B.Sc (HONS.) PHYSICS: It is an Under Graduate (UG) programme in Physics of 03 years (6 semesters) duration and is in accordance with UGC Choice Based Credit System (CBCS).

ELIGIBILITY FOR ADMISSION: Should have passed 10+2 examination with at least 50% marks with English, Physics, Chemistry, Mathematics / Biology

COURSE STRUCTURE: As per the UGC guidelines, UG degree with Honours in Physics includes Core Courses (CC), Ability Enhancement Compulsory Courses (AECC), Discipline Specific Electives (DSE), Generic Electives (GE), Skill Enhancement Courses (SEC) and Non Credit Courses (NCC). On the basis of these guidelines, the course structure for B.Sc. (Hons.) Physics has been designed as detailed below.ics

Sem.	Course Type						Marks	Credits
	CC	DSE	GE	SEC	AECC	NCC		
I	2	0	2	1	1		900	25
II	2	0	2		1	1	900	23
III	3	0	2				900	27
IV	3	0	1			1	800	21
V	2	2	0	1			800	26
VI	2	2	0				600	24
Total	**14**	**4**	**7**	**2**	**2**	**2**	**4900**	**146**

STUDY SCHEME

1st Semester			Contact Hrs.			Marks			Credits
Subject Code	**Course Type**	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BHSMC0-042	AECC-I	Communicative English	2	0	0	40	60	100	2
BMATH5-101	GE-I	Mathematics-I	3	1	0	40	60	100	4
BMATH5-102		Basic Mathematics-I*							
BPHYS1-101	CC-I	Electricity and Magnetism	4	0	0	40	60	100	4
BPHYS1-102	CC-II	Mechanics	4	0	0	40	60	100	4
BCHMS1-101	GE-II	Inorganic Chemistry – I	4	0	0	40	60	100	4
BPHYS1-104	CC-I Lab	Electricity and Magnetism Lab	0	0	4	60	40	100	2
BPHYS1-106	CC-II Lab	Mechanics Lab	0	0	4	60	40	100	2
BCHMS1-103	GE-II Lab	Inorganic Chemistry – I Lab	0	0	2	60	40	100	1
BPHYS1-108	SEC-I	Computational Physics Skills	0	0	4	60	40	100	2
		Total	**-**	**-**	**-**	**440**	**460**	**900**	**25**

*Students from Medical stream will study Basic Mathematics – I and Students from Non Medical stream will study Mathematics – I

2nd Semester			Contact Hrs.			Marks			Credits
Subject Code	**Course Type**	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BHSMC0-041	AECC-II	Environmental Sciences	3	0	0	40	60	100	3
BMATH5-201	GE-III	Mathematics-II	3	1	0	40	60	100	4
BMATH5-202		Basic Mathematics-II*							
BPHYS1-201	CC-III	Thermal Physics	4	0	0	40	60	100	4
BPHYS1-202	CC-IV	Waves and Optics	4	0	0	40	60	100	4
BCHMS1-201	GE-IV	Organic Chemistry – I	4	0	0	40	60	100	4
BPHYS1-204	CC-III Lab	Thermal Physics Lab	0	0	4	60	40	100	2
BPHYS1-205	CC-IVLab	Waves and Optics Lab	0	0	4	60	40	100	2
BCHMS1-203	GE-IVLab	Organic Chemistry – I Lab	0	0	2	60	40	100	1
#BMNCC0-041	NCC-I	Drug Abuse: Problem, Management and Prevention	2	0	0	100	--	100	-
Total			**-**	**-**	**-**	**420**	**480**	**900**	**24**

*Students from Medical stream will study Basic Mathematics–II and Students from Non Medical stream will study Mathematics-II
#Will be implemented from 2021 Batch onwards

3rd Semester			Contact Hrs.			Marks			Credits
Subject Code	**Course Type**	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BMATH5-301	GE-V	Mathematics-III	3	1	0	40	60	100	4
BPHYS1-301	CC-V	Analog System and Applications	4	0	0	40	60	100	4
BPHYS1-302	CC-VI	Elements of Modern Physics	4	0	0	40	60	100	4
BPHYS1-303	CC-VII	Quantum Mechanics and Applications	4	0	0	40	60	100	4
BCHMS1-102	GE-VI	Physical Chemistry- I	4	0	0	40	60	100	4
BPHYS1-305	CC-V Lab	Analog System and Applications Lab	0	0	4	60	40	100	2
BPHYS1-306	CC-VI Lab	Elements of Modern Physics Lab	0	0	4	60	40	100	2
BPHYS1-307	CC-VII Lab	Quantum Mechanics Lab	0	0	4	60	40	100	2
BCHMS1-104	GE-VI Lab	Physical Chemistry - I Lab	0	0	2	60	40	100	1
		Total	-	-	-	**440**	**460**	**900**	**27**

4Th Semester			Contact Hrs.			Marks			Credits
Subject Code	**Course Type**	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BMATH5-401	CC-VIII	Mathematics-IV	3	1	0	40	60	100	4
BPHYS1-401	CC-IX	Digital System and Applications	4	0	0	40	60	100	4
BPHYS1-402	CC-X	Solid State Physics	4	0	0	40	60	100	4
BCHMS1-202	GE-VII	Physical Chemistry- II	4	0	0	40	60	100	4
BPHYS1-404	CC-IX Lab	Digital System and Applications Lab	0	0	4	60	40	100	2
BPHYS1-405	CC-X Lab	Solid State Physics Lab	0	0	4	60	40	100	2
BCHMS1-204	GE-VII Lab	Physical Chemistry II Lab	0	0	2	60	40	100	1
BMNCC0-001	NCC-II	Constitution of India	2	0	0	60	40	100	
Total			**-**	**-**	**-**	**400**	**400**	**800**	**21**

