COURSE SCHEME

FOR

M.Sc. (Hons.)Physics

(Five Year Integrated Programme)

Choice Based Credit System

&

As per New Education Policy -2020 (Multi-Entry: Multi-Exit Programme)

SARDAR BEANT SINGH STATE UNIVERSITY

GURDASPUR

STUDENT INTAKE: 30

ELIGIBILITY: 10+2 (Non-Medical & Medical Stream)

COURSE OPERATIONAL DETAILS:

- M. Sc. - Physics (Honours) will be an Integrated Program of 5 years duration with multiple Entry & Exit option(s) at every succeeding year.

- The program will be implemented under the purview of National Education Policy - 2020 (NEP), of Government of India.

The entry and exit options during the 5 year Integrated Postgraduate course of M.Sc. (Hons.) Physics are as given below:

EXIT POINTS:

Exit Point	**Outcome**
Exit after successful completion of 1st year (Semester 1st&2nd)	Eligible for award of **"CERTIFICATE COURSE IN BASIC PHYSICS"**
Exit after successful completion of 2nd year (Semester 1st to 4th)	Eligible for award of **"DIPLOMA IN APPLIED PHYSICS"**
Exit after successful completion of 3rd year (Semester 1st to 6th)	Eligible for award of **3-years** Bachelor Degree of **"B.S (HONOURS) PHYSICS"**
Exist after successful completion of 4th year (Semester 1st to 8th)	Eligible for award of **4-years** Bachelor Degree of **"B.Sc. (HONOURS) PHYSICS"** **OR** Eligible for award of **4-years** Bachelor Degree **"B.Sc. (HONOURS) PHYSICS with RESEARH"**
Exit after successful completion of 5th year (Semester 1st to 10th)	Eligible for award of dual degree of **"B.Sc. (HONOURS) PHYSICS" and M. Sc. (HONOURS) PHYSICS**

ENTRY/RE- ENTRY POINTS & ELIGIBILITY:

The validity of the credits earned by a student will be of seven (07) years from the year of discontinuation of studies to re-enter again into academic programme as per the National Education Policy - 2020 (NEP), so a student can re-start his/ her academic pursuit journey by making entry at different level(s) / stage (s) of the 5 year Integrated Postgraduate course of M.Sc. (Honours) Physics during this period.

Level/ Stage of Course	**Eligibility**	**Award of Diploma / Degree On successful completion**
2nd Year	Student who have passed 1st Year/2-Semesters, and is awarded with a **Certificate Course in Basic Physics** can re-enter at this stage.	**DIPLOMA IN APPLIED PHYSICS**
3rd Year	Student who have passed 2nd Year / 4-Semesters and is awarded with a **Diploma in Applied Physics** can re-enter at this stage.	**B.Sc. (HONOURS) PHYSICS**
4th Year	Student who have passed 3-yrs Bachelor's degree (B.Sc.) with Physics as one of the subject with an aggregate of 55% marks or equivalent CGPA, shall be allowed to enter in the 4th year of the program	**4-years** Bachelor Degree of **"B.Sc. (HONOURS) PHYSICS"** - with an EXIT Option after successful completion of 4th year of the program **OR** **M. Sc. (HONOURS) PHYSICS**- after successful completion of 5th year of the program
	Student must have passed 3-yrs Bachelor's degree (B.Sc. / B. Sc. Hons.) with Physics as one of the subject with minimum CGPA of 7.5 or equivalent percentage shall be allowed Enter in the 4th year of the program. Student is required to give information of his/her choice for Exit option at the start of 4th year / 7th semester to acquire B.Sc. (HONOURS) PHYSICS with RESEARH	**4-years** Bachelor Degree **"B.Sc. (HONOURS) PHYSICS with RESEARH"**
5th Year	Student must have passed 4 yrs B.Sc. (Honours.) Physics	**M. Sc. (HONOURS) PHYSICS**

SALIET FEATURES:

- Discontinuation of education at yearly stage will not go waste but will be recognized in terms of a Certificate /Diploma or a Degree.
- A learner can restart his/her academic career by making a Re-entry at yearly stage up to a period of Seven (07) Years with validity of credits earned by him/her, from the discontinuation year, as per the guidelines of the National Education Policy (NEP-2020) of UGC., New Delhi.
- Multidisciplinary Education: Options to choose subjects of own choice from other disciplines along with core Course subjects.
- Skill Oriented: Options to Choose Skill Enhancement Courses of Workshop Practices, Computer Skill, Renewable energy, Electronics and Measurement Practices.
- Research Oriented: Credit Based Course, Report Writing / Project Work and Dissertation based on research topics in the 8th / 10^{th} semester of the 5^{th} year of the course.

PROGRAMME OUTCOMES:

- Programme in its whole duration will provide multiple entry and exit options with appropriate certifications at every year and
- B. Sc. (Honours) Physics degree on the successful completion of 3 years.
- 4 years B. Sc. (Honours) - Physics degree on the successful completion of 4 years.
- 4 years B. Sc. (Honours) Physics with Research degree on the successful completion of 4 years if student complete a dissertation in major area of study.
- Student having 4-year bachelor's degree will be eligible to pursue 1-yr Master's programme,
- The 4-Year bachelor's degree with research will make students eligible for entry to Ph.D. degree as notified by UGC.

IMPORTANT NOTE:

- A student will be allowed to enter/re-enter only in the odd semester and can only exit after the even semester. Re-entry at various levels as lateral entrants in academic programmes will be based on the earned credits/prerequisite qualification.

After completion of 6^{th} Semester, students will have to choose if they want to acquire 4-year **B.Sc. (Hons.) Physics with Research**. If no choice is given, then student can exit on 4^{th} year with **B.Sc. (Hons.) Physics** (4-year undergraduate Degree).

Department of Applied Physics
M.Sc. (Hons.) Physics
((Five Year Integrated Programme)

1st Semester **Contact hours: 29**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T1	Mechanics	4	0	0	4	Theory
IPHY-T2	Mathematical Physics	4	1	0	5	Theory
IPHY-L1	Mechanics Lab.	0	0	6	3	Practical
	Generic Elective Course					
BSNM-22105	Differential Calculus	4	0	0	4	Theory
BSNM-22101	Organic Chemistry-I	4	0	0	4	Theory
BSNM-22108	Chemistry Lab.-I	0	0	4	2	Practical
	OR*					
BCCS-21103	Problem Solving using C	4	0	0	4	Theory
BCCS-21104	Problem Solving using C Laboratory	0	0	4	2	Practical
	Ability Enhancement Compulsory Course					
BSNM-22107	English	2	0	0	2	Theory
	Total	**18**	**1**	**10**	**24**	

***Students are required to follow same choice in sem. (1-IV) as adopted in the 1st. semester.**

Marks distribution for Semester 1 to 6th:

Theory Exam: Internal-40 Marks, External-60 Marks
Practical Exam: Internal-60 Marks, External-40 Marks

2nd Semester **Contact hours: 29**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T3	Oscillations and Waves	4	1	0	5	Theory
IPHY-T4	Electricity and Magnetism	4	0	0	4	Theory
IPHY-L2	Electricity and Magnetism Lab.	0	0	6	3	Practical
	Generic Elective Course					
BSNM-22205	Integral Calculus	4	0	0	4	Theory
BSNM-22202	Physical Chemistry-I	4	0	0	4	Theory
BSNM-22208	Chemistry lab.-II	0	0	4	2	Practical
	OR*					
BCCS-21203	Object Oriented Programming using C++	4	0	0	4	Theory
BCCS-21204	Object Oriented Programming using C++ Laboratory	0	0	4	2	Practical
	Ability Enhancement Compulsory Course					
BSNM-22207	Punjabi	2	0	0	2	Theory
	***OR**					
PHC-1	Punjab History & Culture					
	Total	**18**	**1**	**10**	**24**	

***Those students who are either Non-Domicile of Punjab or not have studied Punjabi subject in 8th/10th class, they can choose Punjab History & Culture in place of Punjabi.**

3rd Semester **Contact hours: 30**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T5	Optics	4	0	0	4	Theory
IPHY-T6	Introduction to Quantum Mechanics	4	1	0	5	Theory
IPHY-L3	Optics Lab.	0	0	6	3	Practical
	Generic Elective Course					
BSNM-22306	Differential Equations	4	0	0	4	Theory
BSNM-22301	Organic Chemistry-II	4	0	0	4	Theory
BSNM-22307	Chemistry Lab.-III	0	0	4	2	Practical
	OR*					
BCCS-21302	Operating Systems	4	0	0	4	Theory
BCCS-21304	Operating Systems Laboratory	0	0	4	2	Practical
	Skill Enhancement Course (any one)					
BTMP-21101	Workshop Manufacturing Practices	1	0	4	3	Practical
BCCS-21102	Computer Fundamentals	3	0	0	3	Theory
IPHY-SEC1	Renewable Energy	3	0	0	3	Theory
	Total	**19**	**1**	**14**	**25**	

4th Semester **Contact hours: 30**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T7	Electronics	4	0	0	4	Theory
IPHY-T8	Statistical Physics	4	1	0	5	Theory
IPHY-L4	Electronics Lab.	0	0	6	3	Practical
	Generic Elective Course					
BSNM-22406	Linear Algebra	4	0	0	4	Theory
BSNM-22401	Inorganic Chemistry-III	4	0	0	4	Theory
BSNM-22407	Chemistry lab-IV	0	0	4	2	Practical
	OR*					
BCCS-21402	Database Management Systems	4	0	0	4	Theory
BCCS-21404	Database Management Systems Laboratory	0	0	4	2	Practical
	Skill Enhancement Course (any one)					
BCCS-21406	Web Designing	3	0	0	3	Theory
BTCS-21101	Programming for Problem Solving	3	0	0	3	Theory
IPHY-SEC2	Basic Instrumentation Skill	3	0	0	3	Theory
	Total	**20**	**1**	**14**	**25**	

5th Semester **Contact hours: 32**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T9	Nuclear and Particle Physics	4	1	0	5	Theory
IPHY-T10	Heat and Thermodynamics	4	0	0	4	Theory
IPHY-L5	Thermal Physics Lab.	0	0	6	3	Practical
	Discipline Specific Course					
IPHY-T11	Laser and Fiber Optics	4	0	0	4	Theory
IPHY-T12	Material Science	4	1	0	5	Theory
IPHY-L6	Laser and Optical fiber Lab.	0	0	6	3	Practical
	General Elective Compulsory ID Course					
IPHY-GEC1	Drug Abuse: Management and Prevention	2	0	0	2	Theory
	Total	**18**	**1**	**12**	**26**	

6th Semester **Contact hours: 32**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T13	Solid State Physics	4	0	0	4	Theory
IPHY-T14	Spectroscopy	4	1	0	5	Theory
IPHY-L7	Solid State Physics Lab.	0	0	6	3	Practical
	Discipline Specific Course					
IPHY-T15	Radiation Safety and Measurements	4	0	0	4	Theory
IPHY-T16	Physics of Optoelectronics	4	1	0	5	Theory
IPHY-L8	Seminar and Report Writing	0	0	6	3	Practical
	General Elective Compulsory ID Course					
IPHY-GEC2	Environment Science	2	0	0	2	Theory
	Total	**18**	**2**	**12**	**26**	

7th Semester **Contact hours: 31**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T17	Mathematical Physics-I	4	1	0	5	Theory
IPHY-T18	Classical Mechanics	4	1	0	5	Theory
IPHY-T19	Statistical Mechanics	4	1	0	5	Theory
IPHY-T20	Semiconductors and Electronic Devices	4	1	0	5	Theory
IPHY-T21	Quantum Mechanics-I	4	1	0	5	Theory
IPHY-L9	Semiconductor Electronics Lab.	0	0	6	3	Practical
	Total	**20**	**5**	**6**	**28**	

Marks distribution for Semester 7 to 10th:

Theory Exam: Internal-50 Marks, External-100 Marks
Practical Exam: Internal-50 Marks, External-100 Marks

8th Semester **Contact hours: 34**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T22	Mathematical Physics-II	4	1	0	5	Theory
IPHY-T23	Condensed Matter Physics-I	4	1	0	5	Theory
IPHY-T24	Atomic & Molecular Physics	4	1	0	5	Theory
IPHY-T25	Digital Electronics	4	1	0	5	Theory
IPHY-L10	Digital Electronics Lab.	0	0	6	3	Practical
IPHY-L11	Numerical Analysis and Computer Programming.	4	0	4	6	Practical
	Total	**20**	**4**	**10**	**29**	

***For students opting for 4-Year bachelor's Degree with Research**

***8th Semester** **Contact hours: 20**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T22	Mathematical Physics-II	4	1	0	5	Theory
IPHY-T30	Physics of Nanomaterials	4	1	0	5	Theory
IPHY-T31	Synthesis and Characterization of Materials	4	1	0	5	Theory
IPHY- BD	Dissertation*	0	0	5	14#	
	Total	**12**	**3**	**5**	**29**	

9th Semester **Contact hours: 26**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T26	Quantum Mechanics-II	4	1	0	5	Theory
IPHY-T27	Condensed Matter Physics –II	4	1	0	5	Theory
IPHY-T28	Nuclear Physics	4	1	0	5	Theory
IPHY-T29	Classical Electrodynamics	4	1	0	5	Theory
IPHY-L12	Nuclear Physics Lab.	0	0	6	3	Practical
	Total	**20**	**4**	**10**	**23**	

10th Semester **Contact hours: 21**

Course code	Course Name	Load Allocated			Credits	Type of Course
		L	T	P	C	
	Core Course					
IPHY-T30	Physics of Nanomaterials	4	1	0	5	Theory
IPHY-T31	Synthesis and Characterization of Materials	4	1	0	5	Theory
IPHY-L13	Advanced Material Science Lab.	0	0	6	3	Practical
IPHY- MD	Dissertation*	0	0	5	10#	
	Total	**8**	**2**	**11**	**23**	

***Students will be assigned supervisor for dissertation work at the end of 8th semester, so that during summer break /9th semester, student can have overview of the particular research problem.**

 # The teaching load for dissertation work will be counted as 2 hours.

IPHY-T1
MECHANICS

L	T	P	C
4	0	0	4

Course Objectives: The objective of this course is to illustrate the laws of motion, kinematics of motion and their interrelationship. Mechanics course help the student to develop this ability to visualize, which is so vital to problem formulation.

1. Fundamentals of Dynamics (15)

Co-ordinate system and Motion of a Particle: Reference frames, Inertial frames; area, volume, displacement, velocity and acceleration in Cartesian and Spherical Polar co-ordinate systems; Introduction to cylindrical coordinate system, Solid angle, Galilean transformations; Galilean invariance of space & time intervals, Review of Newton's Laws of Motion. Conservative and non-conservative forces, Work done by conservative forces. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

Collisions: Elastic and inelastic collisions between particles. Relationship of velocities, angles and energies of the colliding particles in Centre of Mass and Laboratory frames. Cross-section of elastic scattering, Rutherford scattering.

2. Rotational Dynamics (10)

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 involving both translation and rotation. Cylinder on an accelerated rough plane, Behavior of angular momentum vector, Principal axes and Euler's equations, Elementary Gyroscope, Motion of a spinning top.

3. Central Force Motion (10)

Forces in nature (qualitative), Central Forces. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Reduced mass. Equation of motion of a reduced mass under central force and energy. Kepler's Laws of Planetary motion. Geosynchronous orbits. Weightlessness.

Non-Inertial Systems:

Non-inertial frames. Fictitious forces, Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force, Effect of Coriolis force on a particle falling freely under gravity. Effect of Coriolis force on a particle moving on the surface of earth, Foucault's pendulum and its equation of motion. Time period of Foucault's pendulum.

4. Special Theory of Relativity (10)

Michelson-Morley Experiment and its out- come, Postulates of Special Theory of Relativity, Lorentz Transformations, Simultaneity and order of events, Length contraction, Time dilation, Relativistic transformation of velocity, Relativistic addition of velocities, Variation of mass with velocity, Mass-energy Equivalence.

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

- Understand the fundamentals of vector mechanics for a classical system.
- Identify various types of forces in nature, frames of references, and conservation laws.
- Know the inertial and non-inertial system, Gravitation force as a Central Force Motion.

Text Books

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, D.S. Mathur, S. Chand and Company Limited 2000.
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
5. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
6. Feynman Lectures, Vol. I, R.P .Feynman, R.B. Leighton, M.Sands, 2008, Pearson.

IPHY-T2
MATHEMATICAL PHYSICS

L	T	P	C
4	1	0	5

Course Objectives: The purpose of the course is to introduce students to methods of mathematical physics and to develop required mathematical skills to solve problems in other fields of theoretical physics taught in different courses this class.

1. **First Order and Second Order Ordinary Differential equations (15)**
   First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problem. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials.

2. **Vector Calculus (5)**
   Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product, Scalar and Vector fields.

3. **Vector Differentiation (15)**
   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. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications.

4. **Orthogonal Curvilinear Coordinates (10)**
   Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. Dirac Delta function: Dirac Delta function and its properties:

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

- Understand basics of vector calculus.
- Understand divergence, gradient and curl and their physical interpretation.
- Understand divergence, Green' and Stokes' theorem and appreciate their applications.
- Understand First Order and Second Order Ordinary Differential with constant coefficients.
- Understand the use of orthogonal curvilinear coordinates, Dirac delta function and its applications.

Text Books

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, (2013) 7th Edn. Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.

4. Mathematical Physics, Goswami, 1st edition, Cengage Learning.
5. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press.

IPHY-L1
MECHANICS LAB.

L	T	P	C
0	0	6	3

Course Objectives: The aim of this Laboratory is to understand some of the basic phenomenon of mechanics through various experiments. Another prime objective of the course is to enhance the scientific data collection and analysis in Physics Laboratories.

1. **Note: Students are required to perform minimum of 5 experiments**
    1. Measurements of length (or diameter) using vernier caliper, screw gauge and traveling microscope.
    2. Idea of systematic and random errors introduced in different instruments.
    3. To determine the Moment of Inertia of a metallic cylinder / rectangular bar about an axis passing through e C.G. and to determine the Modulus of Rigidity of the suspension wire.
    4. To determine the Moment of Inertia of a Flywheel.
    5. To determine the Young modulus, modulus of rigidity and Poisson ratio of the material of a wire by Searle's method.
    6. To determine the value of g using Bar Pendulum.
    7. To measure an accessible (Horizontal and vertical) height using sextant.
    8. To measure inaccessible height by using sextant.
    9. Determination of Young's modulus of the material of a beam by the method of flexure.
    10. To determine the value of g using Kater's Pendulum
    11. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuilles method).

Course Outcomes (COs):

- Learn use of Vernier calipers, screw gauge and travelling microscope, and necessary precautions during the different experiments.
- Learn basics about the errors, their propagation and recording in final result up to correct significant digits.
- Way of writing of scientific laboratory reports, which may include theoretical and practical significance of the experiment performed, apparatus description, relevant theory, necessary precautions to be taken during the experiment, proper recording of observations, data analysis, estimation of the error.

Text Books

1. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
2. B.Sc. Practical Physics, C.L. Arora, S. Chand and Company Limited.

BSNM-22105
DIFFERENTIAL CALCULUS

L	T	P	C
4	0	0	4

Course Objectives: Math and basic science are certainly the foundations of any program. Mathematics is an essential tool for describing and analyzing systems. Mathematics also enables precise representation and communication of knowledge.

1. Definition of a sequence. Limit of a sequence, theorems on limits of sequences, bounded, and Monotonic sequences. Least upper bound and greatest lower bound of a sequence. Limit superior, limit inferior. Nested Intervals. Cauchy's convergence criterion, infinite series. **(10)**

2. Limits of Functions, Ɛ-δ definition, right- and left-hand limits. Theorems on limits. Infinity. Special Limits. Continuity, Ɛ-δ definition, right- and left-hand Continuity, continuity in an interval, theorems on continuity, piecewise continuity, uniform Continuity. **(10)**

3. The concept and definition of a derivative, right- and left-hand derivatives, differentiability in an interval, piecewise differentiability, differentials, differentiation of composite functions, implicit Differentiation, mean value theorems, Taylor theorem, applications. **(10)**

4. Functions of two or more variables, neighborhoods, regions, limits, iterated limits, continuity, uniform continuity, partial derivatives, higher-order partial derivatives, differentials, theorems on differentials, differentiation of composite functions, Euler's theorem on homogeneous functions. Implicit functions, Jacobians, partial derivatives using Jacobians, theorems on Jacobians, applications. **(15)**

Course Outcomes (COs):

Text Books

1. Robert Wrede and Murray R. Spiegel, Advanced Calculus, 3rd Edition, Schaum's Outline Series (McGraw Hill), 2010.
2. Maurice D Weir, Frank R. Giordano and Joel Hass, Calculus, 11th Edition, Pearson, 2008.
3. James Stewart, Calculus, 5th Edition, Brooks/Cole(Thomson), 2003.
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

BSNM-22101
ORGANIC CHEMISTRY-I

L	T	P	C
4	0	0	4

Course Objective: To teach the basic principles, reaction mechanisms and stereochemistry of organic compounds. To impart knowledge regarding physical properties and chemical reactions of alkanes, cycloalkanes, alkenes, dienes, alkynes, alkyl and aryl halides etc. To understand structure and bonding of organic compounds.

