	-	2	2
PHH311B-T	**Computational Condensed Matter Physics**	**CO1**	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2
PHH311B-P	**Computational Condensed Matter Physics LAB**	**CO**	3	3	3	-	1	3	1	3	-	3	1	-	2	2
PHH312B-T	**Laser: Fundamentals and Its Applications**	**CO1**	3	3	3	-	1	3	1	3	-	3	1	-	2	2
		CO2	3	3	3	-	1	3	1	-	2	3	-	2	2	2
		CO3	3	3	3	-	1	3	1	-	2	2	-	2	2	2
		CO4	3	3	3	-	1	3	3	-	2	3	-	2	2	2
PHH312B-P	**Laser: Fundamentals and Its Applications LAB**	**CO**	3	3	3	-	1	3	1	3	-	3	1	-	2	2
CDO312	**Professional Competency V**	**CO1**	--	--	--	--	--	--	--	--	**1**	--	--	--	**2**	**1**
		CO2	--	--	--	--	--	--	--	--	--	**1**	--	--	--	**1**
		CO3	--	--	--	--	--	--	--	--	**2**	--	**1**	--	**1**	**1**
		CO4	--	--	--	--	--	--	--	--	**1**	**1**	--	--	**1**	**2**
PHH307	**Major Project**	**CO**	**3**	**3**	**3**	**3**	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**