5Th Semester			Contact Hrs.			Marks			Credits
Subject Code	**Course Type**	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BPHYS1-501	CC-XI	Mathematical Physics – I	4	2	0	40	60	100	6
BPHYS1-502	CC-XII	Statistical Mechanics	4	0	0	40	60	100	4
BPHYS1-503	CC-XII Lab	Statistical Mechanics Lab	0	0	4	60	40	100	2
BPHYS1-504	SEC-II	Basic Instrumentation Skills	0	0	4	60	40	100	2
Departmental Elective – I (Select any One Subject and Corresponding Lab with total Six Credit)									
BPHYD1-511	DSE-I	Experimental Techniques	4	0	0	40	60	100	4
BPHYD1-512		Experimental Techniques Lab	0	0	4	60	40	100	2
BPHYD1-513		Nano Materials and Applications	4	0	0	40	60	100	4
BPHYD1-514		Nano Materials and Applications Lab	0	0	4	60	40	100	2
BPHYD1-515		Communication System	4	0	0	40	60	100	4
BPHYD1-516		Communication System Lab	0	0	4	60	40	100	2
Departmental Elective – II (Select any One Subject of Six Credit)									
BPHYD1-521	DSE-II	Nuclear and Particle Physics	4	0	0	40	60	100	4
BPHYD1-522		Nuclear and Particle Physics Lab	0	0	4	60	40	100	2
BPHYD1-523		Physics of the Earth	4	2	0	40	60	100	6
BPHYD1-524		Biological Physics	4	2	0	40	60	100	6
Total			-	-	-	**400**	**400**	**800**	**26**

6Th Semester			Contact Hrs.			Marks			Credits
Subject Code		**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BPHYS1-601	CC-XIII	Mathematical Physics – II	4	2	0	40	60	100	6
BPHYS1-602	CC-IV	Electromagnetic Theory	4	0	0	40	60	100	4
BPHYS1-603	CC-IV Lab	Electromagnetic Theory Lab	0	0	4	60	40	100	2
Departmental Elective – III (Select any One Subject of Six Credit)									
BPHYD1-611	DSE-III	Classical Dynamics	4	2	0	40	60	100	6
BPHYD1-612		Astronomy and Astrophysics	4	2	0	40	60	100	6
BPHYD1-613		Applied Dynamics	4	2	0	40	60	100	6
Departmental Elective – IV (Select any One Subject and Corresponding Lab with total Six Credit)									
BPHYD1-621	DSE-IV	Medical Physics	4	0	0	40	60	100	4
BPHYD1-622		Medical Physics Lab	0	0	4	60	40	100	2
BPHYD1-623		Physics of Devices and Communication	4	0	0	40	60	100	4
BPHYD1-624		Physics of Devices and Communication Lab	0	0	4	60	40	100	2
BPHYD1-625		Atmospheric Physics	4	0	0	40	60	100	4
BPHYD1-626		Atmospheric Physics Lab	0	0	4	60	40	100	2
BPHYD1-627		Digital Signal Processing	4	0	0	40	60	100	4
BPHYD1-628		Digital Signal Processing Lab	0	0	4	60	40	100	2
		Total	-	-	-	**280**	**320**	**600**	**24**

Drug Abuse: Problem, Management and Prevention and Introduction and Constitution of India are non-credit courses; however, it is necessary to secure at least E grade in each.

COMMUNICATIVE ENGLISH

Subject Code: BHSMC0-042 **L T P C** **Duration: 30 Hrs.**
2 0 0 2

UNIT-I (8 Hours)

Communication Skills: Introduction, Definition, the Importance of Communication,
The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context
Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

UNIT-II (7 Hours)

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment.
Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

UNIT-III (7 Hours)

Communication Styles: Introduction, The Communication Styles Matrix with example for each Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.
Basic Listening Skills: Introduction, Self-Awareness, Active Listening, becoming an Active Listener, Listening in Difficult Situations

UNIT-IV (8 Hours)

Interview Skills: Purpose of an interview, Do's and Don'ts of an interview
Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery
Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion.

Recommended Text Books / Reference Books:

1. Ruther Ford A. J., 'Basic Communication Skills for Technology', 2nd Edition, Pearson Education, 2011.
2. Kumar S. and Pushplata, 'Communication Skills', 1st Edition, Oxford Press, 2011.
3. Stephen P. Robbins, 'Organizational Behaviour', 1st Edition, Pearson, 2013.
4. Gill H., 'Brilliant-Communication Skills', 1st Edition, Pearson Life, 2011.
5. Gopalawamy R., 'The Ace of Soft Skills: Attitude, Communication and Etiquette for Success', 5th Edition, Pearson, 2013.
6. Dalley D., Burton L. and Margaret G., 'Developing your Influencing Skills', Green Hall, 1 st Edition, Universe of Learning LTD,2010.

7. Konarnira, 'Communication Skills for Professionals', 2nd Edition, PHI, 2011.
8. Mitra B. K., 'Personality Development and Soft Skills', 1st Edition, Oxford Press, 2011.
9. 'Soft Skill for Everyone', Butter Field, 1stEdition, Cengage Learning India Pvt. Ltd., 2011. 10. Francis Peters S.J., 'Soft Skills and Professional Communication', 1st Edition, McGraw HillEducation, 2011.
11. John A., 'Effective Communication', 4th Edition, Pan MacMillan, 2009.
12. Aubrey D., 'Bringing out the Best in People', 2nd Edition, McGraw Hill,1999

MATHEMATICS-I

Subject Code: BMATH5-101 **L T P C** **3 1 0 4** **Duration: 60 Hrs.**

Course Objective: To introduce concept of matrices, vector calculus vector integration and differentiation.
Course Outcome: The students will be able to use and solve the problems related to matrices, vector calculus vector integration and differentiation.

UNIT-I (15 Hours)

Algebra of matrices, Inverse and rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II (14 Hours)

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar triple product and their interpretation in terms of area and volume respectively, Scalar and Vector fields.

UNIT-III (16 Hours)

Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities.

UNIT-IV (15 Hours)

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems (Without proofs) and their applications.

Recommended Text Books / Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
3. Murray R. Spiegel, Vector Analysis, Schaum publishing Company, New York.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
6. Peter Baxandall , Hans Liebeck , 'Vector Calculus', Dover Publications; 2008 edition.

BASIC MATHEMATICS-I

Subject Code: BMATH5-102 **L T P C** **Duration: 60 Hrs.**
3 1 0 4

Course Objective: To introduce concept of limits and continuity, differentiation, integration, tracing of curves and application of definite integrals.
Course Outcome: The student will be able to solve the problems related to concept of limits and continuity, differentiation, integration, tracing of curves and application of definite integrals.

UNIT-I (15 Hrs.)

Basic concept of limit and continuity, Properties of limit and classification of discontinuities, Properties of continuous functions, Differentiability and differentials, Successive differentiation and Leibnitz theorem, Derivatives of higher order, nth derivative of well-known functions.

UNIT-II (13 Hrs.)