1. **Structure and Bonding** **(10)**

Hybridization, bond lengths, bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double- headed arrows, homolytic and heterolytic bond breaking. Types of reagents- electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates (carbocations, carbanions, free radicals, carbenes, arynes and nitrenes). Assigning formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

2. **Stereochemistry of Organic Compounds** **(10)**

Isomerism and its types, Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeric centers, diastereomers, threo and erythro, diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism - determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism - conformational analysis of ethane and n-butane; conformational analysis of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivative. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Difference between configuration and conformation.

3. **Alkanes and Cycloalkanes** **(10)**

Introduction, IUPAC nomenclature, Isomerism and classification of carbon atoms of alkanes. Sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey- House reaction and decarboxylation of carboxylic acids). Physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes - nomenclature, methods of formation, chemical reactions, Baeyer's strain

theoryand its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring; banana bonds.

4. Alkenes, Cycloalkenes, Dienes and Alkynes (15)

Alkenes Nomenclature, methods of synthesis (mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. Saytzeff rule, Hofmann elimination), physical properties and relative stabilities of alkenes. Chemical reactions of alkenes - mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikiff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Cycloalkenes Methods of formation, conformation and Chemical reactions of cycloalkenes. *Dienes* Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions – 1, 2 and 1,4 addition, Diels-Alder reaction.

Alkynes Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration oxidation, metal-ammonia reductions, oxidation and polymerization.

Course Outcomes (COs):

1. This course will equip the students with the necessary chemical knowledge concerning the fundamentals in the basic areas of organic chemistry.
2. The students will be able know about the various reactions involved in alkanes, alkenes, alkynes, cycloalkanes, dienes and cycloalkenes.
3. To develop skills to evaluate, analyze and solve problems competently.

Text Books

1. Organic Chemsitry, Morrison and Boyd, Prentice- Hall.
2. Fundamentals of Organic Chemistry, Solomons, John Wiley.
3. Organic Chemistry. F.A. Carey, McGraw Hill, Inc.
4. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
5. Organic Chemistry Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P.Kapoor, Wiley Eastern Ltd (New Age International).
6. Introduction to organic chemistry, Stritwieser, Heathcock and Kosover, Macmilan

BSNM-22108
CHEMISTRY LAB- I

L	T	P	C
0	0	4	2

Course Objectives: The objective of this course is to provide practical knowledge and illustrative experiments regarding qualitative analysis, isolation, and purification of organic compounds.

1. Inorganic Chemistry

Semi Micro analysis. Cation analysis, Separation and identification of ions from group I, II, III, IV, V, and VI. Anionic analysis. Four ions with no interference.

2. Organic Chemistry Laboratory Techniques

Determination of Melting Point

Naphthalene 80-82^{0}C
Cinnamic acid 132.5-133^{0}C
Benzoic acid 121.5-122^{0}C
Salicylic acid 157.5-158^{0}C
Urea 132.5-133^{0}C
Acetanilide 113.5-114^{0}C
Succinic Acid 184.5-185^{0}C
m-dinitro benzene 90^{0}C
p-dichlorobenzene 52^{0}C
Aspirin 135^{0}C
Determination of Boiling Point
Ethanol 78^{0}C
Cyclohexane 81.4^{0}C
Benzene 80^{0}C
Toluene 110°C

Text Books

1. Robert Wrede and Murray R. Spiegel, Advanced Calculus, 3rd Edition, Schaum's Outline Series (McGraw Hill), 2010.
2. Maurice D Weir, Frank R. Giordano and Joel Hass, Calculus, 11th Edition, Pearson, 2008.
3. James Stewart, Calculus, 5th Edition, Brooks/Cole(Thomson), 2003.
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

BCCS-21103
PROBLEM SOLVING USING C

L	T	P	C
4	0	0	4

Course Objectives

1. To learn the fundamental programming concepts and methodologies which are essential to building good C programs.
2. To practice the fundamental programming methodologies in the C programming language via laboratory experiences.
3. To code, document, test, and implement a well-structured, robust computer program using the C programming language.
4. To write reusable modules (collections of functions).

1. **Introduction to Program Development**: Problem Analysis, Designing a solution**.**
   Overview of C: Brief history of C, introduction to different versions of C. General Structure of a C program, stages in the development of a C program**.**
   Data Types, Operators & Expressions: Constants and variables, data types, declaring variables,storageclasses,differenttypesofexpressionsandtheirevaluation,conditionalexpression,assignment statement, enumerated data type, redefining/creating data types, type casting.
   Console Input/output: Standard input/output devices, unformatted input/output functions (character I/O functions and string I/O functions), formatted input/output functions (scan f() function and print f() function).

2. **Control Statements:** Decision making using if, if – else, else if and switch statements, Looping using for, while and do – while statements, transferring program control using break and continue statements
   Arrays & Strings: Introduction to arrays, declaring arrays, initializing arrays, processing of arrays, introduction to strings. Structures& Unions: Introduction to structures, declaring structures, initializing structures, accessing elements of structures, array of structures, nested structures, passing structures as arguments to a function, introduction to unions**.**

3. **Functions:** Defining a function, local variables, return statement, invoking a function, specifying and passing arguments (including arrays, strings) to a function, function prototyping and use of header files, building own library, recursion
   Pointers: Whypointers?Declaringpointers,accessingvaluesviapointers,pointerarithmetic,pointers to arrays, Array of pointers, pointers to strings, pointers to structures, self–referential structures.
   Program Structure: Program structure revisited, managing multi–file programs using traditional approach of separate compilations and project facility of Turbo C compiler, storage classes revisited.
   File I/O: Introduction to files, different ways of file processing (standard I/O & system I/O), description of various library functions for file handling, updating files.

4. **Introduction to Object Oriented Paradigm–**

Object Oriented programming and C++, Structured Programming methodology, its shortcomings, advantages of OOPS (Object Oriented Programming Style).OOP concepts: Abstraction, Encapsulation, Data Hiding, Inheritance, and Polymorphism. Overview of C++ – Data types, Input/output statements, Flow of control – looping statements, branching statements, Pointers & references, namespaces.

5. Class design

Constructors, destructors, operator over loading, reuse through in heritance, virtual Functions, exception handling. I/O with stream classes, memory management. **The Standard Template Library (STL) :**containers, algorithms, iterations, adaptors, function objects.

Course Outcomes (COs): After completing this course student will be able to:

1. Describe the advantages of a high level language like C, the programming process, and the compilation process.
2. To describe and use software tools in the programming process.
3. ToapplygoodprogrammingprinciplestothedesignandimplementationofCprograms.
4. To design, implement, debug and test programs using the fundamental elements of C
5. To demonstrate an understanding of primitive data types, values, operators and expressions in C.

Text Books

1. E. Balagurusamy “Programming in C”. Tata McGraw Hill
2. Y. Kanetkar“Let UsC”.B P B publication.
3. Ashok N. Kamthane “Programming with ANSI and TURBOC”. Pearson Education
4. Lafore R, Object Oriented Programming, Third Edition, Galgotia Publications
5. Byron S. Gottfried, Programming in C, Second Edition, McGraw Hills.
6. R. S. Salaria, Problem Solving and Programming in C, Second Edition.

BCCS-21104
PROBLEM SOLVING USING C Lab.

L	T	P	C
0	0	4	2

Course Objectives: Math and basic science are certainly the foundations of any program. Mathematics is an essential tool for describing and analyzing systems. Mathematics also enables precise representation and communication of knowledge.

1. Write C program to input and output the text message.
2. Write C Program to perform all arithmetic operations.
3. Write C Program to utilize the math function.
4. Write C Program to perform the mathematical expressions.
5. Write C Program for Local and Global Variables.
6. Write C Program for internal static and external static variables.
7. Write C Program to find the roots of a Quadratic equation.
8. Write C Programs for all the Operators. (Arithmetical, Logical, Relational, Bitwise).
9. Write C Programs for Increment and Decrement Operators.
10. Write C Programs to implement the Ternary Operator.
11. Write C Programs for special Operators.
12. WriteCProgramsforalltheControlStructures.(SequentialControlStructures, Conditional Cont Structures, Iterative Control Structures).
13. Write C Programs to display the different types of patterns using nested for loop.
14. Write C Program for Statements.(switch, break, go to , continue etc.,).
15. Write C Program to print biggest number from numbers.
16. Write a C Program to find the given integer number is even or odd number.
17. Write a C Program to calculate the factorial of a given number.
18. Write a C Program to swap the two numbers using temp variable and without using temp variable.
19. Reading and Printing a single dimensional array of elements.
20. Ascending and descending of an array.
21. Sum of all odd numbers and sum of all even numbers in a single dimensional array.
22. Mathematical operations on single dimensional arrays.
23. Reading and Printing a multi dimensional array of elements.
24. Mathematical operations on multidimensional array of elements.
25. Passing an array element to a function.
26. Reading and Printing a string.
27. C Programs on String functions.
28. Write a C program to calculate string length by writing the user-define function.
29. Function declaration and initialization.
30. C Program to differentiate the parameters and argument sin functions.
31. Programs for different types of inbuilt functions.

32. Call by value and Call by reference programs in functions.
33. Write a program to swap the given 2 number using passing by reference.
34. Write C Programs to perform all valid arithmetic operations using pointers.
35. C programs on Structures and accessing of members of the structures.
36. Write a C program to print a book information(Book name, Book no, author name) by writing a structure.
37. Write a C program by passing structure elements to a function and display employee information (emp no, emp name, emp salary, and emp address).
38. C Programs on Reading a file from the secondary storage device.
39. C Program on writing and appending a file on the secondary storage device.
40. C Program on Opening and closing a file.

Text Books

1. C programming and Data Structures, P. Padmanabham, Third Edition, B S Publications.
2. Let Us C by Yashwanth Kanethar.
3. "Programming in ANSIC" by E. Balaguruswamy.
4. Programming in C, 2ndEdition,Oxford by Pradip Dey, Mannas Ghosh.

BSNM-22107
ENGLISH

L	T	P	C
2	0	0	2

Course Objectives: To help the students become proficient in LSRW-Listening, Speaking, Reading & Writing skills. To help the students become the independent users of English language. It educates their emotions and enhances their power of imagination.

1. Literature **(7)**

(a) The Poetic Palette (Orient Black Swan, Second Edition, 2016)
The following poems from this anthology are prescribed:

1. Apparently With No Surprise: Emily Dickinson,
2. Fool and Flea: Jeet Thayil
3. The Soul's Prayer: Sarojini Naidu,
4. I Sit and Look Out: Walt Whitman
5. Women's Rights: Annie Louise Walker,
6. Pippa's Song: Robert Browning

Vocabulary
Antonyms; Synonyms; One-word substitution; Homophones/Homonyms; Abbreviations.

2. Literature **(7)**

(b) Prose Parables (Orient Black Swan, 2013)
The following stories from the above volume are prescribed:

a. The Eyes Are Not Here: Ruskin Bond
b. Grief: Anton Chekov
c. The Doctor's Word: R.K. Narayan
d. The Doll's House: Katherine Mansfield
e. Dusk: H.H. Munroe (Saki)
f. The Kabuli wallah: Rabindranath Tagore

Grammar
Parts of Speech; Articles, Determiners; Modals; Modifiers; Prepositions; Voice; Transformation Of sentences.

3. Close Reading; Comprehension; Summarizing; Paraphrasing; Analysis and Interpretation; Translation (from Hindi/Punjabi to English and vice-versa). **(5)**

4. Essay Writing -Descriptive/Narrative/Argumentative; Business letters; Précis writing. **(5)**

Course Outcomes (COs): At the end of the course,

- Students will heighten their awareness of correct usage of English grammar in writing and speaking.
- They will enlarge their vocabulary by keeping a vocabulary journal
- They will strengthen their ability to write academic papers, essays and summaries using the process approach.

Text Books

1. Oxford Practice Grammar by John Eastwood (Ed. 2014)
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Black swan, 2013.

4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. Ranjana Kaul.
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006

IPHY-T3
OSCILLATIONS AND WAVES

L	T	P	C
4	1	0	5

Course Objectives: The objective of the course provides an exposure about simple harmonic motions, damped harmonic motions and forced oscillations. Students learn about the different waves, propagation of waves in various mediums and reflection/transmission of waves at the interface of mediums.

1. Simple and Damped Harmonic Motion (15)

Simple harmonic motion, energy of a SHO, Compound pendulum, Torsional pendulum, Electrical Oscillations, Lattice Vibrations, Transverse Vibrations of a mass on a string, Anharmonic Oscillations. Damped simple harmonic motion, Decay of free Vibrations due to damping, types of damping, Determination of damping coefficients – Logarithmic decrement, relaxation time and Q-factor. Electromagnetic damping.

2. Forced Vibrations and Resonance (10)

Forced mechanical and electrical oscillator, Transient and Steady State Oscillations, Displacement and velocity variation with driving force frequency, Variation of phase with frequency resonance, Power supplied to forced oscillator by the driving force. Q-factor and band width of a forced oscillator, Electrical and nuclear magnetic resonances.

3. Coupled Oscillations (10)

Stiffness coupled oscillators, Normal coordinates and modes of vibrations. Inductance coupling of electrical oscillators, Normal frequencies, Forced vibrations and resonance for coupled oscillators, Masses on string-coupled oscillators.

4. Waves in Physical Media (10)

Types of waves, wave equation (transverse) and its solution characteristics impedance of a string, Impedance matching, Reflection and Transmission of waves at boundary, Energy of vibrating string, wave and group velocity.

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

- Understand the simple and damped harmonic motion of an oscillator.
- Understand Forced Vibrations and phenomenon of Resonance
- Apply the Coupled oscillator to the real-life problems.
- Understand the transmission of signals and Electromagnetic Waves.
-

Text Books

1. Book of Vibrations and Waves: S.P. Puri (Macmillan India), 2004.
2. The Physics of Vibrations and Waves: H.J. Pain (Wiley and ELBS), 1976.

IPHY-T4
ELECTRICITY AND MAGNETISM

L	T	P	C
4	0	0	4

Course Objectives: Gain deeper understanding of Electricity and Magnetism. Consolidate the understanding of fundamental concepts in Electricity and Magnetism more rigorously as needed for further studies in physics. Advance skills and capability for formulating and solving problems.

1. Electrostatics (15)

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field.

Dielectrics: Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

2. Magnetism (15)

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-para- and ferro-magnetic materials.

3. Electromagnetic Induction (5)

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

4. Maxwell’s equations and Electromagnetic wave propagation (10)

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

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

- Understand and describe the different concepts of electrostatics and magnetostatics.
- Apply Maxwell’s equation and propagation of EM wave in real problems.
- Compare the different types of magnetic materials.
- Understand foundation in electromagnetism fundamentals required to solve problems.

Text Books

1. Edward M. Purcell, Electricity and Magnetism, McGraw-Hill Education 1986.
2 J.H. Fewkes & J. Yarwood. Electricity and Magnetism, Oxford Univ. Press Vol. I, 1991.
3. D C Tayal, Electricity and Magnetism, Himalaya Publishing House 1988.
4. Ronald Lane Reese, University Physics, Thomson Brooks/Cole 2003.
5. D.J. Griffiths, Introduction to Electrodynamics, Benjamin Cummings 3rd Edn, 1998

IPHY-L2
ELECTRICITY AND MAGNETISM LAB.

L	T	P	C
0	0	6	3

Course Objectives The objective of this course is to enable the students to verify some of the concepts learnt in the theory courses and the usage of electrical systems for the various measurements. Apply the analytical techniques and graphical analysis to the experimental data.

Note: Students are required to perform minimum of 5 experiments

1. To use a multimeter for measuring a) resistance b) AC and DC voltages c) Dc current d) to check electrical fuses.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Fosters Bridge.
4. To compare capacitances using De-Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. 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.
7. To study the response curve of a parallel LCR circuit and determine its (a) resonance frequency and (b) Quality factor Q.
8. To study mutual inductance between two coils.
9. To study unknown capacitance using flashing and quenching of neon bulb.
10. To study frequency of AC supply using Electrical vibrator.

Course Outcomes (COs): In this laboratory-based course, student will learn

- The construction, functioning and uses of different electrical bridge circuits, and electrical devices.
- Linearization of data and the use of slope and intercept to determine unknown quantities.
- How to present their experimental data in a laboratory report.

Text Books:

1. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press
2. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited.

BSNM-22205
INTEGRAL CALCULUS

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are to make the students understand the concept of integration and its definition as limit of sum and area under curve. The concept of improper integrals will also be taught.

1. Integrals of functions of one variable, geometrical interpretation of integral as area, integration of standard functions, integration by substitution and parts, Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. **(15)**

2. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations. Areas and lengths of curves in the plane, volumes and surfaces area of solids of revolution. **(10)**

3. Integrals of functions of two variables, double integrals, Applications to evaluation of area, volumes and surfaces of solids of revolution, Change of order of Integration. Change of variables**.** **(10)**

4. Integrals of functions of three variables, Triple integral, Evaluation of volume, density etc., Change of order of Integration. Change of variables. Implicit and Explicit functions, Integration of hyperbolic and inverse hyperbolic functions. **(10)**

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

1. Understand the concept of integration
2. Apply the knowledge of integral calculus in finding length of arc, area under curves, volume and area of surface swept by curve during revolution

Text Books

1. H. S. Hall and S. R. Knight, Higher Algebra, H. M. Publications, 1994.
2. Chandrika Prasad, Text Book on Algebra and Theory of Equations, Pothi shala Pvt. Ltd., 2017.
3. Richard L. Burden and J. Douglas Faires, Numerical Analysis, 9th Edn., Cengage Learning, 2012.
4. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Edition, New Age International Publishers, 2012.

BSNM-22202
PHYSICAL CHEMISTRY-I

L	T	P	C
4	0	0	4

Course Objective: This course will equip students with the necessary chemical knowledge concerning the fundamentals in the basic areas of physical chemistry viz. different states of matter. The problem solving skills of students are expected to be enhanced through numerical problems.

1. **Gaseous state** **(15)**

   Kinetic molecular theory of gases, derivation of kinetic gas equation, deduction of gas laws from kinetic gas equation, imperfection in real gases, the compressibility of real gases, isotherms of real gases, equations of state, Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between criticalconstants and van der Waals constants, law of corresponding states.

2. **Liquids state** **(8)**

   Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

3. **Colloidal State** **(7)**

   Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical, properties, stability of colloids, protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions): Types of emulsions, preparation. Emulsifiers. Generalapplications of colloids.

4. **Solutions, Dilute Solutions and Colligative Properties** **(15)**

   Ideal and non–ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass degree of dissociation and association of solutes.

Course Outcome: By the end of the course, students will be able to:

- Understand the basic concept of kinetic theory of gases and different aspects of gaseous state.
- Gain insight into various properties of liquid, types of colloids and its applications.
- Know the qualitative properties of solution, the depression in freezing point, elevation in boiling point and osmotic pressure.
- Derive the thermodynamic relations between the colligative properties and understand their applications in everyday life.

Text Books

1. Principles of physical chemistry, S.H. Maron & C.F. Prutton.
2. Physical Chemistry, K.J. Laidler.
3. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
4. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
5. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
6. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

BSNM-22208
CHEMISTRY LAB -II

L	T	P	C
0	0	4	2

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

1. Crystallization:

Concept of indication of crystallization. Phthalic acid from hot water (using fluted filter paper & stem less funnel)

Acetanilide from boiling water.

Naphthalene from Ethanol

Benzoic acid from water

Physical Chemistry:

1. To determine the specific reaction rate of hydrolysis of ethyl acetate catalysed by Hydrogen ions at room temperature.
2. To study the effect of acid strength on hydrolysis of an ester.