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x , log(l+x), $(l+x)^m$, Maxima and Minima, Indeterminate forms, Curvature, Asymptotes, Singular points, Tracing of curves, tracing of curves in polar and Parametric forms.

UNIT-III (16 Hrs.)

Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, properties of definite integral.

UNIT-IV (16 Hrs.)

Applications of Definite Integrals, Plane Area, Arc Length, Areas between Curves, Centroids, Moments of Inertia, Volumes, Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic function and of their combinations.

Recommended Text Books / Reference Books:

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
3. Zafar Ahsan: Differential Equations and Their Applications, Second Edition, PrenticeHall of India Private Limited, New Delhi.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Erwin Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

ELECTRICITY AND MAGNETISM

Subject Code: BPHYS1-101 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To provide a detailed knowledge of basic concept of electricity and magnetism.
Course Outcomes: After completion of the course, student will be able to understand and handle the problems related with electricity and magnetism.

UNIT-I (15 Hours)

Electric Field and Electric Potentials

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor.

UNIT-II (15 Hours)

Magnetic Field and Electric Potentials

Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements.

UNIT-III (15 Hours)

Dielectric and Magnetic Properties of Matter

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

UNIT-IV(15 Hours)

Electromagnetic induction and Electric circuits

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and Band Width. Parallel LCR Circuit. Network theorems: Ideal Constant-voltage and Constant-current Sources. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem.

Recommended Text Books / Reference Books:

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

MECHANICS

Subject Code: BPHYS1-102 | **L T P C** **4 0 0 4** | **Duration: 60 Hrs.**

Course Objective: To understand the concept of Dynamics, Motion under Central Forces, Oscillations and special theory of relativity.

Course Outcomes: The student will be able to analyze and solve a multi level problem in mechanics.

UNIT-I(16 Hours)

Fundamentals of Dynamics

Review of Newton's Laws of Motion. Momentum of variable mass system: motion of rocket. Motion of a projectile in uniform gravitational field. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

UNIT-II(14 Hours)

Gravitation and Central Force Motion

Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.

UNIT-III(15 Hours)

Oscillations

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

UNIT-IV(15 Hours)

Special Theory of Relativity

Reference frames. Inertial frames, Galilean transformations; Galilean invariance, Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect.

Recommended Text Books / Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, Vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. Physics of Waves and Oscillations,H. J. Pain, (Wiley, 2005).
6. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
7. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

INORGANIC CHEMISTRY-I

Subject Code: BCHMS1-101 **L T P C** **Duration: 60 Hrs.**
40 0 4

Course Objectives

1. To familiarize with atomic structure, quantum numbers and shapes of orbitals
2. To understand periodic table and periodicity of elements
3. To understand the concept of various bonding theories
4. To understand importance of redox reactions

Course Outcome:

The completion of this course will make student to acquire the knowledge of:

1.wave mechanics, atomic theories and shapes of orbitals
2. periodic table and various periodic properties
3. ionic bond, covalent bond, metallic bond and various weak chemical forces
4. redox reactions and applications of redox reactions

UNIT-I(14 Hours)

Atomic Structure

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

UNIT-II(16 Hours)

Periodicity of Elements

s, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* &*p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT-III(12 Hours)

Chemical Bonding I

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

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

UNIT-IV(18Hours)

Chemical Bonding II

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

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

Oxidation-Reduction:Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Recommended Text Books / Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.
3. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

ELECTRICITY AND MAGNETISM LAB

Subject Code: BPHYS1-104	L T P C 0 0 4 2	Duration: 60 Hrs.

Course Objective: To learn practically the various concepts of electricity and magnetism. The course will provide hand on training to the students for handling various electrical instruments.

Course Outcome: The completion of this course will make student confident to handle practically the various concepts of electricity and magnetism.

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

MECHANICS LAB

Subject Code: BPHYS1-106 | **L T P C** **0 0 4 2** | **Duration: 60 Hrs.**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To learn practically the various concepts of mechanics. The course will provide hand on training to the students for handling various mechanical instruments.

Course Outcome: The completion of this course will make student confident to handle practically the various concepts of mechanics.

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) acceleration due to gravity (g) and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine g and velocity for a freely falling body using Digital Timing Technique.
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

INORGANIC CHEMISTRY-I LAB

Subject Code: BCHMS1-103	**L T P C**	**Duration: 30 Hrs.**
	0 0 2 1	

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To familiarize with solution preparation.
3. To understand acid-base and oxidation reduction titrimetry.

Course Outcomes: The students will acquire knowledge of:

1. Preparation of solutions
2. Estimation of carbonates, bicarbonates and free alkalis in solution with acid base titrations
3. Estimation of Fe(II) and oxalic acid with oxidation reduction titrimetry

Experiments

(A) Titrimetric Analysis
(i) Calibration and use of apparatus
(ii) Preparation of solutions of different Molarity/Normality of titrants
(B) Acid-Base Titrations
(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents
(C) Oxidation-Reduction Titrimetry
(i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference Book
Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

COMPUTATIONAL PHYSICS SKILLS

Subject Code: BPHYS1-108	L T P C 0 0 4 2	Duration: 60 Hrs.

Course Objective: To learn the basics to computation physics and FORTRAN programming language.
Course Outcomes: After the completion of the course the students will be able to handle the problems related with the physics using Fortran Programming.

Introduction
Importance of computers in Physics, paradigm for solving physics problems for solution. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.
Scientific Programming
Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic.
Control Statements
Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of

Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines.

Visualization

Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data.

Programming:

1. To print out all natural even/ odd numbers between given limits.
2. To find maximum, minimum and range of a given set of numbers.
3. Calculating Euler number using exp(x) series evaluated at x=1.
4. To compile a frequency distribution and evaluate mean, standard deviation etc.
5. To evaluate sum of finite series and the area under a curve.
6. To find the product of two matrices
7. To find a set of prime numbers and Fibonacci series.
8. To write program to open a file and generate data for plotting using Gnuplot.
9. Plotting trajectory of a projectile projected horizontally.
10. Plotting trajectory of a projectile projected making an angle with the horizontally.
11. To find the roots of a quadratic equation.
12. Motion of a projectile using simulation and plot the output for visualization.
13. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
14. Motion of particle in a central force field and plot the output for visualization

Reference Books

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
3. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
4. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
5. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi (1999)
6. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning

ENVIRONMENTAL SCIENCES

Subject Code: BHSMC0-041 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Unit-I (08 Hours)

The Multidisciplinary nature of environmental studies, Natural Resources: Renewable and non-renewable resources

Unit-II (15 Hours)

Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-III (12 Hours)

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Introduction, types, characteristic features of the ecosystems (a) Forest ecosystem (b) Grassland ecosystem (c) (d) Desert ecosystem (e) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit- IV (10 Hours)

Environmental Pollution: Air pollution; Water pollution; Soil pollution

<u>Recommended Books:</u>

1. J.G. Henry and G.W. Heinke, 'Environmental Sc. & Engineering', Pearson Education, **2004**.

2. G.B. Masters, 'Introduction to Environmental Engg. & Science', Pearson Education, **2004**.

3. ErachBharucha, 'Textbook for Environmental Studies', UGC, New Delhi.

MATHEMATICS-II

Subject Code: BMATH5-201 **L T P C** **Duration:60 Hrs.**
3 1 0 4

Course Objective: To introduce concept of probability, basic statistics, sequence and series and Partial differentiation.

Course Outcome: After the completion of the course, the students will be able to solve the problems related to probability, basic statistics, sequence and series and Partial differentiation.

UNIT-I (14 Hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables;

UNIT-II (15 Hours)

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT-III (15 Hours)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Cauchy's Integral test, series of positive and negative terms); Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT-IV (16 Hours)

Partial differentiation –Function of two variables, Partial derivatives of higher order, Homogeneous functions, Euler's theorem and its extension (with proof), Composite functions, Total derivative, Differentiation of implicit functions and composite functions, Jacobians and its properties.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
4. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.
5. S.C. Gupta and V.K. Kapoor ,Fundamentals of Applied Statistics,4th Edition, Sultan Chand & Sons, 2014.

BASIC MATHEMATICS-II

Subject Code: BMATH5-202	L T P C 3 1 0 4	Duration: 60 Hrs.

Course Objective: To introduce concept of matrices and determinants, sequence and series and Partial differentiation.

Course Outcome: After the completion of the course, the students will be able to solve the problems related to matrices and determinants, sequence and series and Partial differentiation.

UNIT-I (14 Hours)

Matrices and Determinants: Algebra of matrices, Inverse and rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II (15 Hours)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Cauchy's Integral test, series of positive and negative terms); Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT-III (16 Hours)

Partial differentiation –Function of two variables, Partial derivatives of higher order, Homogeneous functions, Euler's theorem and its extension (with proof), Composite functions, Total derivative, Differentiation of implicit functions and composite functions, Jacobians and its properties.

UNIT-IV (15 Hours)

Partial derivatives, directional derivatives, total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
4. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
5. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

THERMAL PHYSICS

Subject Code: BPHYS1-201 **L T P C 4 0 0 4** **Duration: 60 Hrs.**

Course Objective: To provide a detailed knowledge of laws of thermodynamics, applications of laws of thermodynamics, and Maxwell's thermodynamic relations.

Course Outcomes: After completion of the course, student will be able to solve the problems related with the laws of thermodynamics, entropy, and Maxwell's thermodynamic relations.

UNIT-I(15 Hours)

Laws of Thermodynamics

Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem.

UNIT-II(15 Hours)

Applications of laws of thermodynamics

Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

UNIT-III (15 Hours)

Entropy

Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

UNIT-IV(15 Hours)

Thermodynamic Potentials and Maxwell's relations

Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations (6) Change of Temperature during Adiabatic Process.

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.

2. Statistical Physics and Thermodynamics, V.S. Bhatia, 1990, Shoban Lal Nagin Chand.
3. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University.
6. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications

WAVES AND OPTICS

Subject Code: BPHYS1-202 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To understand the fundamentals of harmonic oscillations, wave motion, wave optics: diffraction, interferometer and holography.

Course Outcomes: After completion of the course, student will be able to – understand and utilize the idea of harmonic oscillations, wave motion, wave optics. The course will provide basic and advanced concept of interference and diffraction.

UNIT-I (15 Hours)

Harmonic oscillations and Superpositions

Introduction to Harmonic oscillations, Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

UNIT-II(15 Hours)

Wave Motion

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

UNIT-III(15 Hours)

Wave Optics and Interference

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. 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.

UNIT-IV(15 Hours)

Diffraction

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Reference Books

1 Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2 Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3 Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
4 The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
5 The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
6 Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

ORGANIC CHEMISTRY-I

Subject Code: BCHMS1-201 | **L T P C 40 0 4** | **Duration: 60 Hrs.**

Course Objectives
1. To understand the concepts behind basics of organic chemistry
2. To understand the concept of stereochemistry
3. To familiarize with the chemistry of aliphatic compounds
4. To understand concepts behind aromaticity

Course Outcomes:
Students will acquire the knowledge of:
1. Stereochemistry concepts
2. Reaction intermediates, electronic effects and types of reactions
3. Formation of carbon-carbon sigma and pi bonds
4. Conformational analysis of cycloalkanes
5. Aromaticity concepts

UNIT-I(6 Hours)

Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, influence of hybridization on bond properties.

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

UNIT-II(18 Hours)

Stereochemistry

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

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

UNIT-III(16 Hours)

Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds

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

Carbon-Carbon pi bonds:

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

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl
benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-IV(20 Hours)

Cycloalkanes and Conformational Analysis

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

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Reference Books:

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

THERMAL PHYSICS LAB

Subject Code: BPHYS1-204 **L T P C 0 0 4 2** **Duration: 60 Hrs.**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To learn practically the various concepts of thermodynamics. The course will provide hand on training to the students for handling various related instruments.

Course Outcome: The completion of this course will make student confident to handle practically the various concepts of thermodynamics.

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using Null Method
8. To calibrate a thermocouple to measure temperature in a specified Range using Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

Reference Books

1 Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2 A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3 Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4 A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

WAVES AND OPTICS LAB

Subject Code: BPHYS1-205 **L T P C 0 0 4 2** **Duration: 60 Hrs.**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To learn practically the various concepts of waves and optics. The course will provide hand on training to the students for handling various related instruments.

Course Outcome: The completion of this course will make student confident to handle practically the various concepts of waves and optics.

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.
13. To Simulation of interference fringes with different shapes using Fortran Programming
14. To Simulate the effect of coherence on interference fringes
15. To Simulate propagation of EM waves in free space and in an optical fiber

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985,
Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

ORGANIC CHEMISTRY-ILAB

Subject Code: BCHMS1-203 **L T P C** **0 0 2 1** **Duration: 30 Hrs.**

Course Objectives

1. To understand the concepts behind crystallization
2. To understand the determination of melting points and effect of impurities on mp.
3. To understand various purification techniques used for purification.