Viscosity, Surface Tension (Pure Liquids)

3. To study the viscosity and surface tension of CCI glycerine solution in water.
4. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
5. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
6. To determine the enthalpy of dissolution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle

Text Books

1. Practical Organic Chemistry by F.G. Mann and B.C. Saunders
2. Advanced Practical Physical Chemistry by J.B. Jadav.

BCCS–21203
OBJECT ORIENTED PROGRAMMING USING C++

L	T	P	C
4	0	0	4

Course Objectives: To understand how c++ improves C with object oriented features. To learn how to write in line features for efficiency and performance. To learn the syntax and semantics of the c++ classes for code reuse. To understand the concept of data abstraction and encapsulation.

1. **Principles of object oriented programming** **(12)**
   Introduction to OOP and its basic features, Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Difference between Procedure Oriented Language(C) and Object Oriented Language.

2. **Classes & Objects and Concept of Constructors** **(10)**
   Defining classes, Defining member functions, Declaration of objects to class, Access to member variables from objects, Different forms of member functions, Access specifies (Private, public, protected), Array of objects. Introduction to constructors, Parameterized constructors, Copy Constructor, Multiple constructors in class, Dynamic initialization of objects, Destructors.

3. **Inheritance and Operator overloading** **(12)**
   Introduction to Inheritance, Types of inheritance:-Single in heritance, Multiple in heritance, Multi level inheritance, Hierarchical inheritance, Hybrid inheritance, Defining operator overloading, Overloading of Unary and Binary operators, Rules for overloading operators.

4. **Polymorphism and File Handling** **(10)**
   Early Binding, Late Binding, Virtual Functions, pure virtual functions, Abstract Classes. Opening and Closing File, Reading and Writing a file.

Course Outcomes (COs):

- To learn programming from real world examples.
- Solutions to various problems with the help of C++ language.
- To create computer based solutions to various real-world problems using C++.
- To learn various concepts of object oriented approach towards problem solving.

Text Books

1. Object Oriented Programming with C++,E. Balagurusami, Fourth Edition, Tata Mc-Graw Hill.
2. Object Oriented Programming in Turbo C++, Robert Lafore, Fourth Edition Galgotia Publications
3. The C++Programming Language, Bjarna Stroustrup, Third Edition, Addison-esley

Publishing.
4. Object Oriented Programming Using C++, Salaria, R.S, Fourth Edition, Khanna Book Publishing.

BCCS–21204
OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY

L	T	P	C
0	0	4	2

Course Objectives:

To learn how to write inline functions for efficiency and performance. To learn the syntax and semantics of the C++ programming language. To learn how to design C++ classes for code reuse. To learn how to implement copy constructors and class member functions. To understand the concept of data abstraction and encapsulation. To learn how to overload functions and operators in C++.To learn how containment and inheritance promote code reuse in C++. To learn how inheritance and virtual functions implement dynamic binding with polymorphism. To learn how to design and implement generic classes with C++ templates. To learn how to use exception handling in C++ programs.

-**Assignments**

1. Write a program to entermarkof6differentsubjectsandfindoutthetotalmark.
2. Write a function using reference variables as arguments to swap the values of pair of integers.
3. Write a function to find largest of three numbers.
4. Write a program to find the factorial of a number.
5. Write the above program for handling n number of account holders using array of objects.
6. Write a C++ program to compute area of right angle triangle, equilateral triangle, Isosceles triangle using function overloading concept.
7. Write a program for over loading of Unary++operator.
8. Write a program for over loading of Binary +operator.
9. Write a program of Virtual Functions.
10. Write a program of Abstract Classes.
11. Write a program to read and write from file.

Course Outcomes (COs):

- Represent data using various Frequency table and Graphs.
- Applyvariousoperations/formulasusinganysoftware/packagetosolvestatisticalproblems

Text Books

1. Object Oriented Programming with C++, E. Balagurusami, Fourth Edition,Tata Mc-Graw Hill.
2. Object Oriented Programming in Turbo C++, Robert Lafore, Fourth Edition Galgotia Publications.
3. The C++Programming Language, Bjarna Stroustrup, Third Edition, Addison-Wesley Publishing Company.

BSNM-22207
PUNJABI

L	T	P	C
2	0	0	2

ਵਿਸ਼ਾ ਉਦੇਸ਼: ਇਹ ਵਿਸ਼ਾ ਪੜ੍ਹਾਉਣ ਦਾ ਮੂਲ ਉਦੇਸ਼ ਵਿਦਿਆਰਥੀਆਂ ਨੂੰ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੇ ਗਿਆਨ, ਗੁਰਮੁਖੀ ਲਿਪੀ, ਪੰਜਾਬੀ ਸੱਭਿਆਚਾਰ, ਗੁਰੂ ਸਾਹਿਬਾਨ ਅਤੇ ਹੋਰ ਮਹਾਨ ਸ਼ਖ਼ਸੀਅਤਾਂ ਦੇ ਜੀਵਨ ਅਤੇ ਯੋਗਦਾਨ ਬਾਰੇ ਜਾਣੂ ਕਰਵਾਉਣਾ ਹੈ।

ਭਾਗ-ਪਹਿਲਾ

ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਨਿਕਾਸ ਅਤੇ ਵਿਕਾਸ (ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ), ਗੁਰਮੁਖੀ ਲਿਪੀ, ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ (ਸਾਧਾਰਨ ਸ਼ਬਦ, ਸੰਯੁਕਤ ਸ਼ਬਦ, ਮਿਸ਼ਰਤ ਸ਼ਬਦ, ਮੂਲ ਸ਼ਬਦ, ਅਗੇਤਰ ਅਤੇ ਪਛੇਤਰ), ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ (ਸਾਧਾਰਨ ਵਾਕ, ਸੰਯੁਕਤ ਵਾਕ, ਮਿਸ਼ਰਤ ਸ਼ਬਦ, ਬਿਆਨੀਆ ਵਾਕ, ਪ੍ਰਸ਼ਨਵਾਚਕ ਵਾਕ ਅਤੇ ਹੁਕਮੀ ਵਾਕ)।

ਭਾਗ-ਦੂਜਾ

ਪੰਜਾਬੀ ਸਾਹਿਤ ਦੇ ਵੱਖ-ਵੱਖ ਰੂਪਾਂ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ (ਕਵਿਤਾ, ਵਾਰਤਕ, ਕਹਾਣੀ ਅਤੇ ਨਾਵਲ), ਪੰਜਾਬੀ ਦੇ ਮੁੱਖ ਲੇਖਕਾਂ ਅਤੇ ਰਚਨਾਵਾਂ ਦੇ ਨਾਮ (ਕੋਈ ਦਸ), ਪੰਜਾਬੀ ਸੱਭਿਆਚਾਰ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ (ਸੁਹਾਗ, ਘੋੜੀਆਂ, ਸਿੱਠਣੀਆਂ, ਗਿੱਧਾ, ਭੰਗੜਾ ਅਤੇ ਝੂਮਰ), ਪੰਜਾਬ ਦੇ ਮੇਲੇ ਅਤੇ ਤਿਉਹਾਰ, ਪੰਜਾਬ ਦੇ ਪ੍ਰਸਿੱਧ ਧਾਰਮਿਕ ਸਥਾਨ, ਪੰਜਾਬ ਦਾ ਖਾਣ-ਪੀਣ ਅਤੇ ਪਹਿਰਾਵਾ।

ਭਾਗ-ਤੀਜਾ

ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ, ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ, ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਜੀ ਅਤੇ ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ ਜੀ (ਸੰਖੇਪ ਜੀਵਨ ਅਤੇ ਉਪਦੇਸ਼), ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ (ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ), ਮਹਾਰਾਜਾ ਰਣਜੀਤ ਸਿੰਘ, ਜਰਨੈਲ ਹਰੀ ਸਿੰਘ ਨਲਵਾ, ਸ਼ਹੀਦ ਭਗਤ ਸਿੰਘ, ਸ਼ਹੀਦ ਰਾਜਗੁਰੂ ਅਤੇ ਸ਼ਹੀਦ ਸੁਖਦੇਵ (ਸੰਖੇਪ ਜੀਵਨ, ਪੰਜਾਬ ਪ੍ਰਾਂਤ ਅਤੇ ਭਾਰਤ ਦੇਸ਼ ਦੇ ਇਤਿਹਾਸ ਵਿੱਚ ਯੋਗਦਾਨ), ਭਗਤ ਪੂਰਨ ਸਿੰਘ (ਸੰਖੇਪ ਜੀਵਨ ਅਤੇ ਸੇਵਾ ਦਾ ਸੰਕਲਪ)।

ਭਾਗ-ਚੌਥਾ

ਦਫ਼ਤਰੀ ਚਿੱਠੀ-ਪੱਤਰ, ਅਖ਼ਬਾਰ ਨੂੰ ਇਸ਼ਤਿਹਾਰ (ਨਿੱਜੀ ਅਤੇ ਦਫ਼ਤਰੀ), ਈ-ਨਿਊਜਪੇਪਰ, ਪੰਜਾਬੀਪੀਡੀਆ, ਪੰਜਾਬੀ ਕੰਪਿਊਟਰ ਟਾਈਪਿੰਗ, ਪੈਰ੍ਹਾ ਰਚਨਾ, ਅਖਾਣ (ਕੋਈ ਦਸ) ਅਤੇ ਮੁਹਾਵਰੇ (ਕੋਈ ਦਸ), ਦੇਸੀ ਬਾਰ੍ਹਾਂ ਮਹੀਨਿਆਂ ਅਤੇ ਰੁੱਤਾਂ ਦੇ ਨਾਮ, ਹਫਤੇ ਦੇ ਸੱਤ ਦਿਨਾਂ ਦੇ ਨਾਮ, ਫ਼ਸਲਾਂ (ਕੋਈ ਦਸ) ਅਤੇ ਖੇਤੀ ਲਈ ਵਰਤੇ ਜਾਂਦੇ ਸੰਦਾਂ (ਕੋਈ ਦਸ) ਦੇ ਨਾਮ, ਵਪਾਰ ਲਈ ਵਰਤੇ ਜਾਂਦੇ ਸ਼ਬਦ (ਕੋਈ ਦਸ), ਰਿਸ਼ਤੇ-ਨਾਤੇ (ਕੋਈ ਦਸ)।

ਵਿਸ਼ਾ ਨਤੀਜਾ: ਇਸ ਵਿਸ਼ੇ ਰਾਹੀਂ ਵਿਦਿਆਰਥੀ ਪੰਜਾਬ ਦੇ ਇਤਿਹਾਸ ਅਤੇ ਪੰਜਾਬੀ ਸੱਭਿਆਚਾਰ ਵਾਰੇ ਜਾਣਕਾਰੀ ਪ੍ਰਾਪਤ ਕਰਕੇ ਵਧੀਆ ਜੀਵਨ ਜਾਚ ਗ੍ਰਹਿਣ ਕਰਨਗੇ ਅਤੇ ਪੰਜਾਬ ਪ੍ਰਾਂਤ ਅਤੇ ਭਾਰਤ ਦੇਸ਼ ਦੀ ਤਰੱਕੀ ਵਿੱਚ ਵਡਮੁੱਲਾ ਯੋਗਦਾਨ ਪਾਉਣ ਦੇ ਕਾਬਲ ਹੋਣਗੇ। ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਗਿਆਨ ਵਿਦਿਆਰਥੀਆਂ ਨੂੰ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਪੜ੍ਹਨ, ਲਿਖਣ ਅਤੇ ਸਮਝਣ ਵਿੱਚ ਨਿਪੁੰਨਤਾ ਪ੍ਰਦਾਨ ਕਰੇਗਾ।

ਪੁਸਤਕਾਂ ਦੀ ਸੂਚੀ:

1. ਲੋਕਧਾਰਾ ਅਤੇ ਸਾਹਿਤ, ਸੋਹਿੰਦਰ ਸਿੰਘ ਬੇਦੀ, ਪੰਜਾਬੀ ਰਆਈਟਰਜ, ਨਵੀਂ ਦਿੱਲੀ।
2. ਪੰਜਾਬੀ ਲੋਕ ਸਾਹਿਤ ਸ਼ਾਸਤਰ, ਜਸਵਿੰਦਰ ਸਿੰਘ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
3. ਪੰਜਾਬ ਦੇ ਲੋਕ ਤਿਉਹਾਰ, ਨਵਰਤਨ ਕਪੂਰ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
4. ਪੰਜਾਬੀ ਵਿਆਕਰਣ: ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ, ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
5. ਪੰਜਾਬੀ ਵਿਆਕਰਣ: ਮੁੱਢਲੇ ਸੰਕਲਪ, ਮਿੰਨੀ ਸਲਵਾਨ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
6. ਮੁੱਢਲੀ ਪੰਜਾਬੀ (ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ), ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
7. ਸਾਡਾ ਇਤਿਹਾਸ (ਦਸ ਪਾਤਸ਼ਾਹੀਆਂ), ਸਤਿਬੀਰ ਸਿੰਘ, ਨਿਊ ਬੁੱਕ ਕੰਪਨੀ, ਜਲੰਧਰ।

8. ਬਾਬਾਣੀਆਂ ਕਹਾਣੀਆਂ, ਪ੍ਰੋਫੈਸਰ ਸਾਹਿਬ ਸਿੰਘ, ਸਿੰਘ ਬ੍ਰਦਰਜ਼, ਅੰਮ੍ਰਿਤਸਰ।
9. ਭਗਤ ਸਿੰਘ-ਇੱਕ ਮਘਦਾ ਇਤਿਹਾਸ, ਹੰਸਰਾਜ ਰਹਿਬਰ, ਸ਼ਿਲਾਲੇਖ ਪਬਲਿਸ਼ਰ, ਦਿੱਲੀ।
10. ਨਿਥਾਂਵਿਆਂ ਦਾ ਥਾਂਵ-ਭਗਤ ਪੂਰਨ ਸਿੰਘ, ਹਰੀਸ਼ ਢਿੱਲੋਂ।
11. ਸ਼ੇਰ-ਏ-ਪੰਜਾਬ ਮਹਾਰਾਜਾ ਰਣਜੀਤ ਸਿੰਘ, ਬਲਦੇਵ ਸਿੰਘ।
12. ਜੀਵਨ ਬ੍ਰਿਤਾਂਤ-ਸਰਦਾਰ ਹਰੀ ਸਿੰਘ ਨਲਵਾ, ਪ੍ਰੋ. ਰਾਏ ਜਸਬੀਰ ਸਿੰਘ।
13. ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਵਾਰਤਕ, ਡਾ. ਗੁਰਬਚਨ ਸਿੰਘ ਤਾਲਿਬ, ਪੰਜਾਬੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
14. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।

PHC-1
PUNJAB HISTORY & CULTURE

(Special paper in lieu of Punjabi Compulsory)

L	T	P	C
2	0	0	2

Course Objectives: To make aware of Punjab history and culture to those students who either are from other states or do not studied Punjabi in their school time.

1. SECTION-A

1. Land and the People.
2. Fairs and Festivals

2. SECTION-B

3. Life and Teaching of Guru Nanak Dev.
4. Contribution of Guru Angad Dev, Guru Arjun Dev, Guru Amar Das and Guru Ram Das.

3. SECTION-C

5. Guru Gobind Singh and the Khalsa.
6. Martyrdom of Guru Teg Bahadur

4. SECTION-D

7. Role of Punjab in the Freedom Struggle.
8. Ranjit Singh: Conquests, Administration and the Anglo-Sikh Relations.

Course Outcomes (COs): Students will come to know the about Punjab History and culture, teachings of Guru and their sacrifices for the mankind, role of Punjab in freedom struggle.

Text Books

1. Kirpal Singh (ed.), History and Culture of the Punjab, Part-ii, Punjabi University, Patiala.1990.
2. Fauja Singh (ed.), History of Punjab, Vol, III Punjabi University, Patiala, 1987.
3. J.S. Grewal, The Sikhs of the Punjab, Cup, Cambridge, 1991.
4. Khushwant Singh, A History of the Sikhs, Vol. I, OUP, New Delhi, 1990.

IPHY-T5
OPTICS

L	T	P	C
4	0	0	4

Course Objectives: This course is designed to present wave optics, interference, interferometer, diffraction, Polarization and Holography. It covers the Interference, diffraction and polarisation of light and their applications with emphasis on Holography.

1. Wave Optics (18)

Electromagnetic nature of light. Definition and properties of wave front.HuygensPrinciple.Temporal and Spatial Coherence, Superposition of N coherent waves.

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Principle of optical reversibility; Phase change on reflection. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes).Newton's Rings: Measurement of wavelength and refractive index.

Interferometer: Michelson Interferometer (1) Idea of form of fringes (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes, Fabry-Perot interferometer.

2. Diffraction (15)

Introduction, Fraunhoffer diffraction at a single slit, double slit and Nslits. Fraunhoffer diffraction missing orders. Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating. Diffraction from a circular slit.

Fresnel Diffraction: Fresnel's Half-Period Zones for Plane Wave, Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel diffraction pattern of a straight edge and circular aperture.

3. Polarization (8)

Transverse nature of light, production and detection of polarized light, Polarization by reflection and refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, Optical activity.

4. Holography (4)

Principle of Holography. Recording and Reconstruction Method, Theory of Holography as Interference between two Plane Waves, Point source holograms. Applications of holography.

Course Outcomes (COs):

After passing this programme the students will be able to understand the concept of interference of waves and concept of coherence. Students will have the knowledge of interferometers. They can understand the concept of diffraction and the polarization of light.

Text Books

1 Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill

2. Principles of Optics, Max Born and Emil Wolf, 7thEdn. 1999, Pergamon Press.
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
5. Optics, E. Hecht, 2008, 4th Edition, Pearson Education.
6. Schaum's Outline of Theory and Problems of Optics, E. Hecht, 1998 McGraw Hill.

IPHY-T6
INTRODUCTION TO QUANTUM MECHANICS

L	T	P	C
4	1	0	5

Course Objectives: After learning the elements of modern physics, in these course students would be exposed to more advanced concepts in quantum physics and their applications to problems of the subatomic world.

1. **Dual Nature of Waves and Particles** **(15)**

Need and origin of Quantum concept, Black body radiation, Wien's law, Rayleigh-Jeans Law, Planck's law, Planck's quantum, Planck's constant and light as a collection of photons; Photo Electric effect and Compton scattering. de-Broglie wavelength and matter waves; Davisson-Germer experiment, Wave-particle duality, Wave packets, Phase velocity and group velocity, Heisenberg uncertainty principle, Energy-time uncertainty principle. Applications of uncertainty principle.

2. **Time dependent and independent Schrodinger equation** **(15)**

Wave function and its interpretation, Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Time dependent Schrodinger wave equation, Time independent Schrodinger wave equation, dynamical evolution of a quantum state, Position, momentum & Energy operators; Expectation value, Commutator of position and momentum operators; Wave Function of a Free Particle., Hamiltonian, stationary states and energy eigen values; General solution of the time dependent Schrodinger equation, Fourier transforms and momentum space wave function

3. **Applications of Schrodinger Equation** **(15)**

General discussion of bound states in an arbitrary potential continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential. Potential step (energy less than step height), Potential step (energy more than step height), Potential barrier of finite width and height (tunnel effect). Quantum mechanics of simple harmonic oscillator energy levels and energy eigen functions using Frobenius method.

Course Outcomes (COs):

- Understand the origins of quantum mechanics.
- Understand and explain the differences between classical and quantum mechanics.
- Understand the idea of wave function, and uncertainty relations. U
- Understand the Schrödinger wave mechanics and operator formalism.
- Solve the Schrödinger equation for simple 1D time-independent potentials.
- Appreciate the importance and develop an understanding of angular momentum.

Text Books

1. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Ed., 2010, Mc Graw Hill

2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
7. Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education.

IPHY-L3
OPTICS LAB.

L	T	P	C
0	0	6	3

Course Objectives: The main objective of this laboratory component is to understand the different phenomenon of optics through though laboratory experiments.

1 Note: Students are required to perform minimum of 5 experiments

1. To determine wavelength of (1) Na source and (2) spectral lines of Hg (3) laser light source using plane diffraction grating.
2. To determine wavelength of laser light source using plane diffraction grating.
3. To determine wavelength of sodium light using Newton's Rings
4. To determine refractive index of the Material of a prism using sodium source.
5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
6. To determine the wavelength of light source using Michelson's interferometer.
7. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
8. Measurement of the spacing between the adjacent slits in a grating by measuring $\sin\theta$ vs graph of a certain order of grating spectra.
9. To determine dispersive power and resolving power of a plane diffraction grating.
10. To Find the angle of prism by (i) rotating telescope and (ii) rotating table method.
11. To find refractive index of material/liquid using prism and spectrometer
12. To verify the law of Malus for plane polarized light.
13. To determine the specific rotation of sugar solution using Polarimeter.