Course Outcomes:

After completion of course students will acquire the knowledge of:

1. Purification of organic compound using various solvent combinations
2. Determination of melting and boiling points of various organic compound
3. Chromatographic techniques

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:

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

Reference Books

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

DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION

Subject Code: BMNCC0-041 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

UNIT-I (6 Hours)

Meaning of Drug Abuse
Meaning: Drug abuse, Drug dependence and Drug addiction. Nature and extent of drug abuse in India and Punjab.

UNIT-II (8 Hours)

Consequences of Drug Abuse
Individual: Education, Employment, Income. Family: Violence. Nation: Law and Order problem.

UNIT-III (8 Hours)

Prevention of Drug Abuse
Role of Family: Parent-child relationship, Family support, supervision, shipping values, active scrutiny.
School: Counselling, Teacher as role-model, Parent-teacher-health professional coordination, Random testing on students.

UNIT-IV (8 Hours)

Treatment and Control of Drug Abuse
Medical Management: Medication for treatment and to reduce withdrawal effects. Psychological Management: Counselling, Behavioural and Cognitive therapy. Social Management: Family, Group therapy and Environme-ntal intervention. Treatment: Medical, Psychological and Social Management. Control: Role of Media and Legislation.

Recommended Books:

1. Ram Ahuja, 'Social Problems in India', Rawat Publications, Jaipur, 2003.
2. 'Extent, Pattern and Trend of Drug Use in India', Ministry of Social Justice and Empowerment, Govt. of India, 2004.
3. J.A. Inciardi, 'The Drug Crime Connection', Sage Publications, Beverly Hills, 1981.
4. T. Kapoor, 'Drug Epidemic among Indian Youth', Mittal Publications, New Delhi, 1985.
5. Kessel, Neil and Henry Walton, 'Alcoholism, Harmond Worth', Penguin Books, 1982.
6. Ishwar Modi and Shalini Modi, 'Addiction and Prevention', Rawat Publications, Jaipur, 1997.
7. 'National Household Survey of Alcohol and Drug Abuse', Clinical Epidemiological Unit, All India Institute of Medical Sciences, New Delhi, 2003 & 2004.
8. Ross Coomber and Others, 'Key Concept in Drugs and Society', Sage Publications, New Delhi, 2013.
9. Bhim Sain, 'Drug Addiction Alcoholism, Smoking Obscenity', Mittal Publications, New Delhi, 1991.
10. Ranvinder Singh Sandhu, 'Drug Addiction in Punjab: A Sociological Study', Guru Nanak Dev University, Amritsar, 2009.
11. Chandra Paul Singh, 'Alcohol and Dependence among Industrial Workers', Shipra, Delhi, 2000.
12. S. Sussman and S.L. Ames, 'Drug Abuse: Concepts, Prevention andCessation', Cambridge University Press, 2008.
13. P.S. Verma, 'Punjab's Drug Problem: Contours and Characteristics', Vol. LII, No. 3, P.P. 40-43, Eco -nomic and Political Weekly, 2017.
14. 'World Drug Report', United Nations Office of Drug and Crime, 2016.
15. 'World Drug Report', United Nations Office of Drug and Crime, 2017.

MATHEMATICS-III

Subject Code: BMATH5-301 | **L T P C** **3 1 0 4** | **Duration: 60 Hrs.**

Course Objective: To introduce concept of ordinary and partial Differential equations.

Course Outcome:The students will be able to use and solve the problems related to concept of ordinary and partial Differential equations.

UNIT-I (14 Hours)

First Order Ordinary Differential Equations: Linear and Bernoulli's equations, exact equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II (16Hours)

Ordinary Differential Equations of higher Orders: Second order linear differential equations with variable coefficients, (complementary function, particular integral) method of variation of parameters, Cauchy-Euler equation.

UNIT-III (15Hours)

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method, Second-order linear equations and their classification.

UNIT-IV (15Hours)

Separation of variables in a PDE; wave and heat equations in one dimensional form, Elementary solutions of Laplace equations.

Reference Books:

1. G.B. Thomas and R.L. Finney, ‘Calculus and Analytic Geometry’, 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, ‘Advanced Engineering Mathematics’, 9th Edn, John Wiley & Sons,2006.
3. T. Veerarajan, ‘Engineering Mathematics for First Year’, Tata McGraw Hill, New Delhi, 2008.
4. B.V. Ramana, ‘Higher Engineering Mathematics’, 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
5. B.S. Grewal, ‘Higher Engineering Mathematics’, 36th Edn., Khanna Publishers, 2010.

ANALOG SYSTEM AND APPLICATIONS

Subject Code: BPHYS1-301 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To understand the concepts of semiconductor diodes, bipolar junction transistors and amplifiers, h parameters and operational amplifiers.

Course Outcome: At the end of the course the students will be able to solve the problems related to the semiconductor diodes, bipolar junction transistors and amplifiers, h parameters and operational amplifiers.

UNIT-I(15 Hours)

Semiconductor Diodes and their Applications
P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode: 1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, 2) Zener Diode and Voltage Regulation. Principle and structure of: 1) LEDs, 2) Photodiode and 3) Solar Cell.

UNIT-II(15 Hours)

Bipolar Junction Transistors and Amplifiers
n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions. Amplifiers:Transistor Biasing and Stabilization Circuits. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

UNIT-III(15 Hours)

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

stage RC-coupled amplifier and its frequency response. Sinusoidal Oscillators:Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.

UNIT-IV(15 Hours)

Operational Amplifiers and Applications

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning.
3. Electronic Devices and Circuits,S.Salivahanan & N.S.Kumar, 3rd Ed., 2012Tata Mc-Graw Hill.
4. OP-Amps and Linear Integrated Circuits,R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
5. Malvino ElectronicPrinciples,Albert Malvino and David Bates, Tata Mc-Graw Hill.

ELEMENTS OF MODERN PHYSICS

Subject Code: BPHYS1-302 **L T P C** **4 0 0 4** **Duration: 60 Hours**

Course Objective: To learn and understand basic concept of Modern Physics.

Course Outcomes: After completion of the course, student will be able to understand and use the basic laws of quantum mechanics and their applications, Constituents of nucleusand their properties and Basics of Laser and its applications.

UNIT-I(15 Hours)

Introduction to Quantum Mechanics

Planck’s quantum, Planck’s constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

UNIT-II (15 Hours)

Quantum Mechanical Uncertainty

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence.

UNIT-III (15 Hours)

Nuclear Physics

Constituents of nucleus and their intrinsic properties, Qualitative facts about size, mass, density, energy, charge. Binding energy, angular momentum, magnetic moment and electric quadruple moments of the nucleus, Wave mechanical properties of nucleus, average binding energy and its variation with mass numbers, Properties of nuclear forces, Non existence of electrons in the nucleus and neutron-proton model, Liquid drop model and semi empirical mass formula, Conditions of nuclear stability.Radioactivity. Modes of decay and successive radioactivity. Alpha emission. Electron emission, Positron emission. Electron capture, Gamma-ray emission, Internal conversion.

UNIT-IV(15 Hours)

Laser and its Applications

Introduction**,** Coherence**,** Spatial and temporal coherence,Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Einstein's A and B coefficients. Three-Level and Four-Level Lasers. Components of Laser, Types of Laser: Ruby Laser and He-Ne Laser, Semiconductor Laser and CO_2 Laser.Q-switching, Mode locking, Applications of lasers–a general outline. Basics of holography.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

QUANTUM MECHANICS AND APPLICATIONS

Subject Code:BPHYS1-303 **L T P C** **4 0 0 4** **Duration: 60 Hrs.**

Course Objective: To understand Schrodinger equation and applications, and quantum theory of hydrogen like atoms.

Course Outcome: After the completion of the course the students will be able to solve the problems related to Schrodinger equation and applications, and quantum theory of hydrogen like atoms.

UNIT-I (15 Hours)

Time dependent Schrodinger equation

Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

UNIT-II (15 Hours)

Time independent Schrodinger equation

Introduction to quantum mechanics, Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; Position-momentum uncertainty principle.

UNIT-III(15 Hours)

Applications of Schrodinger wave equation

Continuity of wavefunction, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions; ground state, zero point energy & uncertainty principle.

UNIT-IV(15 Hours)

Atoms in Electric and Magnetic Field

Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.

Reference Books:

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed.,2010, McGraw Hill
2. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
3. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
4. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.
5. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
6. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education

PHYSICAL CHEMISTRY I

SUBJECT CODE–BCHMS1-102	L T P C	(60 Lectures)
	4 0 0 4	

Course Objectives

1. To familiarize the student with the basic phenomenon/concepts of equation of state and properties of liquids and solids.
2. To understand nature of solid state, crystal systems and defects in crystals.
3. To understand the concept of ionisation, pH and hydrolysis.

Course Outcomes: The completion of this course will make student to acquire the knowledge of:

1. Kinetic modular model of gases, behaviour of ideal and real gases.
2. Concept of equilibrium, its types and the factors affecting the state of equilibrium
3. Different type of crystal systems, Bragg's law and Miller indices.
4. Comparison of the behaviour of ideal and real gases.

UNIT-I(8 Hours)

Gaseous stateI:

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation;collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

UNIT-II (10 Hours)

Gaseous stateII:
Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of correspondingstates.

UNIT-III (22 Hours)

Liquid state:
Qualitative treatment of the structure of the liquid state; Radial distribution function; 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. Qualitative discussion of structure of water.

Solid state:
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Detailed study of defects in crystals. Glasses and liquid crystals.

UNIT-IV (20 Hours)

Ionic Equilibria:
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).
Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.
Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Reference Books:
• Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press13(2006).
• Ball, D. W. Physical Chemistry Thomson Press, India (2007).
• Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
• Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

ANALOG SYSTEM AND APPLICATIONS LAB

Subject Code: BPHYS1-305 | **L T P C 0 0 4 2** | **Duration: 60 Hrs.**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To understand practically the various concepts of analogue system and applications.

Course Outcome: After the completion of the course the students will be able to handle practically the various analogue circuits.

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt`s oscillator.
11. To design a digital to analog converter (DAC) of given specifications.
12. To study the analog to digital convertor (ADC) IC.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.
21. To design a circuit to simulate the solution of a 1st/2nd order differential equation.

Reference Books:

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

ELEMENTS OF MODERN PHYSICS LAB

Subject Code: BPHYS1-306 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To understand practically the laws of Modern Physics.

Course Outcomes: The completion of this course will make student confident to handle practically the various experiments related with modern physics.

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

QUANTUM MECHANICS LAB

Subject Code:BPHYS1-307 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Note:

1. Any other subject related experiment can also be included.
2. Use any programming language to solve following problems based on Quantum Mechanics

Course Objective: To solve and understand practically the various quantum mechanical problems.

Course Outcome: After the completion of the course the students will be confident in solving different quantum mechanical problems.

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

   $\frac{D^2y}{D^2x} = A(r)\,u(r),\, A(r) = \frac{2m}{h^2}(V(r) - E) where\, V(r) = -\frac{e^2}{r}$

   Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 (eVÅ) $^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511×10^6 eV/c^2.

2. Solve the s-wave radial Schrodinger equation for an atom:

   $\frac{D^2y}{D^2x} = A(r)\,u(r),\, A(r) = \frac{2m}{h^2}(V(r) - E)$

   Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

   $$V(r) = -\frac{e^2}{r}e^{-r/a}$$

   Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ)$^{1/2}$, m = 0.511×10^6 eV/c^2 , and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

   $\frac{D^2y}{D^2x} = A(r)\,u(r),\, A(r) = \frac{2m}{h^2}(V(r) - E)$

   For the anharmonic oscillator potential

   $$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

   for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2 , k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3}. In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

   $\frac{D^2y}{D^2x} = A(r)\,u(r),\, A(r) = \frac{2m}{h^2}(V(r) - E)$

   where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D\left(e^{-2\alpha r'} - e^{-\alpha r'}\right), r' = \frac{r - r_o}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: m = 940x106 eV/C^2 , D = 0.755501 eV, α = 1.44, ro = 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
6. To study the photoelectric effect.
7. To study the quantization of energy levels.
8. To find the first ionization potential of mercury.
9. Study of Zeeman effect: with external magnetic field; Hyperfine splitting.
10. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

    Note: Other experiments related to quantum mechanics may be included.