Course Outcomes (COs):

- Use of spectrometer and lasers and other sources of light and necessary precautions during the experiments.
- Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
- How to present their experimental data in a laboratory report.

Text Books

1. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited.
2. Advanced Practical Physics, Vol 1, B. Ghosh, K.G.Majumdar, Shreedhar Publishers.
3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press
4. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited.

BSNM-22306
DIFFERENTIAL EQUATIONS

L	T	P	C
4	0	0	4

Course Objectives: The objective of this course is to introduce ordinary differential equations and basic theory of existence and uniqueness of solutions. This course further explains the analytic techniques in computing the solutions of various ordinary differential equations appearing in various fields of science and technology.

1. Exact differential equations, first order and higher degree equations solvable for x, y and p=dy/dx. Clairaut's form, singular solution as an envelope of general solutions. Geometric meaning of a differential equation. Orthogonal trajectories. Linear differential equations with constant coefficients. **(10)**

2. Linear differential equations with variable coefficients: Cauchy and Legendre equations. Linear differential equations of second order- transformation of the equation by changing the dependent variable/ the independent variable, methods of variation of parameters and reduction of order, Simultaneously differential equations. **(15)**

3. Partial differential equation: Formation of first and second order equations, linear equation of first order, integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces. **(10)**

4. Nonlinear first order partial differential equations: Charpit's method, Higher order linear partial differential equations with constant coefficients: complementary function, particular integral. **(10)**

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

1. Understand the basic definitions to know about ordinary differential equations, its various types and their solutions
2. Visualize the geometrical meaning of first order differential equation.

Text Books

1. W E Boyce and R C DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley
2. R K Jain and S R K Iyengar, Advanced Engineering Mathematics, 4th Edition, Narosa Publishing House Pvt LtD, New Delhi
3. I N Sneddon, Elements of Partial Differential Equations, McGraw-Hill
4. S L Ross, Differential Equations, John Wiley & Sons
5. M D Raisinghania, Advanced Differential Equations, 19th Edition, S. Chand

BSNM-22301
ORGANIC CHEMISTRY-II

L	T	P	C
4	0	0	4

Course Objectives: To provide a complete knowledge of nomenclature, structure and bonding methods of preparation and chemical reactions of the compounds related to functional groups like alcohols, phenols, aldehydes and ketones. To provide the knowledge of alkyl and aryl halides, arenes and aromaticity in detailed manner.

1. **Alkyl and Aryl Halides** **(10)**

   Nomenclature and classes of alkyl halides, Chemical reactions. Mechanisms of nucleophilic substitution reaction of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

2. **Arenes and Aromaticity** **(10)**

   Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: Molecular formula and Kekule structure. Stability and carbon carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity : the Huckel's rule, aromatic ions. Aromatic electrophilic substitution–general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Methods of formation and chemical reactions of alkylbenzenes.

3. **Alcohols** **(10)**

   Classification and nomenclature. Monohydric alcohols-nomenclature. Acidic nature. Reactions of alcohols. Dihydric alcohols-nomenclature, methods of formation, chemical reactions of vicinalglycols, oxidative cleavage [Pb(OAC)4] and [HIO4] and pinacol-pinacolone rearrangement.

   Phenols

   Nomenclature, structure and bonding, Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution,
   acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Reimer Tiemann reaction.

4. Aldehydes and Ketones **(15)**

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Witting reaction. Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, LIAIH4 and NaBH4 reductions. Halogenation of enolizable ketones. Halogenation of enoliable ketones.

Course Outcome:

- This course will equip the students with the necessary chemical knowledge concerning the organic chemistry of functional groups like alcohols, phenols, aldehydes and ketones.
- To develop skills to interpret and explain the mechanism of organic reactions involving different functional groups.
- The students will be able to know about the complete knowledge of alkyl and aryl halides, arenes and aromaticity.

Text Books

1. Organic Chemsitry, Morrison and Boyd, Prentice- Hall.
2. Fundamentals of Organic Chemistry, Solomons, John Wiley.
3. Organic Chemistry. F.A. Carey, McGraw Hill, Inc.
4. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
5. Organic Chemistry Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd (New Age International).

BSNM-22307
CHEMISTRY LAB -III

L	T	P	C
0	0	4	2

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

1. Quantitative Analysis
Volumetric Analysis

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Determination of alkali content-antacid tablet using HCI.
3. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
4. Estimation of hardness of water by EDTA.
5. Estimation of ferrous and ferric by dichromate method.
6. Estimation of copper using sodium thiosulphate.

Gravimetric Analysis

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime)

Organic Chemistry Laboratory
Techniques Thin Layer
Chromatography

Determination of Rf values and identification of organic compounds.

1. Separation of green leaf pigments (spinach leaves may be used).
2. Preparation and separation of 2, 4 dinitro phenyl hydrazones of acetone, 2-butone, 2- Butanone, Hexan-2 and 3-one using toluene and light petroleum (40:60).
3. Separation of a mixture of dyes using cyclo hexane and ethyl acetate (8.5:1.5).

Text Books

1. Practical Organic Chemistry by F.G. Mann and B.C. Saunders
2. Practical Inorganic Chemistry by J.R. Barrante G. Marr and B.W. Rockett
3. Vogel's Inorganic Quantitative Analysis

BCCS-21302
OPERATING SYSTEMS

L	T	P	C
4	0	0	4

Objectives

1. To learn the fundamentals of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication
3. To learn the mechanisms involved in memory management in contemporary OS
4. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
5. To learn to implement simple OS mechanisms.

1. Fundamentals of Operating system (15)

Introduction to Operating system, Functions of an operating system. Operating system as a resource manager. Structure of operating system (Role of kernel and Shell). Views of operating system. Evolution and types of operating systems. Process & Thread Management: Program vs. Process; PCB, State transition diagram, Scheduling Queues, Types of schedulers, Concept of Thread, Benefits, Types of threads, Process synchronization.

CPU Scheduling: Need of CPU scheduling, CPU I/O Burst Cycle, Pre-emptive. Non-pre-emptive scheduling, Different scheduling criteria's, scheduling algorithms (FCSC, SJF, Round-Robin, Multilevel Queue).

2. Memory Management (8)

Introduction, address binding, relocation, loading, linking, memory sharing and protection; Paging and segmentation; Virtual memory: basic concepts of demand paging, page replacement algorithms.

3. I/O Device Management (7)

I/O devices and controllers, device drivers; disk storage. File Management: Basic concepts, file operations, access methods, directory structures and management, remote file systems; file protection.

4. Advanced Operating systems (15)

Introduction to Distributed Operating system, Characteristics, architecture, Issues, Communication & Synchronization; Introduction Multiprocessor Operating system, Architecture, Structure, Synchronization & Scheduling; Introduction to Real-Time Operating System, Characteristics, Structure & Scheduling. Case study of Linux operating system.

Course Outcomes (COs): Students will be able to:

1. Discuss the evaluation of operating systems.
2. Explain different resource managements performed by operating system.
3. Describe the architecture in terms of functions performed by different types of OS.
4. Analyze the performance of different algorithms used in design of operating system components.

Text Books

1. Operating System Principles by Abraham Silberschatz and Peter Baer Galvin, Seventh Edition, Published by Wiley-India.
2. Principals of Operating System by Naresh Chauhan, Published by OXFORD Uni. Press, India.

BCCS-21304
OPERATING SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

1. List of practical exercises

1. To explore and installation process different operating systems like Linux, Windows etc.
2. Virtualization, Installation of Virtual Machine Software and installation of Operating System on Virtual Machine.
3. Execute various basic and advance Linux commands, commands for files and directories, creating and viewing files, File comparisons, and Disk related commands.
4. Execute Linux commands for Processes in Linux, connecting processes with pipes, background processes, managing multiple processes.
5. Study and usage of VI Editor.
6. Basics of Shell programming, various types of shell, Shell Programming in bash.
7. Study and implementation of shell variables, shell keywords.
8. Implement conditional statements, looping statement and case statement in Shell programming.
9. Implement parameter passing and arguments in Shell programming. Implement.
10. Shell programs for automate system tasks and report printing.

BTMP-21101
WORKSHOP MANUFACTURING PRACTICES

L	T	P	C
1	0	4	3

Course Objectives: 1. Define and identify various manufacturing processes. 2. Describe different manufacturing processes commonly employed in industry 3. Fabricate small components using different manufacturing processes.

1. **Carpentry Shop**
   Types of timbers, defects in timber, seasoning of wood; tools, wood operation and various joints; exercises involving use of important carpentry tools to practice various operations and making joint.
2. **Foundry Shop**
   Introduction to molding materials; moulds; use of cores; melting furnaces; tools and equipment used in foundry shops; firing of a cupola furnace; exercises involving preparation of small sand moulds and castings.
3. **Forging Shop**
   Introduction to forging tools; equipments and operations; forgability of metals; exercises on simple smithy; forging exercises.
4. **Machine Shop**
   Machines, Grinders etc; cutting tools and operations; exercises on small work pieces.
5. **Welding Shop**
   Introduction to different welding methods; welding equipments; electrodes; welding joints; welding defects; exercises involving use of gas and electric arc welding.
6. **Electrical and Electronics**
   Shop Introduction to electrical wiring; preparation of PCBs involving soldering applied to electrical and electronic applications; exercises on preparation of PCBs involving soldering applied to electrical and electronic applications.
7. **Practice in Sheet Metal Shop**
   Shop development of surfaces of various objects; sheet metal forming and joining operations, joints, soldering and brazing; exercises involving use of sheet metal forming operations for small joints.
8. **Fitting Shop**
   Introduction of fitting and tools used in fitting shop; exercise involving marking, cutting, fitting.

Course Outcomes (COs):

- Understand the Various manufacturing Processes.
- Classify the manufacturing processes commonly employed in industry.
- Fabricate small components using different manufacturing processes.
- Capable to use the various methods to manufacture a product in industry.

Text Books

1. Raghuwanshi, B.S. ; A Course in Workshop Technology, Vol. 1 & II, Dhanpat Rai &

Sons, New Delhi.
2. Jain, R.K.; Production Technology, Khanna Publishers, New Delhi.
3. Singh, S., ; Manufacturing Practice, S.K. Kataria & Sons, New Delhi
4. D.J. Griffiths, Introduction to Electrodynamics, Benjamin Cummings 3rd. Edn. 1998.

BCCS-21102
COMPUTER FUNDAMENTALS

L	T	P	C
3	0	0	3

Course Objective: The subject aims to provide the student with an understanding of basic concepts of computer science and engineering and introduction to the fundamentals of hardware, software and programming. An understanding to various emerging Technologies such as IoT, Cloud computing and Big Data.

1. **Introduction to Computer:**
   Definition, Computer Hardware & Computer Software Components: Hardware – Introduction, Input devices, Output devices, Central Processing Unit, Memory- Primary and Secondary. Software - Introduction, Types – System and Application.

2. **Programming Paradigms and Development Tools**
   Problem Analysis, Program Constructs Sequential, Decision, Loop), Algorithms, Flowcharts, Pseudo code. Decision table, Modular Programming, Top– down and Bottom–up Approaches, functional, Procedural object–oriented, and logic programming, Programming Languages – Syntax & Semantics.

3 **Operating system**
   Definition, Functions, Types, Classification, Elements of command based and GUI based operating system. Computer Network: Overview, Types (LAN, WAN and MAN), Data communication, topologies.

4. **Internet**
   Overview, Architecture, Functioning, Basic services like WWW, FTP, Telnet, Gopher etc., Search engines, E-mail, Web Browsers.

5. **Internet of Things (IoT)**
   Definition, Sensors, their types and features, Smart Cities, Industrial Internet of Things.

6. **Emerging Technologies**
   Applications and use cases Cloud Computing: Nature and benefits, AWS, Google, Microsoft & IBM Services, Virtual Reality, Grid computing, Green computing, Big data analytics, Quantum Computing and Brain Computer Interface.

Course Outcomes (COs): After completing this course student will be able to:

1. Demonstrate the knowledge of the basic structure, components, features and generations of computers.
2. Describe the concept of computer languages, language translators and construct algorithms.
3. Compare and contrast features, functioning & types of operating system and computer

networks.

4. Demonstrate architecture, functioning & services of the Internet. Illustrate the emerging trends and technologies in the field of Information Technology.

Text Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

IPHY-SEC1
RENEWABLE ENERGY

L	T	P	C
3	0	0	3

Course Objectives: 1. Define and identify various manufacturing processes. 2. Describe different manufacturing processes commonly employed in industry 3. Fabricate small components using different manufacturing processes.

1. Fossil fuels and Alternate Sources of energy (7)

Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

2. Solar energy (7)

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

3. Wind Energy harvesting (5)

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

4. Ocean Energy (6)

Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

5. Geothermal and Hydro Energy (5)

Energy Geothermal Resources, Geothermal Technologies. Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

6. Piezoelectric Energy harvesting (6)

Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power

Course Outcomes (COs):

1. Students will be able to develop an understanding about different types of energies.
2. The course will develop analytical abilities related to solar energy production & consumption.
3. It is expected that students will be able to have conceptual understanding about geothermal, wind

energy & bio-fuels.

Text Books

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

IPHY-T7
ELECTRONICS

L	T	P	C
4	0	0	4

Course Objectives: The course content covers basic semiconductor physics and devices, diodes, bipolar junction transistors, amplifiers, feedback concepts, introduction basics of digital electronics.

1. P.N. Junction (12)

Intrinsic/Extrinsic semiconductor, Fermi level, Charge carries in semiconductors, PN junctions, depletion region, current components in pn junction, Characteristic of pn junction diode, pn junction as rectifier, characteristics and applications of Zener diode, Photodiode, LED and photocells.

2. Electronic Devices (12)

Bipolar junction transistor, current components in transistors, CB, CE, CC configuration, h-parameters, transistor biasing, transistor as an amplifier, Emitter follower, characteristics and applications of FET, MOSFET.

3. Transistor Circuits (12)

Feedback amplifiers; classification of amplifiers, feed-back concept, Sinusoidal oscillations; phase shift oscillators, Wien Bridge Oscillator, Crystal oscillator, Basic idea about AM modulation and demodulations, Oscilloscope.

4. Digital Principles (9)

Number system, Decimal, binary, Octal, hexadecimal, logic gates, AND, OR, NOT, NAND, NOR, XOR, XNOR, Karnaugh map techniques.

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

- Illustrate working principle of different electronic circuit and their applications in real life
- Understand the working of semiconductor device and different operating condition and their performance parameter.
- Design and analyse the different types of amplifiers and understand the feedback mechanism.
- Design and analyse the different types of oscillators.

Text Books

1. Integrated Electronics: J. Millman and C.C.Halkias (Tata McGraw Hill,2001).
2. Electronic Devices & Circuits –J. Millman and C.C.Halkias (Tata McGraw Hill, 2009).
3. Digital Principles & Applications–P.Malvine & Leach (Tata McGraw Hill,1993

IPHY-T8
STATISTICAL PHYSICS

L	T	P	C
4	1	0	5

Course Objectives: Statistical Physics deals with a physical system consisting of large number of particles (solid, liquid or gas) from knowledge of the underlying microscopic behavior of atoms and molecules that comprises it. The main objective of this course work is to introduce the techniques of Statistical Mechanics which has applications in various fields including Astrophysics, Semiconductors, Plasma Physics, Bio-Physics etc. and in many other directions.

1. Basic Concepts of Thermodynamics (5)

Thermodynamic Systems, thermodynamic variables, equation of state, thermodynamic equilibrium, laws of thermodynamic, Maxwell relations, Ideal monoatomic gas and its equation of state.

2. Introduction to Statistical Physics (15)

The statistical basis of thermodynamics, elements of classical statistics, concept of state in classical mechanics, basic ideas of probability theory, Distribution of molecules in two halves of a box, Phase space, Microstate and Macrostate, fluctuations and their dependence on N, Constraints and accessible states, fundamental postulates of classical statistical mechanics, Thermodynamic probability, division of phase space into cells, Boltzmann canonical distribution law, Condition of equilibrium between two systems in thermal contact and β parameter, Entropy and probability, Derivation of thermodynamic quantities from Boltzmann function.

3. Quantum Statistics (10)

Basic fundamental ideas of quantum mechanics, Concept of state in quantum mechanics, need for quantum statistics, postulates of quantum statistics, The Bose-Einstein Statistics, The Fermi-Dirac statistics, Results and comparison of three statistics, relative occupation of energy states.

4. Applications of Quantum statistics (15)

Quantum Systems, Planck's oscillators, Bose –Einstein gas, Black body and Black body radiations, Stefan Boltzmann law, distribution spectrum in and Black body radiations, Quantum theory of radiations, Average energy of a classical and Planck's oscillator, Fermi-Dirac gas, Electron gas in metals, specific heat anomaly of metal and its solution.

Course Outcomes (COs):

- Understanding of the concepts of microstate, macrostate, ensemble, phase space, thermodynamic probability and partition function.
- Understanding of the combinatory studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.

- Comprehending and articulating the connection as well as dichotomy between classical statistical mechanics and quantum statistical mechanics.

Text 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. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
5 Statistical Physics and Thermodynamics, V.S. Bhatia and T.S. Bhatia(Vishal Publishing Co)

IPHY-L4
ELECTRONICS LAB.

L	T	P	C
0	0	6	3

Objectives

The objective of this course is to setup various types of laboratory experiments on analogue electronics and understand some different concept of electronics.

Note: Students are required to perform minimum of 5 experiments.

1. To study the forward and reverse characteristics of PN junction diode.
2. To study the reverse characteristics of Zener diode.
3. To study the input and output characteristics of BJT in CE Configuration.
4. To study the input and output characteristics of BJT in CB Configuration.
5. To study characteristics of FET.
6. To verify the truth table of logic gates.
7. To verify the universal property of NAND and NOR gate.
8. To measure the voltage and frequency using CRO.
9. Half Wave and Full Wave Rectifier Without Filter

Course Outcomes (COs):

- Construction and use of specific analogue devices and experimental apparatuses used in the lab, including necessary precautions.
- Hand on experience on analogue electronics related phenomena and Data analysis, error calculation and laboratory report preparation.
- Review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
-

Text Books

1. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited.
2. Advanced Practical Physics, Vol 1, B. Ghosh, K.G.Majumdar, Shreedhar Publishers.

BSNM-22406
LINEAR ALGEBRA

L	T	P	C
4	0	0	4

Course Objectives:
To make the students become familiar with the basic concepts of linear algebra with a thorough understanding of vector spaces, linear transformations and matrix operations enhancing the students' ability to reason mathematically and able to apply this knowledge to many fields in science and technology.

1. Linear independence of row and column vectors, row rank, column rank and rank of a matrix and their equivalence. Applications of matrices to a system of linear equations (both homogeneous and non-homogeneous). Theorems on consistency of a system of linear equations (both homogeneous and non-homogeneous). **(15)**

2. Eigen values, eigenvectors and characteristic equation of a matrix, Cayley-Hamilton theorem and its use in finding inverse of a matrix. Diagonalization. **(10)**

3. Vector Space: Definition and Examples of Vector Spaces, Subspaces, Algebra of subspaces, Linear span, Linear dependence and independence of vectors, Basis and dimension of a vector space, Basis and dimension of subspace, Direct sums and complements. **(10)**

4. Linear transformations, Rank and Nullity of a linear transformation, Vector space of linear transformations. Linear transformations and matrices Change of basis. **(10)**

Course Outcomes (COs): Upon successful completion of this course, students will:

- Solve systems of linear equations by matrix inversion and rank method.
- Demonstrate understanding of the concepts of vector space and subspace.
- Demonstrate understanding of linear independence, span, and basis.
- Determine eigen values and eigen vectors and solve eigen value problems.
- Apply principles of matrix algebra to linear transformations.

Text Books:

1. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, First Course in Linear Algebra, New Age International Publishers.
2. Bernard Kolman, David R. Hill, Elementary Linear Algebra with Applications, Pearson
3. Vivek Sahai, Vikas Bist, Linear Algebra, Narosa, 2017.

BSNM-22401
INORGANIC CHEMISTRY-III

L	T	P	C
4	0	0	4

Course objective: The objective of this course is to study the chemistry of coordination complexes, lanthanides, actinides elements and behaviour of molecules in different solvents. This course also helps in understanding the chemistry of bioinorganic chemistry.

Coordination Compounds **(10)**

1. Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Non-aqueous Solvents **(10)**

2. Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Oxidation and Reduction

Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, Latimer andPourbaix diagrams.

Chemistry of Lanthanide Elements **(10)**

3. Electronic structure, oxidation states and ionic radii and lanthanide contraction. Electronic absorption and magnetic properties of lanthanides.

Chemistry of Actinides

General features and chemistry of actinides, similarities between the later actinides and the later lanthanides. Electronic and magnetic properties of actinides and their general comparison with the lanthanide elements.

Bioinorganic Chemistry **(5)**

4. Essential and trace elements in biological processes, metalloporphyrins and special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

Course Outcome:

1. This course will equip the students with the knowledge of lanthanides and actinides elements.
2. To know about some bioinorganic compounds
3. To categorise coordination compounds and understand the concept of valence bond theory.
4. To understand the properties of non-aqueous solvents and analysis of redox reactions.

Text Books

1. J.D. Lee, Concise Inorganic Chemistry, 4th Ed.
2. J.E. Huheey, Inorganic Chemistry, Harper & Row.
3. F.A.Cotton and G. Wilinson, Advanced Inorganic Chemistry, Interscience Publishers.
4. N.N. Greenwood and A. Earnshaw, Chemistry of Elements, Pergamon Press.
5. D.F.C. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chem., ELBS Oxford, 1991s

BSNM-22407
CHEMISTRY LAB.-IV

L	T	P	C
0	0	4	2

1. Qualitative Analysis

Detection of elements
1. Nitrogen,
2. Sulphur
3. Halogens

Detection of functional groups
1. Phenolic
2. carboxylic,
3. carbonyl,
4. esters,
5. carbohydrates,
6. amines, amides, nitro and anilide in simple organic compounds and preparing their derivatives

Text Books

Practical Organic Chemistry by F.G. Mann and B.C. Saunders.

BCCS-21402
DATA BASE MANAGEMENT SYSTEMS

L	T	P	C
4	0	0	4

Course Objectives: The subject aims to provide the student with an understanding Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database and Formulate, using SQL, solutions to a broad range of query and data update problems. It also aims to demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.

1. Introduction to DBMS (9)

Introduction of DBMS, Data Modeling for a Database, Three level Architecture of DBMS, Components of a DBMS. Introduction to Data Models, Hierarchical, Network and Relational Model, Comparison of Network, Hierarchical and Relational Model, Entity Relationship Model.

2. RDBMS and SQL Fundamental (8)

Relational Database, Relational Algebra and Calculus, SQL Fundamentals, DDL, DML, DCL, PL/SQL Concepts, Cursors, Stored Procedures, Stored Functions, Database Triggers.

3. Normalization (8)

Introduction to Normalization, First, Second, Third Normal Forms, Dependency Preservation, Boyce-Codd Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Domain-key normal form (DKNF).

4. Database Security (8)

Database Recovery, Concurrency Management, Database Security, Integrity and Control. Structure of a Distributed Database, Design of Distributed Databases.

Course Outcomes (COs): After completing this course student will be able to:

- Construct data base for software applications.
- Understand approaches for data base optimization.
- Formulate, using SQL, solutions to a broad range of query and data update problems.
- Understand the concept of Transaction and Query processing in DBMS.

Text Books

1. An Introduction to Data base System", BipinC. Desai, Galgotia Publications Pvt. Ltd-New Delhi, Revised Edition, (2012).
2. “Database System Concepts”, Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Tata McGraw Hill, 6th Edition, (2013).

BCCS-21404
DATA BASE MANAGEMENT SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

1.
1. Use of CREATE, ALTER, RENAME and DROP statement in the data base tables (relations)
2. Use of INSERT INTO, DELETE and UPDATE statement in the data base tables (relations).
3. Use of simple select statement.
4. Use of select query on two relations
5. Use of nesting of queries.
6. Use of aggregate functions.
7. Use of substring comparison.
8. Use of order by statement.
9. Consider the following scheme for a Library Database.

Write SQL queries to

1. Retrieve details of all books in the library_ id, title, name of publisher, authors, number of copies in each branch, etc.
2. Get the particulars of borrowers who have borrowed more than 3 books between Jan 2018 to Jun 2018
3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.
4. PartitiontheBOOKtablebasedonyearofpublication.Demonstrateitsworking with a simple query.
5. Createaviewofallbooksanditsnumberofcopiesthatarecurrentlyavailableinthe Library.

10. Consider the following scheme for Order Database:

SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) Write SQL queries to

1. Count the customers with grades above Amritsar's average.
2. Find the name and numbers of all salesmen who had more than one customer.
3. Listallsalesmenandindicatethosewhohaveanddon'thavecustom ersintheir cities (Use UNION operation.)
4. Create a view that finds the salesman who has the customer with the highest order of a day.
5. DemonstratetheDELETEoperationbyremovingsalesmanwithid1 000.Allhis orders must also be deleted.

11. Write a PL/SQL code to add two numbers and display the result. Read the numbers during run time.

12. Write a PL/SQL code to find sum of first10 natural number s using while and for loop.

13. Write a program to create a trigger which will convert the name of a student to upper case before inserting or updating the name column of student table.

14. Write a PL/SQL block to count the number of rows affected by an update statement using SQL ROW COUNT

15. Write a PL/SQL block to increase the salary of all doctors by 1000.

Text Books

1. "SQL, PL/SQLThe Programming Language of Oracle", 4th Revised Edition, Ivan Bay ross (2009).
2. Oracle PL/SQL Programming", 5th Edition, Steven Feuersteinand Bil lPribyl (2009).

BCCS-21406
WEB DESIGNING

L	T	P	C
3	0	0	3

Course Objectives: The main goal of this course is to understand the core concepts of Internet and Web Services and to describe and differentiate Programming Language and Markup Language. Subject also aims to list various web pages and web sites together to Capture user input from the remote users.

1. **Introduction to Internet and HTML**
   Basic concepts, communicating on the internet, internet domains, internet server identities, establishing connectivity on the internet client IP address. Information Files Creation, Web Server, Web Client/Browser, Hyper Text Markup Language (HTML Tags, Paired Tags, Singular Tags), Commonly Used Html Commands (Document Head, Document Body), Title and Footer, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page (Heading Styles, Drawing Lines). Basic Formatting Tags HTML Basic Tags, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page Heading Styles, Drawing Lines), Text Styles (Bold, Italics, Underline),Other Text Effects (Centering(Text, Images etc.), Spacing (Indenting Text), HTML Color Coding.

2. **HTML Components**
   Type of Lists (Unordered List (Bullets), Ordered Lists (Numbering), Definition Lists. Using The Border Attribute, Using The Width And Height Attribute, Using The Align Attribute, Using The Alt Attribute. Introduction (Header, Data rows, The Caption Tag), Using the Width and Border Attribute, Using the Cell padding Attribute, Using the Cells pacing Attribute, Using the BGCOLOR Attribute, Using the COLSPAN and ROWSPAN Attributes Links (External Document References, Internal Document References), Image as Hyperlinks. Introduction to Frames: The <FRAMESET> tag, The<FRAME> tag, Targeting Named Frames. DHTML: Cascading Style Sheets, Style Tag.

3. **Forms Used by a Web Site**
   The Form Object, The Form Object's Methods (The Text Element, The Password Element, The Button Element, The Submit (Button) Element, The Reset (Button) Element, The Checkbox Element, The Radio Element, The Text Area Element, The Select and Option Element, The Multi Choice Select Lists Element).

4. **Introduction to Java Script**
   JS Introduction, Where To, Output, Statements, Syntax, Comments, Variables, Operators, Arithmetic, Assignment, Data Types, Functions, Objects, Events, Strings, String Methods, Numbers, Number Methods, Arrays, Array Methods, Array Sort, Array Iteration, Dates, Date Formats, Date Get Methods, Date Set Methods, Math, Random, Booleans, Comparisons, Conditions, Switch, Loop For, Loop While, Break, Type Conversion, Bitwise, Reg Exp, Errors, Scope, Hoisting, Strict Mode, JSON, Forms, Forms API JS Functions, Function Definitions, Function Parameters, Function Invocation, Function Call, Function Apply, Function Closures.

Course Outcomes (COs): After the completion of this subject students will be able to:

1. Understand the core concepts of Internet and Web Services.
2. Describe and differentiate Programming Language and Markup Language.
3. List various web pages and websites together.
4. Capture user input from the remote users.
5. Learn connectivity concepts of Front End and Back End process.

Text Books

1. Internet for Every One: Alexis Leon, 1stEdition, Leon Tech world, Publication, 2009.
2. GreenlawR;Heppe,"FundamentalsofInternetandWWW",2ndEdition,TataMcGraw- Hill,2007
3. Raj Kamal," Internet & Web Technologies", edition Tata McGraw-Hill Education.2009.

BTCS-21101
PROGRAMMING FOR PROBLEM SOLVING

L	T	P	C
3	0	0	3

Course Objectives: 1. Define and identify various manufacturing processes. 2. Describe different manufacturing processes commonly employed in industry 3. Fabricate small components using different manufacturing processes.

1. Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code. (4)

2. Arithmetic expressions and precedence. (2)

3 Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.(3)

4. Arrays: Arrays (1-D, 2-D), Character arrays and Strings. (6)

5. Basic Algorithms Searching (Linear Search), Basic Sorting Algorithms (Bubble Sort), Finding roots of Equations. (6)

6. Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference. (5)

7. Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series. (4-5)

8. Structure: Structures, Defining structures and Array of Structures. (4)

9. Pointers: Idea of pointers, Defining pointers. (2)

10. File handling (only if time is available, otherwise should be done as part of the lab). (2)

Course Outcomes (COs): The student will learn

1. To formulate simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs (in C language).
3. To test and execute the programs and correct syntax and logical errors.
4. To implement conditional branching, iteration and recursion.

5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
6. To use arrays, pointers and structures to formulate algorithms and programs.
7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
8. To apply programming to solve simple programming problems, namely root finding of function, differentiation of function and simple integration.

Text Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Reference Book :

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PHI

IPHY-SEC2
BASIC INSTRUMENTATION SKILL

L	T	P	C
3	0	0	3

Course Objectives: This course is to get exposure with various aspects of instrumentation and usage through lectures as wells as hands on mode. To impart knowledge of design, operation and use of various electrical and electronic instruments in real life applications and paraphrase their importance.

1. Basic of Measurement (6)

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

2. Current and Voltage Sources (7)

Sources of electrical power, Internal impedance of a source, concept of voltage source, concept of current source, equivalence between voltage and current source, Usefulness of the concept of voltage and current source in electronics.

3. Electronic Voltmeter (8)

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

4. Cathode Ray Oscilloscope and Signal Generators (10)

Block diagram of basic CRO. Brief introduction to of CRT, Electron gun and screen phosphor. Use of CRO for the measurement of voltage (*dc* and *ac* frequency, time period. Introduction to digital oscilloscope, Block diagram and principle of working. Block diagram, explanation and Specifications of low frequency signal generators. Pulse generator, and function generator.

5. Digital Instruments (5)

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

Course Outcomes (COs): On completion of these course students will be able to:

- Analyze the signal accordance to accuracy, precision, sensitivity, resolution, errors etc.
- Use and measure frequency, phase etc. of the signal with CRO.
- Acquire purpose, scope and concepts of signal generator and wave analyzer.
- Understand different types of bridges and their construction to find unknown values.
- Develop an understanding of construction and working of different analog /digital devices.

Text Books

1. B L Theraja, A text book in Electrical Technology.
2. Basic Electronics and linear circuits, NN Bhargava, DC Kulshreshtha, SC Gupta, Tata McGraw-Hill, New Delhi.
3. S. Salivahanan & N. S. Kumar:Electronic Devices and Circuits, 3rd Edn.
7. U. Tietze, Ch. Schenk :Electronic circuits: Handbook of design and Applications
8. Thomas L. Floyd: Electronic Devices, 7/e, 2008, Pearson, India.

IPHY-T9
NUCLEAR AND PARTICLE PHYSICS

L	T	P	C
4	1	0	5

Course Objectives: The objective of this course is to study general properties of nuclei, nuclear models, radioactive decays, nuclear reactions, fission and fusion processes and applications, interaction of radiation with matter, respective detectors and basic elementary particles.

1. Structure and Properties of the Nucleus (10)

Discovery of the nucleus, composition, basic properties; charge, mass, size, spin, magnetic moment, electric quadruple moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus, coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve,

Nuclear Models: liquid drop model of the nucleus, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, nuclear force.

2. Radioactive decays (10)

Alpha decay: basics of α-decay processes, theory of alpha emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) ß-decay: energy kinematics for ß-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Nuclear Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction.

3. Interaction of Radiation with Matter (10)

Energy loss of particles in passage through matter, stopping power of matter for charged particles, energy range relationship and straggling. Interaction of gamma radiation with matter: photoelectric effect, Compton effect and pair production. Thomson scattering and Rayleigh scattering. Particle Accelerators: need of accelerators, cyclotron, Betatron and electron synchrotron.

4. Cosmic Rays and Elementary Particles (10)

Discovery of cosmic rays: hard and soft components, discovery of elementary particle, Particle interactions; basic features, types of particles and its families. Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model.

Course Outcomes (COs): The student will be able to understand the roles of nuclear and particle physics in energy production, medicine, and astrophysics.

Text Books:

. R.D. Evans: Atomic Nucleus, Krieger Publishing Co. 2003
2. K.S. Krane: Introductory Nuclear Physics, Wiley 2008.
3. P. Mermier and E. Sheldon: Physics of Nuclei and particles, Academic Press, 2013.

IPHY-T10
HEAT AND THERMODYNAMICS

L	T	P	C
4	0	0	4

Course Objectives: This course discusses relationship between the macroscopic properties of physical systems in equilibrium. The primary goal is to understand the fundamental laws of thermodynamics and their applications to various systems and processes like liquification of gases, Heat engines and refrigerators. In addition, it will also give exposure to students about the Kinetic theory of gases and transport phenomena involved.

1. Basic Concepts and Zeroth Law of Thermodynamics (7)

Thermodynamic System, Boundaries, Extensive and intensive thermodynamic variables, Thermodynamic Equilibrium, Reversible, Irreversible and Quasi-static Processes, Representation of a Process on an Indicator Diagram. Zeroth Law of Thermodynamics & Concept of Temperature. Equation of state.

2. Heat and First Law of Thermodynamics (5)

Concept of heat, Heat and Work: path functions, Internal energy, First Law of Thermodynamics, its differential form. Heat capacity, Work Done during Isothermal and Adiabatic Processes.

3. Second and third Law of Thermodynamics (15)

Carnot's Cycle: Conversion of Heat into Work. Carnot's Cycle, Carnot engine & efficeciency. Carnot Cycle as Refrigerator & coefficient of performance.

Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

*Entropy***:** Physical Concept of Entropy, Clausius Theorem. Second Law of Thermodynamics in terms of Entropy. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes. Representation of Carnot Cycle on Entropy-Temperature Diagram. Third Law of Thermodynamics, Unattainability of Absolute Zero.

4 Maxwell's thermodynamic relations, potentials and Applications (10)

Thermodynamic Potentials, derivation of Maxwell's thermodynamic Relations. Applications of Maxwell's relations: cooling produced by adiabatic stretching and compression, stretching of films, change of internal energy with volume, TdS-Equations, Clausius - Clapeyron Equation, Joule-Thomson Effect, temperature inversion, liquefaction of gases. Cooling due to adiabatic demagnetization (qualitative).

5 Kinetic Theory of Gases (8)

Introduction to Kinetic theory of matter, kinetic theory of perfect gases, Maxwell- Boltzmann distribution law and its experimental verification, expressions for Average speed , mean square and most probable speed. Law of equipartition of energy, degree of freedom and heat capacity of gases.

Course Outcomes (COs):

Students will gain knowledge about the basic concepts of thermodynamics, laws of thermodynamics, the concept of entropy, the thermodynamic potentials and their physical interpretations. Heat and energy, transformation process. Latent heat, specific heat, liquifaction of gases and working process of heat engines. Basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation etc.

Text Books

1. Statistical Physics and Thermodynamics-V.S. Bhatia, Punjab University, Chandigarh, 1977.
2. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
3. Heat and Thermodynamics, M.W. Zemasky and R. Dittman, 1981, McGraw Hill
4. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

IPHY-L5
THERMAL PHYSICS LAB.

L	T	P	C
0	0	6	3

Course Objectives In the laboratory course, the students are expected to do some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, temperature coefficient of resistant, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple.

Note: Students are required to perform minimum of 5 experiments.

1. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
2. Coefficient of thermal conductivity of good conductor (e.g. copper) by Searle's apparatus
3. To study mechanical equivalent of heat using Joule Apparatus.
4. Verify laws of probability distribution by throwing of similar coins.
5. To study and Very Newton's law of cooling.
6. To study and verify Stefan's law of radiation.
7. Variation of thermo-emf across two junctions of a thermocouple with temperature
8. Determination of the coefficient of thermal expansion of a metallic rod using an optical lever.
9. Calibration of a thermocouple by direct measurement of the thermo- emf. using potentiometer and the constants. One end in ice and another end at water bath which to be heated.
10. To determine the boiling point of a liquid using Platinum Resistance Thermometer (PRT).
11. To find the Plank's constant and very Inverse Square law of radiation.

Course Outcomes (COs):

- Construction and use of specific measurement instruments and experimental apparatuses used in the thermal physics lab, including necessary precautions.
- Analysis of experimental data, error estimation and writing scientific reports.

Text Books

1. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited.
2. Advanced Practical Physics, Vol 1, B. Ghosh, K.G.Majumdar, Shreedhar Publishers.

IPHY-T11
LASER AND FIBER OPTICS

L	T	P	C
4	0	0	4

Course Objectives: The basic understanding of laser and optical fiber communication. The course is designed to provide knowledge of light as propagation of wave, laser, optical fiber at fundamental level and understanding of various components of laser and optical fiber communication system.

1. Laser Fundamentals (12)

Laser, Fundamental characteristics of laser. Three level and four level lasers. Properties of laser, Einstein coefficient, Condition for laser action, Population inversion, Pumping, Laser modes, Resonator configuration – Q-switching and mode locking. Basic Laser Systems:

(i) Solid state laser: • Ruby Laser • Nd: YAG laser • Semiconductor laser

(ii) Gas Laser:• He-Ne laser • CO_2 Laser

(iii) Liquid laser: Dye laser.

2. Applications of Laser (8)

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

3. Optical Fibers (12)

Introduction, Principles of light propagation through a fiber, Different types of fibers and their properties, fiber Characteristics,Numerical aperture, Attenuation of optical fibers, absorption losses, scattering losses, bending loss, Pulse Dispersion - Intramodal dispersion, Intermodal dispersion. Pulse dispersion Modes of a planar waveguide: TE and TM modes. Physical understanding of modes. Connectors and splices, Fiber termination, Optical sources, Optical detectors.

4. Application of Optical Fibers (8)

Fiber optic sensors – Fiber optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain. Applications of optical fibers in Communication and Sensing.

Course Outcomes (COs):

After passing this course, the students will be able to understand the principle, transmission, dispersion and attenuation characteristics of optical fibers. Also students are able to understand laser theory and laser generation system. Students will gain ability to apply laser theory and optical fibers for its use as communication medium for specific industrial and medical application.

Text Books

1. Lasers: Theory and Applications , A. Ghatak & K. Thyagarajan

2. Principles of Lasers , O. Svelto, 2009, Springer
3. Laser Physics, M. Sargant, M. Scully & W. Lamb , 1974, Westview Press
4. Introduction to Fiber Optics, A. Ghatak, 1998, Cambridge University Press
5. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008
6. Optics, E. Hecht & A. Ganesan, 2009, Pearson Prentice Hall
7. Optical Fiber Communications– – John M. Senior, Pearson Education. 3 rd Impression, 2007.
8. Fiber optic communication – Joseph C Palais: 4th Edition, Pearson Education.

IPHY-T12
MATERIAL SCIENCE

L	T	P	C
4	1	0	5

Course Objectives: This course serves as a foundation for understanding the structure-property correlation in materials. Phase diagram will make students understand the various phases present during solidification of crystals.