Reference Books:

1. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.
2. Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al., 3rdEdn., 2007, Cambridge University Press.
3. Elementary Numerical Analysis, K.E.Atkinson, 3 rdEdn . , 2 0 0 7 , Wiley India Edition.
4. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.
5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896
6. Scilab by example: M. Affouf2012ISBN: 978-1479203444.
7. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706.
8. Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A

PHYSICAL CHEMISTRY –I LAB

Subject Code: BCHMS1-104 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To familiarize with basics of the phenomenon of surface tension and viscosity.
3. To understand pH metric titrations.

Course Outcomes: The students will acquire knowledge of:

1. Surface tension and Viscosity measurement
2. Preparation of buffer solution
3. pH metric titrations.

1. **Surface tension measurements.**
a. Determine the surface tension by (i) drop number (ii) drop weight method.
b. Study the variation of surface tension of detergent solutions with concentration.
2. **Viscosity measurement using Ostwald's viscometer**.
a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
b. Study the variation of viscosity of sucrose solution with the concentration of solute.
3. Indexing of a given powder diffraction pattern of a cubic crystalline system.
4. pH metry
a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
b. Preparation of buffer solutions of different pH
i. Sodium acetate-acetic acid
ii. Ammonium chloride-ammonium hydroxide
c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
d. Determination of dissociation constant of a weak acid.

Reference Books

• Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
• Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw-Hill: New York (2003).
• Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003)

MATHEMATICS-IV

Subject Code: BMATH5-401 **L T P C** **Duration: 60 Hrs.**
3 1 0 4

Course Objective: To introduce concept of Fourier series, Fourier transformand Laplace transform.

Course Outcome:After the completion of the course students will be able to solve the problems related toFourier series, Fourier transformand Laplace transform.

UNIT-I (14Hours)

Fourier series: Definition of Periodic functions, Euler's formula, Even and odd functions, half range expansions, Fourier series of different wave forms.

UNIT-II (16Hours)

Fourier transform: Dirichlet's conditions, Fourier integral formula, properties of Fourier transform, inversion formula, convolution, Parseval's equality; Fourier transform of generalized functions, application of transforms to heat wave and Laplace equation.

UNIT-III (15Hours)

Laplace Transforms: Laplace transforms of functions and its properties, inverse Laplace transforms, transform of derivatives and integrals.

UNIT-IV (15Hours)

Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients and simultaneous differential equations.

References Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.
3. Ian N. Sneedon, Elements of Partial Differential Equations, McGraw- Hill, Singapore, 1957.
4. Advanced Engineering Mathematics, O'Neil, Cengage Learning.
5. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
6. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.

DIGITAL SYSTEMS AND APPLICATIONS

Subject Code:BPHYS1-401 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To understand various circuits (Integrated, Digital,Data Processing,Sequential circuits and counters and converters).

Course Outcome : After the completion of the course the students will become familiarize to various circuits (Integrated, Digital,Data Processing, Sequential and counters and converters).

UNIT-I (15 Hours)

Digital Circuits

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

UNIT-II (13 Hours)

Data Processing Circuits

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

UNIT-III (16 Hours)

Sequential Circuits

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

UNIT-IV (16 Hours)

Counters and Converters

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

Reference Books:

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

SOLID STATE PHYSICS

Subject Code:BPHYS1-402 **L T P C 4 0 0 4** **Duration: 60 Hrs.**

Course Objective: To introduce concept of physical properties of crystal structure, Elementary Lattice dynamics, properties of matter, Elementary band theory and superconductivity.

Course Outcome: After the completion of the course, the students will become familiarize the physical properties of crystal structure, Elementary Lattice dynamics, properties of matter, Elementary band theory and superconductivity.

UNIT-I(14 Hours)

Crystal Structure

Solids: Amorphous and Crystalline. Lattice Translation Vectors.Unit Cell, Bravais Lattices, Lattice with a Basis – Central and Non-Central Elements, Nearest Neighbours, Packing Fraction. Miller Indices. Primitive Cell Reciprocal Lattice. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

UNIT-II(13 Hours)

Elementary Lattice Dynamics

Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Specific Heat of solids: basic concept, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids and T^3 law.

UNIT-III(18 Hours)

Properties of Matter

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Ferroelectric Properties of Materials: Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.

UNIT-IV(15 Hours)

Elementary band theory and Superconductivity

Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient. Superconductivity:Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation).

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, 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. Solid State Physics, Rita John, 2014, McGraw Hill.
7. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India.
8. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

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PHYSICAL CHEMISTRY-II

Subject Code:BCHMS1-202 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives:
1. To familiarize the student with the basic concepts of thermodynamics.
2. To elaborate the system of variable composition and their properties.
3. To understand the concept of chemical equilibrium.
4. To understand the concept of solutions and colligative properties.

Course Outcomes: The completion of this course will make student to acquire the knowledge of:
1. Systematic knowledge of concepts of thermodynamics and able to identify and describe energy exchange processes.
2. Concept of chemical equilibrium, and the factors affecting the state of equilibrium
3. Variation of system properties with composition.
4. Solutions and their properties.

UNIT-I(18 Hours)

Chemical Thermodynamics I:
Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.
First law: Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.
Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

UNIT-II (18 Hours)

Chemical Thermodynamics II:
Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.
Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.
Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

UNIT-III(16 Hours)

Systems of Variable Composition:
Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical Equilibrium:
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

UNIT-IV(8 Hours)

Solutions and Colligative Properties:
Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Reference Books

• Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.,* Oxford University Press (2011).
• Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
• Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
• McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
• Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
• Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
• Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006).

DIGITAL SYSTEM AND APPLICATIONS LAB

Subject Code:BPHYS1-404 | **L T P C 0 0 4 2** | **Duration: 60 Hrs.**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To understand practically the various concepts of digital system and applications.

Course Outcome: After the completion of the course the students will be able to handle practically the various digital circuits.

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

Reference Books:

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
3. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
4. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

SOLID STATE PHYSICS LAB

Subject Code:BPHYS1-405 | **L T P C 0 0 4 2** | **Duration: 60 Hrs**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To understand the experiments related with the Solid State Physics lab.

Course Outcome: After the completion of the course, the students will be able to handle experiments related with the Solid State Physics lab.

1.Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal usingSurface Plasmonresonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probemethod (room temperature to 150 ^{o}C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Reference Books

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

PHYSICAL CHEMISTRY-II LAB

Subject Code:BCHMS1-204 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Thermochemistry

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

(f) Determination of enthalpy of hydration of copper sulphate.