1. Classification of Materials (2)
Metals, Semiconductors, Ceramics, Polymers, Composites, Biomaterials, Advanced materials.
Introduction to Material Properties (2)
Chemical properties, Physical properties, Dimensional properties, Mechanical properties. Structure-property relationship.

2. Material behaviour under stress (12)
Introduction to point, line, surface and volume defects. Elastic and plastic deformation, Stress-strain curve. Creep- types of creep, creep curve. Fracture-ductile and brittle. Fatigue- Cyclic stress, S-N curve, Crack initiation and propagation.

3. Phase Diagrams (12)
System, Component, Solubility limit. Phase. Metal and alloys- theory of alloys. Solid solutions- Substitutional solid solution (Hume Rothery's rule), Interstitial solid solution, Order-disorder solid solution, determination of type of solid solution. Phase diagram- Gibb's Phase rule, Unary phase diagram (Phase diagram of water and iron), Binary systems (phase diagram of Cu-Ni or Ge-Si or Au-Ag alloys). Lever rule.

4. Conducting and Insulating Materials (10)
Low resistivity materials (Cu, Al) and their characteristics, High resistivity materials (Nichrome, Constantan, Manganin) and their characteristics. Contact materials (Ag, Pt, Pd, W, Mo) and their properties. Fusible materials (Pb, Sn and its alloys) and their properties. Filament materials and their characteristics. Insulating materials- Ceramic insulating materials, Polymeric insulating materials, Liquid insulating materials, Gaseous insulating materials.
Magnetic Materials (5)
Origin of magnetism, types of magnetism, Magnetic domains, Hysteresis. Hard and soft magnetic materials. Ferrites and their characteristics. Applications of soft and hard magnetic materials.

Course Outcomes (COs):
At the end of this course, students should be able to classify various types of materials and their connection with various properties of the material.

Text Books

1. W. D. Callister, "Materials Science and Engineering: An Introduction",John Wiley & Sons, 2007.
2. C. Kittel, "Introduction to Solid State Physics" Wiley Eastern Ltd, 2005.
3. V. Raghavan, “Materials Science and Engineering: A First Course",Prentice Hall, 2006.

IPHY-L6
LASER AND OPTICAL FIBER LAB.

L	T	P	C
0	0	6	3

Course Objectives: The objective of this course is to enable the students to verify some of the concepts learnt in the theory courses. The course provides them training in carrying out precise measurements and handling sensitive equipment.

Note: Students are required to perform minimum of 5 experiments.

1. To measure the numerical aperture of an optical fiber using a He-Ne LASER.
2. To measure the numerical aperture of an optical fiber using a Signal generator, emitter on a board, numerical aperture measurement fig. etc.
3. To measure the attenuation or the propagation loss in an optical fiber using He-Ne laser.
4. To measure the attenuation or the propagation loss in an optical fiber using a signal generator, emitter and photo detector.
5. To determine wavelength of He-Ne laser by double slit interference.
6. To measure divergence of given Laser source
7. To measure wavelength of laser source by transmission diffraction grating.

Course Outcomes (COs):

Text Books

1. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited
2. Advanced Practical Physics, Vol 1, B. Ghosh, K.G.Majumdar, Shreedhar Publishers

IPHY-GEC1
DRUG ABUSE: MANAGEMENT AND PREVENTION

L	T	P	C
2	0	0	2

Course Objectives: This course will cover some basic information about the nature and effects of drugs of abuse. The course will also address the social and personal dynamics involved in the phenomena of drug abuse. Finally, the various measures for prevention currently being employed to combat drug abuse will be explored.

1. **Drug Abuse, Nature and Extent of the Problem**
   Concept and Overview, Historical Perspective of Drug Abuse, Types of Abused Drugs and their Effects (Stimulants, Depressants, Narcotics, Hallucinogens, Steroids). Drug Dependence, Drug Addiction, Physical and Psychological Dependence: Drug Tolerance and withdrawal symptoms. Magnitude or prevalence of the menace of Drug Abuse in India and Punjab.

2. **Management of Drug Abuse**: Medical Management: Medication for treatment and to reduce withdrawal effects. Psychiatric Management: Counseling, Behavioral and Cognitive therapy. Social Management: Family, Group therapy and Environmental Intervention.

3. **Prevention of Drug abuse**
   Role of family: Parent child relationship, Family support, Supervision, Shaping values.
   School: Counseling, Teacher as role-model. Parent-teacher-Health Professional Coordination Random testing on students.
   Controlling Drug Abuse: Media: Restraint on advertisements of drugs, advertisements on bad effects of drugs, Publicity and media, Campaigns against drug abuse, Educational and awareness program.

4. **Legislation**
   NDPs act, Statutory warnings, Policing of Borders, Checking Supply/Smuggling of Drugs, Strict enforcement of laws, Time bound trials.

Course Outcomes (COs): Students will be able to:

- Identify some of the current trends in subject matter.
- Recognize the impact drugs have on individuals and society as a whole.
- Describe the action of drugs and the role the drug has had in societies of the past and in the current world.
- Classify drugs into the drug category to which they belong, as well as identify the schedule the drug is assigned in this country.
- Evaluate the pros and cons of substance use, society's view of different substances, and the pros and cons of current drug law.

Text Books

1.Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.

2. Kapoor. T. (1985) Drug epidemic among Indian Youth, New Delhi: Mittal Pub. 15

3. Modi, Ishwar and Modi, Shalini (1997) Drugs: Addiction and Prevention, Jaipur: Rawat Publication.

4. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.

5. Sain, Bhim 1991, Drug Addiction Alcoholism, Smoking obscenity New Delhi: Mittal Publications.

6. Sussman, S and Ames, S.L. (2008). Drug Abuse: Concepts, Prevention and Cessation, Cambridge Uni. Press.

IPHY-T13
SOLID STATE PHYSICS

L	T	P	C
4	0	0	4

Course Objective: The course gives an introduction to solid state physics, and will enable the student to employ classical and quantum mechanical theories needed to understand the physical properties of solids.

1. Crystal Structure **(12)**

Basis and crystal structure, Unit Cell, Lattice vectors, Two dimensional lattice, Three dimensional lattices, Symmetry operations, Miller indices, Cubic structures, Hexagonal close packed structure. Interplanar spacing, Diffraction of X-rays, Bragg's law of diffraction. Reciprocal lattice, Reciprocal lattice to SC, BCC and FCC lattice, Brillouin zone, Atomic form factor, geometrical structure factor.

2. Lattice Vibrations **(10)**

Lattice vibrations of 1D monoatomic lattice and diatomic lattice. Phonons and their momentum. Inelastic scattering of photons by phonons. Specific heat, classical theory of lattice heat capacity, Einstein's theory of lattice heat capacity, Debye model of lattice heat capacity, Debye approximation, Limitations of Debye model.

3. Free Electron Theory **(10)**

Drude-Lorentz theory, Electrical conductivity and Ohm’s Law, Sommerfeld model, Fermi-Dirac distribution function, Effect of temperature on f-d distribution, Thermal conductivity of metals. Wiedemann -Frenz law, Hall effect.

4. Band Theory **(10)**

Origin and magnitude of energy band gap, Density of states, Bloch theorem, Kronig-Penney model of an infinite one dimensional crystal, Classification of insulators, semiconductors and metals. The tight-binding approximation in evaluating the energy levels for an electron in a solid. Direct and indirect energy band semiconductors.

Course Outcome: At the end of this course:

1. Students will be able to classify various types of structures and correlate various properties of solid materials.
2. Students will be able to know the concept of phonons, heat capacity etc.

3. Students will be able to classify metals, semiconductors and insulators on the basis of band theory.

Text Books

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

IPHY-T14
SPECTROSCOPY

L	T	P	C
4	1	0	5

Course Objectives: The course contents cover the basics of atomic spectra, hydrogen, and alkali spectra, coupling schemes, Raman and X-ray spectra.

1. Introduction to Atomic Spectra (15)

Observation of spectra, Types of spectra, Light sources, Spectral analysis, Units in spectroscopy, Bohr's Theory and Hydrogen spectrum, Ritz combination rule, Correction for finite nuclear mass, Variation of Rydberg constant, Explanation of Spectral series, Energy level diagram, Discovery for heavy hydrogen, Evidences in favour of Bohr's Theory, Bohr's correspondence principle, Franck-Hertz Experiment.

2. Spectra of Alkali Atoms (15)

Different series in Alkali Spectra, Term values. Fine structure in Alkali spectra: The Spinning electron and the vector model, Electron Spin orbit interaction, Doublet structure in alkali Spectra, Intensity rules for fine structure, Energy level diagram of Sodium Atom. Effect of external field on spectra: Normal and Anomalous Zeeman Effect, The Paschen-Bach effect.

3. Raman Spectra (7)

Raman effect, Rotational and Vibrational Raman spectrum, Raman Spectra and Molecular structure, Infrared spectra Versus Raman Spectra.

4. X-rays Spectra (8)

Production of X-rays, Origin of X-rays from electromagnetic theory, X-ray diffraction, Bragg's law, Laue Spots, Bragg's spectrometer, Reflection and refraction of X-rays, X ray scattering, Continuous X-ray spectrum, Characteristics absorption and emission Spectra, comparison of optical and X-ray Spectra, Moseley's law, Applications of Moseley's law.

Course Outcomes (COs):

- Understand basic elements of spectroscopy and intensity of spectral transitions.
- Understand spectra of alkali like atoms and interaction of spins.
- Understand effect of external fields to spectra like, Zeeman effect and Paschen-Bach effect.
- Understand rotational, vibrational, electronic and Raman spectra of molecules.

Text Books

1. Introduction to Atomic Spectra by H. E. White-Aurkland Tata Mc-Graw Hill, 1934.
2. Atomic Spectra and Atomic structure by Gerhard Herzberg, NY, 1944.
3. Concepts of Modern Physics by Arthur Beiser, Tata Mc-Graw Hill 2003.
4. Atomic and molecular spectra by Raja Kumar, Kadar Nath Ram Nath, New Delhi

IPHY-L7
SOLID STATE PHYSICS LAB.

L	T	P	C
0	0	6	3

Course Objectives: This laboratory component aims to explain various properties exhibited by solid and to determine some of the parameter of material experimentally. It enables the students to appreciate how the interesting and wonderful properties exhibited by matter depend upon its atomic and molecular constituents. The gained knowledge helps to solve problems in solid state physics using relevant mathematical tools.

Note: Students are required to perform minimum of 5 experiments.

1. To study B-H hysteresis of ferromagnetic material.
2. To determine dielectric constant of different materials (solid and liquid) using fixed frequency alternating source.
3. Measurement of variation of resistivity in a semiconductor and investigation of intrinsic band gap using linear four probes.
4. Measurement of hall voltage by four probe method.
5. To draw the resistance temperature characteristics of a thermistor.
6. To find temperature coefficient of resistance of a thermistor.
7. To draw V-I characteristics of a thermistor.
8. Measurement of susceptibility of paramagnetic solution (Quincks Tube- Method)
9. To study the characteristics of photovoltaic cell (Solar cell)
10. To draw the characteristics o a p-n junction diode for current under reverse bias and temperature and find band gap of semiconductor material.

Course Outcomes (COs):

- Learning of the measurement of the magnetic susceptibility, dielectric constant, trace hysteresis loop.
- They will also employ four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.
- Operation of measuring instruments and experimental apparatuses used in the solid-state physics lab, including necessary precautions.

Text Books

1. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited.
2. Advanced Practical Physics, Vol. 1, B. Ghosh, K.G. Majumdar, Shreedhar Publishers.

IPHY-T15
RADIATION SAFETY AND MEASUREMENTS

L	T	P	C
4	0	0	4

Course Objectives: The objective of course is to study the interaction of α, β, γ and neutrons with matter construction & working of various dosimeters and nuclear track detectors. Also they would be made aware of hazards of nuclear radiation & appropriate safety measures.

1. Ionizing Radiations and Radiation Quantities (10)

Types, sources and properties of ionizing radiation, fluence, energy fluence, kerma, exposure rate and its measurement - The free air chamber and air wall chamber, Absorbed dose and its measurement ; Bragg Gray Principle, Radiation dose units - REM, RAD, GRAY and SIEVERT dose commitment, dose equivalent and quality factor.

2. Radiation Measurements (10)

Pocket dosimeter, films, solid state dosimeters such as TLD, SSNTD, Track formation criteria, Mechanism of track formation and applications of SSNTDs, Proportional counter, GM counter, scintillation counter, Semiconductor Detectors and neutron detectors.

3. Radiation Effects and Protection (15)

Biological effects of radiation at molecular level, acute and delayed effects, stochastic and non stochastic effects, Relative Biological Effectiveness (RBE), Linear Energy Transformation (LET), Dose response characteristics. Permissible dose to occupational and non-occupational workers, maximum permissible concentration in air and water, safe handling of radioactive materials, The ALARA, ALI and MIRD concepts, single target, multi target and multi hit theories, Rad waste and its disposal.

4. Radiation Shielding (10)

Thermal and biological shields, shielding requirement for medical, industrial and accelerator facilities, shielding materials, radiation attenuation calculations-The point equation from a uniform plane source. The exponential point-Kernal. Radiation attenuation from a line and plane source.

Course Outcomes (COs): After passing the course Radiation Safety and measurement, the students will have the knowledge of Radiation safety and its protection and to develop a knowledge and understanding the effects of radiations in our everyday life.

Text Books:

1. Nuclear Reactor Engineering by . S. Glasstone and A. Sesonke ,Van Nostrand Reinhold.
2. Radiation Theory by Alison. P. Casart
3. Radiation Biology-Radiation Bio by A. Edward Profio /Prentice Hall.
4. Introduction to Radiological Physics and Radiation Dosimetry by F.H. Attix -Wiley-VCH.
5. G.F. Knoll, 'Radiation Detection and Measurement', 3rd Edn., John Wiley & SonsInc.,2000.

IPHY-T16
PHYSICS OF OPTOELECTRONICS

L	T	P	C
4	1	0	5

Course Objectives: To know the basics of solid state physics and understand the nature and characteristics of light. To learn the principle of optical detection mechanism in different detection devices.To studies the integration process and application of opto-electronic integrated circuits in transmitters and receivers. To understand the basic working mechanism of the devices, understand the governing equations to be able to perform calculations to characterize the performance of the devices and have the practical knowledge and an understanding of the trade-offs when using these devices in their respective applications.

1. Elements of light and Solid State Physics (15)

Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device, Introduction to energy bands and charge carriers in semiconductors, doping in semiconductors, Direct and indirect band gap semiconductors, electron-hole pair generation and recombination, non-radiative and radiative recombination in semiconductors

2. Optoelectronic Devices (18)

Principle of a photo-detector, construction and working of photodiode, Photodiodes, current and voltage in an illuminated junction, solar cells, photo-detectors, noise and bandwidth of photo-detectors, Light emitting diodes (LED), characteristics of LED, quantum efficiency of LED, advantages, and applications of LED, Population inversion at a junction, emission spectra of a pn junction, Semiconductor lasers, Photovoltaic effect, construction and working of solar cell, V-I characteristics of solar cell, conversion efficiency, fill factor, types of solar cells, applications of solar cells.

3. Microwave Devices (12)

Degenerate Semiconductors, tunnel diode operation, The gun-diode, the impatt diode, power devices, basic structure of pnpn diode, Semiconductor controlled rectifier.

Course Outcomes (COs):

Text Books

1. J.Wilson&J F B Hawkes, Opto Electronics: An Introduction, Prentice Hall of India, (2011),3rd ed.
2. RajpalS.Sirohi , Wave Optics and its Application, (2001),1st ed.
3. A Yariv , Optical Electronics/C.B.S. Collage Publishing, New York, (1985)
4. Pollock ,Fundamentals of OPTOELECTRONICS,(1994)
5. Solid State Electronic Devices, Ben G Streetman and Sanjay Banerjee, Pearson Education

IPHY-L8
SEMINAR AND REPORT WRITING

L	T	P	C
0	0	6	3

1. Students will learn how to write scientific report by knowing about:

1. Document classes: Different type of document classes, e.g., article, report, book etc.

2. Page Layout: Titles, Abstract, Chapters, Sections, subsections, paragraph, References, Equation references, citation.

5. Representation of mathematical equations Inline math, Equations, Fractions, trigonometric, logarithmic, exponential functions, line-surface-volume integrals with and without limits, closed line integral, surface integrals, Scaling of Parentheses, brackets etc.

6. Customization of fonts: Bold fonts, emphasis, math bf, math cal etc. Changing sizes Large, Larger, Huge, tiny etc.

7. Writing tables: Creating tables with different alignments, placement of horizontal, vertical lines.

8. Figures: Changing and placing the figures, alignments.

2. Students will be required to submit report and present seminar on a given topic.

ENVIRONMENT SCIENCE

L	T	P	C
2	0	0	2

Course Objectives: The objective of this paper is to provide basic concept of on Environment, Ecology, Natural Resources, Importance of biodiversity and need for their conservation along with various environmental issues and Govt. policies, and Environmental movements.

1. Introduction (6)

Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness. Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot Spots of biodiversity, Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

2. Environmental Pollution (6)

Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: Floods, earthquake, cyclone and landslides.

3. Social Issues and the Environment (6)

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

4. Human Population and the Environment (6)

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.

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 lectures)

Course Outcomes (COs):

- Learners will be able to understand environment science and its importance.
- Learners will understand the various types of pollution and hazards caused by them.
- Learners will understand ways to monitor environment and the various green technologies.
- Learners will know the various Acts enacted for the protection of the environment.

Text Books

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.

4.Cunningham,W.P.Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p.

5. De A.K., Environmental Chemistry, Wiley Eastern Ltd.

IPHY-T17
MATHEMATICAL PHYSICS-I

L	T	P	C
4	1	0	5

Course Objectives: The emphasis of course is to equip students with the mathematical tools required in solving problems interest to physicists. The course will develop understanding of the basic concepts underlying complex analysis and complex integration. This course will aim at introducing the concepts of special functions, linear partial differential equations by separation of variable method.

1. Elements of complex analysis (15)

Introduction to function of complex variables, Analytic function, Cauchy-Riemann conditions, Tailor and Laurent series expansion, singularity, Cauchy Integral theorem and formula, poles, residues, residue theorem, application of residues to evaluate real and definite integrals.

2. Differential Equations (10)

Linear differential equations with constant coefficients, Cauchy's homogeneous linear equation, Use of Partial differential equations in physics problems, Separation of variables.

3. Special Functions (15)

Dirac delta function, Gamma function, Beta function. Bessel function of first and second kind, Generating function, integral representation and recurrence relations for Bessel's functions of first kind, orthogonality. Legendre functions: generating function, recurrence relations and special properties, orthogonality, Associated parity.

Course Outcomes (COs)

Understand and use, advanced mathematical methods and theories on various mathematical and physical problems. Identify different special mathematical functions. Students will be able to: Think critically about the theories of physics. Think critically about the contribution of various scientists in the mathematical world.

Text Books

1. Mathematical Methods for Physicists: G. Arfken and H.J. Weber (Academic Press, San Diego).
2. Mathematical Physics: P.K. Chattopadhyay (Wiley Eastern, New Delhi).
3. Mathematical Physics : A.K. Ghatak, I.C. Goyal and S.J. Chua (MacMillan,India, Delhi).
4. Mathematical Methods in the Physical Sciences – M.L. Boas (Wiley, New York).
5. Special Functions : E.D. Rainville (MacMillan, New York).
6. Mathematical Methods for Physics and Engineering : K.F.Riley, M.P.Hobson and S.J. Bence
7. Advanced Mathematical Physics by Erwin Kreyszig

IPHY-T18
CLASSICAL MECHANICS

L	T	P	C
4	1	0	5

Course Objectives: Students will learn concepts of Lagrangian Formulation and Hamiltonian for different systems and will learn to apply these and understand canonical transformation, rigid body motion and concept of small oscillations.

1. **Lagrangian Formulation** **(10)**
   Mechanics of a system of particles; constraints of motion, generalized coordinates, D'Alembert's Principle and Lagrange's velocity- dependent forces and the dissipation function, Applications of Lagrangian formulation.

2. **Hamilton's Principles** **(10)**
   Calculus of variations, Hamilton's principle, Lagrange's equation from Hamilton's principle, extension to non-holonomic systems, advantages of variational principle formulation, symmetry properties of space and time and conservation theorems.

3. **Rigid Body Motion** **(12)**
   Independent co-ordinates of rigid body, orthogonal transformations, Eulerian Angles and Euler's theorem, infinitesimal rotation, Rate of change of a vector, Coriolis force, angular momentum and kinetic energy of a rigid body, the inertia tensor, principal axis transformation, Euler equations of motion, Torque free motion of rigid body, motion of a symmetrical top.

4. **Small Oscillations** **(5)**
   Eigen value equation, Free vibrations, Normal Coordinates, Vibrations of a tri atomic molecule.

5. **Hamilton's Equations** **(8)**
   Legendre Transformation, Hamilton's equations of motion, Cyclic-co-ordinates, Hamilton's equations from variation principle, Principle of least action.

6. **Canonical Transformation and Hamilton-Jacobi Theory** **(10)**
   Canonical transformation and its examples, Poisson's brackets, Equations of motion, Angular momentum, Poisson's Bracket relations, infinitesimal canonical transformation, Conservation Theorems. Hamilton-Jacobi equations for principal and characteristic functions.

Course Outcomes (COs): Students will understand Classical Mechanics in depth and will be able to apply concepts learned efficiently.The Students will have understanding of Langrangian and its applications in all cases. The difference between classical and quantum physics. Hamiltonian and its applications in all cases.

Text Books

1. Classical Mechanics: H. Goldstein, C.Poole and J.Safko (Pearson Education Asia, New Delhi).
2. Classical Mechanics of Particles and Rigid Bodies: K.C. Gupta (Wiley Eastern, New Delhi).
3. Analytical Mechanics : L.N. Hand and J.D. Finch (Cambridge University Press, Cambridge)
4. Mechanics: L.D. Landau and E.M. Lifshitz (Pergamon, Oxford).
5. Classical Mechanics: N.C. Rana and P.J. Joag (Tata McGraw Hill, New Delhi).

IPHY-T19
STATISTICAL MECHANICS

L	T	P	C
4	1	0	5

Course Objectives: Students will get acquainted with the concept of Statistical mechanics and Ensemble theory. They will also learn about quantum statistics. Students will understand various applications of these concepts.

1. **Review of Thermodynamics** **(7)**
   Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potentials, Phase equilibrium.

2. **The Statistical Basis of Thermodynamics** **(8)**
   The macroscopic and microscopic states, contact between statistics and thermodynamics, classical ideal gas, Gibbs paradox and its solution.

3. **Ensemble Theory** **(15)**
   Phase space and Liouville's theorem, the micro-canonical ensemble theory and its application to ideal gas of monatomic particles; The canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations, equipartition and virial theorems, a system of quantum harmonic oscillators as canonical ensemble, statistics of paramagnetism; The grand canonical ensemble and significance of statistical quantities, classical ideal gas in grand canonical ensemble theory, density and energy fluctuations.

4. **Quantum Statistics** **(7)**
   Quantum-mechanical ensemble theory: Density matrix, simple applications of density matrix. Symmetric and Antisymmetric Wavefunctions. Microcanonical ensemble of ideal Bose, Fermi and Boltzmann gases. Statistics of the occupation numbers

5. **Ideal Bose and Fermi Systems** **(8)**
   Ideal Bose systems: basic concepts and thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation, discussion of gas of photons (the radiation fields) and phonons (the Debye field); Ideal Fermi systems: thermodynamic behavior of an ideal Fermi gas, discussion of heat capacity of a free electron gas at low temperatures, Pauli paramagnetism.

Course Outcomes (COs): Students will understand Statistical Mechanics in depth and will be able to apply concepts learned efficiently.. Explain statistical physics and thermodynamics as logical consequences of the postulates of statistical mechanics. Apply the principles of statistical mechanics to selected problems. Apply techniques from statistical mechanics to a range of situations.

Sugested Books

1. Statistical Mechanics (2nd edition): R.K. Pathria (Butterworth-Heinemann, Oxford).
2. Statistical Mechanics: K. Huang (Wiley Eastern, New Delhi).
3. Statistical Mechanics: B.K. Agarwal and M. Eisner (Wiley Eastern, New Delhi).
4. Elementary Statistical Physics: C. Kittel (Wiley, New York).
5. Statistical Mechanics: S.K. Sinha (Tata McGraw Hill, New Delhi)
6. Statistical Physics by E S Rajagopal.

IPHY-T20
SEMICONDUCTORS AND ELECTRONIC DEVICES

L	T	P	C
4	1	0	5

Course Objectives: The major objective of the course is to develop a better understanding of semiconductor physics. To cultivate skills at formulating and solving physics problems. To develop familiarity with the physical concepts and to understand how a circuit works. Provide the student with different practical, intellectual and transferable skills.

1. **Semiconductors and Junction diodes (14)**
   Introduction to semiconductors, Drift and diffusion of carriers, Fermi level, Direct and indirect semiconductors, Photoconductors, Capacitance of p-n junctions, Varactors, Tunnel diode, Light emitting diodes, Metal-semiconductor junctions; Ohmic and rectifying contacts, FET as switch and amplifier, MOSFET, Enhancement and depletion mode. Introduction to CMOS, CMOS Capabilities and Limitations and CMOS Transistors as logic gates (*viz*. NOT, NAND and NOR etc.)

2. **Circuit Analysis Theorems (12)**
   Sources of electrical power, Voltage and Current sources, equivalence between voltage and current source, Thevenin and Norton theorems, maximum power transfer theorem (statement and proof), Delta star (Y) transformations.

3. **Operational Amplifier (17)**
   Operational amplifier, open loop op-amp, differential amplifier, inverting amplifier, non- inverting amplifier, voltage follower, difference and common mode gain, common mode rejection ratio. Input bias current, input offset current, input offset voltage, frequency response, slew rate, concept of feedback, Stability of operational amplifier.
   Operational Amplifier as: Summing, integrator and differential, Logarithmic and anti-logarithmic amplifiers, Current-to-voltage and Voltage-to-current converter, Comparators; Schmitt trigger and square wave generator. Sinusoidal Oscillators: Phase Shift, Wein bridge.

4. **Switching circuits and Power electronics (12)**
   Construction and Working of Silicon controlled rectifier (SCR) Diac, Triac, Unijunction Transistor (UJT) and their applications, Transistor multi-vibrators: astable, mono-stable and bistable multi-vibrators.

Course Outcomes (COs): Students will have knowledge of Basics of Semiconductor Physics, Basics of Diode, Transistor, Op-Amp. Students will be able to: Think critically about the theories of physics. Think critically about the contribution of various scientists in the electronic world.

Text Books

1. Semiconductor Devices - Physics and Technology by S.M. Sze(Wiley)
2. Linear and Non-linear Circuits by Chua, Desoer and Kuh(Tata McGraw)
3. Integrated Electronics by Millman and Halkias(Tata McGraw Hill)
4. Electronic devices and Circuit theory by Boylestad and Nashelsky(Preutice Hall).
5. OPAMPS and Linear Integrateed circuits by Ramakant A Gayakwad (Prentice Hall).
6. Electronic Principles by A.P. Malvino(Tata McGraw, New Delhi).
7. Principles of Electronics: V.K. Mehta and Shalu Mehta, S. Chand & Co. Ltd. New Delhi.

IPHY-T21
QUANTUM MECHANICS-1

L	T	P	C
4	1	0	5

Course Objectives: The major objective of the course is to develop a better understanding of Quantum Physics of sub atomic particles. To cultivate skills at formulating and solving physics problems. To develop familiarity with the physical concepts and mathematical methods of quantum mechanics.

1. **Introduction to Wave Mechanics and Quantum Behaviour** **(13)**
Wave equation and its general solution, Quantisation in wave mechanics and bound waves, the two-slit diffraction experiment, Particle/wave duality, The classical/quantum description of the state of a particle, the wave function and its interpretation, The cordinate and momentum representation of the quantum state, Fourier series and Fourier Transform, The wave equation in momentum space, The uncertainty principle.

2. **Formalism of Quantum Theory** **(14)**
The principle of superposition, Formation of wave-packet, Fourier analysis of wave-packet and its group velocity, Gaussian wave packet, probability current density, equation of continuity, Basic postulates of Quantum Mechanics, Probabilities in momentum and coordinate space, operator representation of dynamical variables, Hermitian operators and properties of eigen values and eigen functions of hermitian operators, expectation values and indeterminacies, Ehrenfest's theorem, Eigen value equation, Eigen value and eigen function, Ket Bra notation and Dirac delta function.

3. **Schrodinger equation and its applications** **(8)**
Hamiltonian operator andenergy eigenvalue equation, Time independent and time dependent schrodinger equation, particle in one dimensional box, the one dimensional simple harmonic oscillator, the hydrogen atom.

4. **Angular Momentum in Quantum Mechanics** **(10)**
Compatible and incompatible variables, commuting observables and simultaneous measurements, The angular momentum operators, commutation relations of angular momentum operators, Orbital angular momentum eigenfunctions and eigenvalues, the parity operator, The ladder operator method for the angular momentum spectrum, Electron spin, Pauli's spin matrices and their properties, Addition of two angular Momenta.

5. **Matrix Formulation** **(10)**
Alternative to Schrödinger's wave mechanics, the representation of the state of a particle in a discrete basis, the matrix representation for dynamical variables, eigenvalue equations in the matrix formulation, a spin half particle in a magnetic field.

Course Outcomes (COs): Students will be able to think critically about the theories of physics, Think critically about the contribution of various scientists in the quantum world. Identify the process of how spin of individual electron plays a crucial role in understanding the world of

microscopic bodies.

Text Books

1. E. Merzbacher, Quantum Mechanics.
2. R.P. Feynman, Feynman Lectures on Physics
3. Sara M. McMurry, Quantum Mechanics
4. L.I. Schiff, QuantumMechanics
5. J J. Sakurai,Modern Quantum Mechanics

IPHY-L9
SEMICONDUCTOR ELECTRONICS LAB

L	T	P	C
0	0	6	3

Course Objectives: The aim and objective of the courses on Physics Laboratory is to expose the students of M.Sc. to the experimental techniques in general Physics, analog electronics, and semiconductor devices so that they can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipments wherever necessary.This course aims to impart practical knowledge to students related to electronics.

Note : Students are expected to perform at least 8 experiments in one semester

I.

1. To trace I-V characteristic curves of diodes and transistors on a CRO, and learn their uses in electronic circuits.
2. Study of Zener regulator as voltage regulator.
3. To plot the input and output characteristics of CE configuration.
4. To Study the D C characteristics and applications of DIAC.
5. To study the D C characteristics and applications of SCR.
6. To study the D C characteristics and applications of TRIAC.
7. Investigation of the D C characteristics and applications of UJT.
8. Investigation of the D C characteristics of MOSFET.
9. Study of bi-stable, mono-stable and astable, multivibrators.
10. Study of Op-Amps and their applications such as an amplifier (inverting, non-inverting), scalar, summer, differentiator and integrator.
11. To determine the energy gap and resistivity of the semiconductor using four probe method.
12. To study temperature dependence of conductivity of a given semiconductor crystal using four-probe method and Vander Paw method.

Course Outcomes (COs): Students will have knowledge of electronic components like, Basics of Diode, Transistor, Op-Amp. Students will be able to know about the working of electronic instruments.

IPHY-T22
MATHEMATICAL PHYSICS-II

L	T	P	C
4	1	0	5

Course Objectives: The emphasis of course is to equip students with the mathematical tools required in solving problems interest to physicists. The course will develop understanding of the basic concepts underlying Fourier, Laplace analysis and group theory.

1. **Fourier Analysis** **(10)**
   Fourier series of periodic functions, even and odd functions, half range expansions and different wave forms, complex form of Fourier series and practical harmonic analysis. Fourier transforms of various standard functions.

2. **Laplace Analysis & Inverse Laplace Analysis** **(10)**
   Laplace transforms of various standard functions, properties of Laplace transforms and inverse Laplace transforms.

3. **Group theory** **(10)**
   Definition of a group, multiplication table, conjugate elements and classes of groups, direct product Isomorphism, homomorphism, permutation group, definition of the three dimensional rotation groups.

4. **Elementary Statistics** **(10)**
   Introduction to probability theory, random variables, Binomial, Poisson and Normal distributions, Central limit theorem.

Course Outcomes (COs): Understand and use theories on various mathematical and physical problems. Identify different special mathematical functions. Students will be able to: Think critically about the theories of physics.

Text Books

1. Mathematical Methods for Physicists: G. Arfken and H.J. Weber (Acad. Press,San Diego).
2. Mathematical Physics: P.K. Chattopadhyay (Wiley Eastern, New Delhi).
3. Mathematical Physics: A.K. Ghatak, I.C. Goyal and S.J. Chua (MacMillan,India,Delhi).
4. Mathematical Methods in the Physical Sciences M.L. Boas (Wiley, New York).
5. Special Functions: E.D. Rainville (Mac Millan, New York).
6. Mathematical Methods for Physics and Engineering : K.F.Riley, M.P.Hobson and S.J. Bence
7. Mathematical Physics: Satya Prakash (S. Chand & Sons).

IPHY-T23
CONDENSED MATTER PHYSICS -1

L	T	P	C
4	1	0	5

Course Objectives: This course aims to establish fundamental concepts in condensed matter physics, and applies the physics you have learned previously (in particular quantum mechanics, classical mechanics, electromagnetism and statistical mechanics) to these real-world materials. The structure and properties of solids including thermal and electrical properties are described in detail.

1. **Crystal Structure** **(12)**
   Crystals, Bravais lattice, symmetry operations and classification of Bravais lattices, Common crystal structures, Determination of crystal structure: X-ray diffraction, Bragg's law, qualitative idea of electron and neutron diffraction. Elastic strain and stress component. Elastic compliance and stiffness constants. Elastic constants of cubic crystals. Elastic waves in cubic crystals.

2. **Thermal properties of Crystal lattices** **(12)**
   Specific heat, lattices heat capacity, classical, Einstein and Debye theories of specific heat, Born's modification of the Debye theory, Thermal expansion.

3. **Free Electron Theory of metals** **(12)**
   Free electron gas model, Electrical conductivity of metals, Drift velocity and relaxation time, the Boltzmann transport equation. Drude and Lorentz theory, The Sommerfeld theory of conductivity, thermal conductivity, Widemann-Franz law, Hall effect.

4. **Magnetism** **(19)**
   Classification of magnetic materials, the origin of permanent magnetic dipoles, diamagnetic susceptibility, classical theory of Para magnetism, Quantum theory of Para magnetism, Quenching of orbital angular momentum, cooling by adiabatic demagnetization. Paramagnetic susceptibility of conduction electrons, Ferromagnetism, the Weiss molecular field, the interaction of the Weiss field, Ferromagnetic domains, Antiferro, Ferrimagnetism: The two sub lattice model, exchange interaction, Neel's theory of ferrimagnetisms
   Superconductivity: Critical field, Meissner effect, Types of superconductors, specific heat, London equations, penetration depth, BCS Theory, Tunneling phenomena, Josephson effect, Introduction to high temperature superconductors.

   Course Outcomes (COs): Students will have a basic knowledge of lattice specific heat and elastic constants. Understand the concept of point defects and be able to use it as a tool. Know the significance of grain boundaries. know the fundamental principles of mean free path in metals and qualitative discussion of the features of resistivity. know basic models of dipole theory and thermodynamics of ferroelectric ttransitions.

Text Books

1. C. Kittel, Introduction to Solid State Physics.
2. N.W. Ashcroft and N.D. Mermin, Solid State Physics.
3. A.J. Dekker, Solid State Physics.
4. M.P. Marder, Condensed Matter Physics.
7. B. D. Cullity, Elements of X-Ray Diffraction
8. R. L Sighal, Solid State Physics.

IPHY-T24
ATOMIC AND MOLECULAR PHYSICS

L	T	P	C
4	1	0	5

Course Objectives: Atoms and molecules are the fundamental units for all matters in the Universe. Whatever state of matter it is made of atoms. All the properties of matter are governed by the electronic structure of atoms and molecules. This course enlightens the knowledge of structure of atoms and molecules with various spectroscopic techniques.

One Electron Atom **(10)**

1. Vector model of a one electron atom, Quantum states of an electron in an atom, Hydrogen atom spectrum, Spin-orbit coupling, Relativistic correction, Hydrogen fine structure, Spectroscopic terms, Hyperfine structure.

Two valance Electron Atom **(10)**

2. Vector model for two valance electrons atom, LS coupling, Pauli exclusion principle, Interaction energy for LS coupling, Lande interval rule, jj coupling, and interaction energy for jj coupling.

3. Atom in Magnetic Field **(10)**

Zeeman effect, Magnetic moment of a bound electron, Magnetic interaction energy in weak field. Paschen-Back effect, Magnetic interaction energy in strong field.

4. Atom in Electric Field **(5)**

Stark effect, First order Stark effect in hydrogen.

5. Molecular Spectroscopy **(12)**

Rotational and vibrational spectra of diatomic molecule, Raman Spectra, Electronic spectra, Born-Oppenheimer approximation, Vibrational coarse structure, Franck-Condon principle, Rotational fine structure of electronic-vibration transitions.

6. Spin Resonance Spectroscopy **(8)**

Electron spin resonance and nuclear magnetic resonance spectroscopy.

Course Outcomes (COs): Students will learn About the structure of atom and molecules with various theoretical and experimental observations. Understand and explain basic concepts of different spectroscopic techniques to explore the physical and chemical properties of matter.

Text Books

1. White H. E., Introduction to Atomic Spectra, McGraw Hill (1934).
2. Banwell C. N. and McCash E. M., Fundamentals of molecular spectroscopy, Tata McGraw Hill (1994).

IPHY-T25
DIGITAL ELECTRONICS

L	T	P	C
4	1	0	5

Course Objectives: Use concept of Digital Principles for electronic conversions and demonstrates application of sequential circuits.

1. Number System and Binary Code (8)

Binary, Octal and Hexadecimal Number System (Conversion, Addition & Subtractions). Signed and unsigned numbers, Binary Subtractions using 1's and 2's compliment, ASCII code, Excess 3 code, Grey code, BCD code and BCD additions. Parity, Error Detection codes, Hammings Error correction code.

2. Minimization of logic function (8)

OR, AND, NOT, NOR, NAND, EX-OR, EX-NOR, Basic theorem of Boolean Algebra, Sum of Products and Product of Sums, canonical form, Minimization using K-map.

3. Combinational Circuits (8)

Combinational circuit design, Encoders, decoders, Adders, Sub tractors and Code converters. Parity checker, seven segment display, Magnitude comparators. Multiplexers, De-multiplexer, Implementation of Combinational circuit using MUX.

4. Sequential Circuits (10)

Introduction, flip flops, Clocked flip flops, SR, JK, D, T and edge triggered flip- flops. Excitation tables of Flip flops. Shift Registers, Type of Shift Registers, Counter, Counter types, counter design with state equation and state diagram

Course Outcomes (COs): Students will have knowledge of number system, logic functions and Basics of combinational and sequential circuits. Students will be able to think critically about the theories of digital physics.

Text Books

1. Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill
2. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.

IPHY-L10
DIGITAL ELECTRONICS LAB

L	T	P	C
0	0	6	3

Course Objectives: The aim and objective of the courses on Physics Laboratory II is to expose the students of M.Sc. to the experimental techniques in digital electronics, condensed matter physics and spectroscopy, so that they can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipments wherever necessary.

Note: Students are expected to perform at least 10 experiments in one semester.

I. 1. To study the use of digital to analog and analog to digital converter.
2. To study logic gates and flip flop (JK, RS and D) circuits using on a bread-board. 14. 8085 microprocessor kit – familiarization and introductory programming.
3. Study of Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates;
4. Realization of OR, AND, NOT and XOR functions using universal gates.
5. Realization Half Adder / Full Adder using Logic gates.
6. Realization Half Subtractor / Full Subtractor using Logic gates
7. Design 4-Bit Binary-to-Gray & Gray-to-Binary Code Converter.
8. Design 4-Bit magnitude comparator using logic gates. Multiplexer: Truth-table verification and realization of Half adder and Full adder using MUX.
9. Demultiplexer: Truth-table verification and realization of Half subtractor and Full subtractor using DEMUX.
10. Flip Flops: Truth-table verification of RS, JK , D, JK Master Slave Flip Flops.12
11. Design MOD-7 Synchronous up-counter using JK/RS/D Flip Flops.
12. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO & Shift left operations using IC7495 chip.

Course Outcomes (COs): Students will have knowledge of electronic components like gates, flip flop, register, adder, subtractor, counter etc. Students will be able to know about the working of electronic instruments.

Text Books

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. OP-Amps & Linear Integrated Circuit, R.A. Gayakwad, 4th Edn, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

IPHY-L11
NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

L	T	P	C
4	0	4	6

Course Objectives: The major objective of the course is to develop a better understanding of computational methods required to solve many physical problems.

Note: Regarding evaluation and paper setting of Numerical Analysis and Computer Programming

It has been decided that 40% weightage of practical class must be given in the internal awards on the basis of performance of students in the concerned lab and its exam thereof. Similarly, at least 20% weightage of practical class must be given while preparing the question paper for end semester exam i.e. there should be few questions based upon flow chart, how to develop logic and how to write a program etc.

1. **Methods of approximation and errors** **(2)**
   Truncation and round-off errors; Accuracy and precision.
2. **Roots of Equations** **(5)**
   Bisection method, False position method, Iteration methods (Newton Raphson). Systems of linear algebraic equations: inversion and LU decomposition methods. Gauss elimination method.
3. **Curve fitting** **(5)**
   Least squares regression, linear and nonlinear regressions.
4. **Interpolation Methods** **(5)**
   Interpolating polynomials. Newton's divided difference.
5. **Numerical differentiation and integration** **(5)**
   Trapezoidal and Simpson's rules.
6. **Ordinary differential equations** **(8)**
   Euler's method, Runge - Kutta methods. Boundary value and Eigen value problems. Partial differential equations: Numerical solution of Laplace's equation, Few applications.
7. **Fourier approximation** **(5)**
   Introduction, Discrete Fourier and Fast-Fourier Transforms.
8. **Computer Programming** **(10)**
   Some computer programs in suitable languages, based on above topics.

   Course Outcomes (COs): Students will be able to: Think critically about the theories of physics. Think critically about the contribution of various scientists in the Physical world.

Text Books

1. Shastry, S.S., "Numerical Methods", Prentice Hall Inc., India, 1998.
2. Richard L. Burden and J. Douglas Faires, Numerical Analysis , Brooks/Cole, C Learning
3. Noble Ben, "Numerical Methods", New York International Publications, New York, 1964.
4. Numerical Analysis with Algorithms and Programming; Santanu Saha, CRC press, 2016
5. Buckingham R.A., "Numerical Methods", Sir Isaac Pitman Sons. Ltd., London, 1957.
6. Uri M. Ascher and Chen Greif, A first Course in Numerical Methods SIAM, 2011.
7. Bakhvalov, N .S. "Numerical Methods", Mir. Pub., Moscow, 1977.
8.Numerical recipes in C++ or Fortran.

IPHY-T26
QUANTUM MECHANICS-II

L	T	P	C
4	1	0	5

Course Objectives: Quantum Mechanics-II is a basic continuation course in quantum mechanics that aims at the applications of quantum mechanics. The aim of the course is that the students acquire in-depth knowledge about the foundations of quantum mechanics, as well as skills in applying quantum mechanics in advanced problems.

1. **Perturbation Theory** **(12)**
   Time-independent perturbation theory, First order perturbations, Second order perturbations: anharmonic oscillator, Degenerate perturbation theory: spin-orbit coupling, the time dependent Schrodinger equation, Resonant transition between two energy states, Time dependent perturbation theory, Transition rates and Fermi golden rule.

2. **Relativistic Quantum Mechanics** **(12)**
   Basic notions of relativity and the Lorentz transformations, Klein Gordon equation, Lorentz transformation of spinors and the Dirac equation, The Dirac equation in the presence of an electromagnetic field and the magnetic moment.

3. **Elements of Scattering Theory** **(12)**
   Elastic scattering : elementary considerations on quantum theory of scattering in a given potential method of partial waves, the optical theorem, Born approximation, Low energy scattering and bound states, Scattering in a Coulomb field, scattering of identical particles and scattering of particles with spin, A brief overview of time dependent formulation of scattering. Inelastic collisions and the S matrix : a brief overview.

4. **Systems of Identical Particles** **(12)**
   Classical vs. quantum descriptions, Brief introduction to identical particles in quantum mechanics, Permutation operators and many body wave functions, Application to 2 -electron systems, Pauli exclusion principle, Bose Einstein and Fermi Dirac Statistics.

Course Outcomes (COs): Students will Learn about basic non-relativistic quantum mechanics. Study about the approximate methods for solving Schrödinger equations such as perturbation theory, variational method and Born approximations. Gain knowledge about relativistic quantum mechanics . Become familiar with the study of identical particles in quantum mechanics.

Text Books

1. Modern Quantum Mechnics: J.J. Sakurai-Pearson Educaton Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics: L I Schiff-Tokyo Mc Graw Hill, 1968.
3. Feynmann lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics: Powel and Craseman-Narosa Pub. New Delhi, 1961.
5. Quantum Mechanics: Merzbacher-John Wiley & Sons, New York, 197

IPHY-T27
CONDENSED MATTER PHYSICS-II

L	T	P	C
4	1	0	5

Course Objectives: Provide the student with a broad spectrum of physics courses. Develop the ability of the students to conduct, observe, analyzes and report an experiment. . Develop the ability of the students to deal with physical models and formulas mathematically. Provide the student with different practical, intellectual and transferable skills.

1. **Defects and Diffusion in Solids** **(15)**
   Point defects: Impurities, Vacancies- Schottky and Frankel vacancies, Color centers, F-centres, Line defects (dislocations), Edge and screw dislocations, Berger Vector, Slip, Planar (stacking) Faults, Grain boundaries, Low angle grain boundaries, the Hydration energy of ions, Activation energy for formation of defects in ionic crystals, Diffusion in solids, Classification of diffusion process, Ficks law, Factor affecting diffusion and applications, Kirkendal law interpretation of diffusion in alkali halides.

2. **Dielectric Properties of Solids** **(10)**
   Dielectrics and Ferroelectrics: Macroscopic field, The local field, Lorentz field. The Claussius-Mossotti relations, different contribution to polarization: dipolar, electronic and ionic polarisabilities, General properties of ferroelectric materials. The theories of ferroelectricity.

3. **Electronic Energy bands in Solids** **(10)**
   Wave functions in periodic potential and Bloch theorem, Kronig-Penney Model, E vs. K relations, Motion of electron in one dimension according to band theory, Crystal momentum, Concept of effective mass and hole. Distinction between metals, insulators and semiconductors, Brillouin zones, density of states, overlapping of energy bands.

4. **Optical Properties of Solids** **(10)**
   Dielectric function of electron gas, plasma frequency Plasmons, Excitons, Photoconductivity, influence of traps, Luminescence: excitation and emission, Efficiency of a phosphor, Decay mechanisms, Thermo-luminescence and glow curves, Electroluminescence.

Course Outcomes (COs): Students will: have a basic knowledge of crystal systems and spatial symmetries. Understand the concept of reciprocal space and be able to use it as a tool. know the significance of Brillouin zones. know the fundamental principles of semiconductors, including pn-junctions, and be able to estimate the charge carrier mobility and density.

Text Books

1. C. Kittel, Introduction to Solid State Physics.
2. N.W. Ashcroft and N.D. Mermin, Solid State Physics.
3. J.M. Ziman, Principles of the Theory of Solids.
4. A.J. Dekker, Solid State Physics.
5. G. Burns, Solid State Physics.

6. M.P. Marder, Condensed Matter Physics.
7. B. D. Cullity, Elements of X-Ray Diffraction
8. L V Azaroff, Introduction to Solids
9. R.L. Singhal, Solid State Physics.

IPHY-T28
NUCLEAR PHYSICS

L	T	P	C
4	1	0	5

Course Objectives: This course introduces students to the fundamental concepts and an overview of the development of nuclear and particle physics, the course builds on previous learning in quantum mechanics and electromagnetism to develop students' understanding of the properties of the strong and weak forces.

1. **Properties of Atomic Nucleus** **(15)**
   Theories of nuclear composition (proton-electron, proton-neutron), Binding Energy, Semi-empirical Mass Formula for nuclear stability, Quantum numbers of nucleons, Quantum properties of nuclear states, nuclear angular momentum, Nuclear Magnetic dipole moment, Electric quadrupole moment, potential well, quantum statistics.

2. **Nuclear Interactions** **(15)**
   Nuclear Forces: Two nuclear system, deuteron problem, proton-proton and proton-neutron scattering experiments at low energy, meson theory of nuclear forces, exchanges forces and tensor forces, effective range theory-spin dependence of nuclear forces-Charge independence and charge symmetry of nuclear forces-Isospin formalisim.

3. **Nuclear Models** **(15)**
   Bohr-Wheeler theory of fission, Experimental evidence for shell effects, Shell Model, Spin-Orbit coupling, Magic-Applications of Shell model like Angular momenta and parities of nuclear ground states, Quantitative discussion and estimates of transition rates-magnetic moments and Schmidt lines, Collective model, Nuclear vibrations spectra and rotational spectra, applications.

4. **Nuclear Reactions** **(10)**
   Direct and compound nuclear reaction mechanisms, cross sections in terms of partial wave amplitudes, Compound nucleus, scattering matrix, Reciprocity theorem, Breit Winger one level formula, Resonance scattering.

Course Outcomes (COs): Students will be able to Understand the various decay properties of unstable nuclei such as beta decay, gamma decay, and parity violation. .Compare different nuclear reaction mechanisms in relation to cross-sections, excitation functions and angular distributions.

Text Books

1. Roy R.R. & Nigam B.P., Nuclear Physics, New Age International Ltd (2001).
2. Preston M. A. and Bhaduri R. K., Structure of Nucleus Addision-Welsey (2000).
3. Pal, M.K., Theory of Nuclear Structure, East-West Press Delhi (1983).
4. Kaplan Irving Nuclear Physics, Narosa Publishing House (2000).
5. Tayal D. C., Nuclear Physics, Himalaya Publication home (2007)

6. Perkins D.H., Introduction to High Energy Physics, Cambridge University Press (2000).
7. Hughes I.S., Elementary Particles, Cambridge University Press (1991).
8. Close F.E., Introduction to Quarks and Partons, Academic Press (1979).
9. Segre E., Nuclei and Particles, Benjamin-Cummings Pub. Co. (1997).
10. Khanna M.P., Introduction to Particle Physics, Prentice Hall of India Pvt. Ltd (2004).
11. G.N. Ghoshal, Nuclear Physics , S. Chand (2014).

IPHY-T29
CLASSICAL ELECTRODYNAMICS

L	T	P	C
4	1	0	5

Course Objectives: The major objective of the course is to make the students familiar with the vast implications of Electricity and Magnetism to cultivate skills at formulating and solving physics problems. To develop familiarity with the physical concepts and mathematical methods of electrodynamics.

1. Boundary Value Problems (11)

Uniqueness Theorem, Dirichlet or Neumann Boundary conditions, Green's Theorem, Formal solution of Electrostatic & Magnetostatic Boundary value problem, Method of images with examples.

2. Time Varying Fields and Maxwell Equations (10)

Faraday's Law of induction, Displacement current, Maxwell equations, scalar and vector potentials, Gauge transformation, Lorentz and Coulomb gauges, General Expression for the electromagnetic fields energy, Poynting's Theorem.

3. Electromagnetic Waves (14)

Wave equation, Plane waves in free space and isotropic dielectrics, Polarization, Energy transmitted by a plane wave, Waves in conducting media, Skin depth. Reflection and Refraction of electromagnetic waves at plane surface between dielectrics, Fresnel's amplitude relations. Reflection and transmission coefficients, Polarization by reflection and total internal reflection.

4. Wave Guides (10)

Field at the surface of and within the conductor, Wave guides, TE, TM and TEM waves, Energy flow and attenuation in wave guides, Cavity resonators and Power loss in cavity and quality factor.

5. Radiation Systems (10)

Fields of radiation of a localized oscillating source, Electric & Magnetic dipole fields and electric quadrupole fields, Centre fed linear antenna, Introduction to radiation damping and radiation reaction.

Course Outcomes (COs): Students will uunderstand how a wave propagates in wave guides, understand relativistic formulation of electrodynamics, understand the theory of field of moving charges.

Text Books

1. Jordan E. C. and Balmain K. G., Electromagnetic Wave and radiating systems, Prentice Hall India Ltd. (1997).
2. Griffiths D.J., Introduction to Electrodynamics, Prentice Hall (1998).
3. Jackson J.D., Classical Electrodynamics, Wiley Eastern (1999).
4. Puri S.P., Classical Electrodynamics, Tata McGraw Hill (1999).

IPHY-L12
NUCLEAR PHYSICS LAB

L	T	P	C
0	0	6	3

Objectives: The aim and objective of the courses on Physics Laboratory II is to expose the students of M.Sc. to the experimental techniques in condensed matter physics and nuclear physics, so that they can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipments wherever necessary.

1. 1. To determine the dead time of given G. M Counter.
2. To study the statistical fluctuations of background counts in a G. M. Counter.
3. To determine the absorption coefficient of Pb and Fe for gamma rays using G. M.Counter.
4. To determine the energy of a pure beta-emitter using G.M. Counter and Al absorbers.
5. To study the energy resolution of Cs137.
6. To identify the unknown gamma source using energy calibration.
7. To study time regulation of gamma – ray coincidence set-up
8. To study anisotropy of gamma-ray for 60Co using coincidence set-up
9. To study energy resolution and calibration of a gamma-ray spectrometer using multichannel analyzer.
To study time resolution and calibration of a coincidence set-up using a multi-channel analyzer.

Course Outcomes (COs): The student will be able to carry out experimental work using GM counter in the field of radiation shielding and radioactive analysis of various materials. Understand the interaction of beta particles, alpha particles and gamma ray with matter. Students can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipments.

IPHY-T30
PHYSICS OF NANOMATERIALS

L	T	P	C
4	1	0	5

Course Objectives: The program focuses on the foundation knowledge of the nanoscience and related fields and acquiring an understanding of Nanoscience and Nanotechnology and its applications.

1. Nanostructures (15)

Free electron theory and its features, Idea of band structure - metals, insulators and semiconductors. Density of states for solids, Nanomaterials, Quantum Confinement: How small?, Electron confinement in infinitely deep square well, Surface area to volume ratio, Nanostructures; Quantum well, Quantum wire, Quantum Dots, Density of states for various quantum structures, Interacting quantum dots, Superlattice, Effect of size on energy band gap of semiconductors, excitons, Confining excitons,.

2. Preparation Techniques (7)

Bottom up: Ion implantation technique, Co-precipitation method, Chemical bath deposition; Top down: Ball Milling, Lithography techniques.

3. Carbon Nanotubes and metal nanoparticles (15)

Carbon allotropes, Carbon nanostructures (carbon nanotubes) and its synthesis, mechanism of growth, Properties and applications of Carbon nanotubes, Nanosized metal particles and metal to insulator transition, Optical properties of metal nanoparticles: Surface plasmon resonance (SPR), Interaction of metal nanoparticles with electromagnetic radiation.

4. Size Characterization Techniques (8)

X-ray diffraction, Determination of particle size using XRD, Study of texture and microstructure, Strain and Size effects on XRD peaks, X-ray diffraction peaks for bulk and its nanoparticles.

Course Outcomes (COs): After completing course students will be able to understand the synthesis of nanomaterials and their applications and the impact of nano-materials and will be able to apply their knowledge to develop Nanomaterials.

Text Books

1. Chow G-M & Gonsalves K.E., Nanotechnology - Molecularly Designed Materials, American Chemical Society.
2. Jain K.P., Physics of Semiconductor Nanostructures, Narosa Publishing House (1997).
3. Cao, G., Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Emperial College Press (2004).

IPHY-T31
SYNTHESIS AND CHARACTERIZATION OF MATERIALS

L	T	P	C
4	1	0	5

Course Objectives: The syllabus introduces the basic concepts and principles to understand various synthesis/growth methods of materials of bulk and nano size as well as thin film fabrication methods. The course is also providing basic understanding of characterization techniques to study electrical, optical and structural, electronic and magnetic properties of materials to explore the field in detail.

I. Synthesis of Materials (10)

Bulk Synthesis: Solid state reaction method, sol gel method, chemical co- precipitation method. Film deposition methods: Physical vapor deposition, Chemical vapor deposition, Spray pyrolysis, sputtering (RF, DC); pulsed laser deposition (PLD), Spin coating technique.

II. Microscopic Techniques (8)

Transmission electron microscopy (TEM), Scanning electron microscopy (SEM); scanning tunneling microscopy (STM); Atomic force microscopy (AFM).

III. Spectroscopic Techniques (12)

Diffraction techniques: X-ray diffraction, data manipulation of diffracted X-rays for structure determination; X-ray fluorescence spectrometry for element detection with concentration; Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS). FTIR, UV-Visible spectroscopy.

IV. Electrical and Magnetic Characterization Techniques (10)

Electrical resistivity, Dielectric properties measurements, Hall effect, Magnetic characterization by measuring Magnetization viz. M-H loop, temperature dependent magnetization, time dependent magnetization, Measurements using AC susceptibility by Force and Induction method using Vibrating Sample magnetometer(VSM) and introduction to Superconducting Quantum Interference Device (SQUID).

Course Outcomes (COs): After completing course students will be able to understand the methods and basics of instrumentation used in synthesis of materials and thin film fabrication as well as characterization techniques to analyse the various physical properties of materials.

Text Books

1. Thin Film Phenomena: K.L. Chopra-Mc Graw Hill Book, Comp., 1979.
3. Material Science and Engg :W.D. Callister-John Wiley, 2001
4. Elements of X-ray Diffraction (3rd edition) : B.D. Cullity, S.R. Stock-Prentice Hall, 2001.
5. X-ray Fluorescence spectroscopy: R. Jenkins-Wiley Interscience, New York, 1999.
7. The Principles and Practice of Electron Microscopy: Ian M. Watt-Cambridge Uni. Press, 1997

8. Modern techniques for surface science: D.P. Woodruff and T.A. Delchar- Cambridge University Press, 1994.

11. "*Vacuum Technology*", 1983, A. Roth, Pergamon Press (Oxford).

13. "Low-temperature Physics: an introduction for scientists and engineers, "1992, P V E McClintock, D J Meredith and J K Wigmore, Blackie (Glasgow).

IPHY-L13
ADVANCED MATERIAL SCIENCE LAB

L	T	P	C
0	0	6	3

Course Objectives: The objective of the course is to expose the students to the experimental techniques in general Physics, so that they can co-relate the theoretical concepts with the experimental ones and develop confidence to handle sophisticated equipment.

1. Students will learn the synthesis of materials using different techniques like solid state reaction method, chemical route etc.

2. Students will also get hand on experience on sophisticated instruments (muffle furnace, LCR meter, FTIR, UV-Vis., Four probe, TLD reader etc.) and collect and analysis of acquired data to explore underlying physical properties of materials.

Text Books

.1 The Principles and Practice of Electron Microscopy: Ian M. Watt-Cambridge Uni. Press, 1997
2. Thin Film Phenomena: K.L. Chopra-Mc Graw Hill Book, Comp., 1979.
3. Material Science and Engg :W.D. Callister-John Wiley, 2001
4. Elements of X-ray Diffraction (3rd edition) : B.D. Cullity, S.R. Stock-Prentice Hall, 2001.

IPHY-MD
DISSERTATION

L	T	P	C
0	0	5	10

Course Objectives: Dissertation involves project work with the intention of exposing the student to research /development. It involves open ended learning based on student ability and initiative, exposure to scientific writing and inculcation of ethical practices in research and communication.

1. Experimental Methodology: Students will learn how to design a problem and write hypothesis, set up and perform experiments, analysis of obtained results, drawing inferences and conclusions, which will be followed by a detailed report of outcomes.

2. Students will be required to perform detailed study on a problem in one of the following fields:

· Experimental Physics

· Theoretical Physics

In all, it will be a collaborative work to perform experimental/theoretical work and to prepare final report, may involve a maximum of 05 students in each group. The final evaluation will comprise of pre-submission seminar for Internal Evaluation and final presentation of results for External Evaluation.

3. The report must have minimum three chapters namely (1) Introduction, (2) the main work including theoretical /experimentation and Results, and (3) Discussion and Conclusion. At the end adequate references must be included. Plagiarism should be avoided by the student.

Course Outcomes (COs):

- Exposure to research methodology
- Picking up skills relevant to dissertation/project
- Development of creative ability and intellectual initiative
- Developing the ability for scientific writing
- Becoming conversant with ethical practices in acknowledging other sources, avoiding.

Text Books: As suggested by the student's supervisor pertaining to work assigned.