(g) Study of the solubility of benzoic acid in water and determination of ΔH.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R.Chand & Co.: New Delhi (2011).
2. Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New AgeInternational: New Delhi (2001).

CONSTITUTION OF INDIA

Subject Code: BMNCC0-001 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objective: To familiarize the students with Indian constitution.

Course Outcome: After the completion of the course, students will have the knowledge about Indian constitution.

UNIT-1 (7 Hours)

History of Making of the Indian Constitution

History, Drafting Committee, (Composition & Working). Philosophy of the Indian Constitution: Preamble Salient Features.

UNIT-II (8 Hours)

Contours of Constitutional Rights & Duties

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III (7 Hours)

Organs of Governance

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV (8 Hours)

Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati Raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village Level: Role of Elected and Appointed officials, importance of grass root democracy Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Reference Books

1. 'The Constitution of India', (Bare Act), Government Publication, 1950.
2. S.N. Busi, B.R. Ambedkar, 'Framing of Indian Constitution', 1st Edn., 2015.
3. M.P. Jain, 'Indian Constitution Law', 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, 'Introduction to the Constitution of India', Lexis Nexis, 2015.

MATHEMATICAL PHYSICS -I

Subject Code: BPHYS1-501 **L T P C** **Duration: 90 Hours**
4 2 0 6

Course Objective: The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.
Course Outcomes: The students will be able to use and solve the problems related tocomplex analysis, Vector differentiation, vector integration and tensors.

UNIT-I(24 Hours)

Complex Analysis
Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Harmonic functions and Milne Thomson Method Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy’s Integral formula. Laurent and Taylor’s expansion. Residues and Residue Theorem.

UNIT-II(22 Hours)

Recapitulation of vectors and vector differentiation
Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

UNIT-III(23 Hours)

Vector Integration and Orthogonal Curvilinear Coordinates
Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

UNIT-IV(21 Hours)

Tensors
Transformation of Co-ordinates. Einstein’s Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Antisymmetric Tensors. Invariant Tensors : Kronecker and Alternating Tensors. Association of Antisymmetric Tensor of Order Two.

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jonesand Bartlett Learning.
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning.
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press.

9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.

STATISTICAL MECHANICS

Subject Code: BPHYS1-502 **L T P C** **Duration: 60 Hours**

4 0 0 4

Course Objective: To understand Classical Statistics, Classical and Quantum theory of radiations and Kinetic theory of gases.

Course Outcome: After the completion of the course, students will be able to solve the problems related to Classical Statistics, Classical and Quantum theory of radiations and Kinetic theory of gases.

UNIT-I(14 Hours)

Classical Statistics

Concept of probability,Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical EntropyExpression, Gibbs Paradox,Sackur Tetrode equation (concept only), Law of Equipartition of Energy(without proof).

UNIT-II(15 Hours)

Classical Theory of Radiation

Classical Theory of Radiation:Properties of Thermal Radiation. Blackbody Radiation.Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamicproof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe.

UNIT-III(14 Hours)

Quantum Theory of Radiation

Quantum Theory of Radiation:Spectral Distribution of Black Body Radiation.Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: ExperimentalVerification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3)Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law. Concept of Bose Einstein and Fermi Dirac Statistics.

UNIT-IV(17 Hours)

Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Specific heats of Gases. Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance. Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. JouleThomson Effect for Real and Van der Waal Gases. Temperature of Inversion. JouleThomson Cooling.

Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

STATISTICAL MECHANICS LAB

Subject Code: BPHYS1-503	L T P C 0 0 4 2	Duration: 60 Hrs.

Note:

1. Use Fortran/ C/C++/Scilab/other numerical simulations for solving the problems based on Statistical Mechanics lab
2. Any other subject related experiment can also be included.

Course Objective: To solve and understand computationally the various Statistical mechanics problems.

Course Outcome: After the completion of the course, students will be able to solve and understand computationally the various Statistical mechanics problems.

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
   a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
   b) Study of transient behavior of the system (approach to equilibrium)
   c) Relationship of large N and the arrow of time
   d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution
   e) Computation and study of mean molecular speed and its dependence on particle mass
   f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed

2. Computation of the partition function $Z(\beta)$ for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics:
   a) Study of how $Z(\beta)$, average energy $\langle E \rangle$, energy fluctuation ΔE, specific heat at constant volume Cv, depend upon the temperature, total number of particles N and the spectrum of single particle states.
   b) Ratios of occupation numbers of various states for the systems considered above
   c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T.

3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.

4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.
5. Plot the following functions with energy at different temperatures
   a) Maxwell-Boltzmann distribution
   b) Fermi-Dirac distribution
   c) Bose-Einstein distribution

Reference Books:

1. Elementary Numerical Analysis, K.E.Atkinson, 3 r d Edn. 2007, Wiley India Edition
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
3. Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.
7. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
8. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
9. Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub., ISBN: 978- 6133459274.

BASIC INSTRUMENTATION SKILLS

Subject Code: BPHYS1-504	L T P C 0 0 4 2	Duration: 60 Hrs

Course Objective: To enhance the skills of the students to handle basic instruments.

Course Outcome: After the completion of the course, the students will be able to use various basic instruments.

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution rangeetc. Errors in measurements and loading effects.
Multimeter: Principles of measurementof dc voltage and dc current, ac voltage, ac current and resistance. Specifications of amultimeter and their significance.
Electronic Voltmeter: Advantage over conventional multimeter for voltagemeasurement with respect to input impedance and sensitivity. Principles of voltage,measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance.
AC millivoltmeter: Type of AC millivoltmeters:
Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,**specifications and their significance.
Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT,Electron gun, electrostatic focusing and acceleration (Explanation only– nomathematical treatment), brief discussion on screen phosphor, visual persistence &chemical composition. Time base operation, synchronization. Front panel controls.Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Specialfeatures of dual trace,

introduction to digital oscilloscope, probes. Digital storageOscilloscope: Block diagram and principle of working.

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

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

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

Digital Multimeter: Block diagram and working of a digital multimeter. Workingprinciple of time interval, frequency and period measurement using universal counter/frequency counter, time- base stability, accuracy and resolution.

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

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

Laboratory Exercises:

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

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books:

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

EXPERIMENTAL TECHNIQUES

Subject Code: BPHYD1-511 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

UNIT-I

Measurements, Signals and Systems(16 hrs.)
Basic concept of measurements, accuracy and precision. Significant figures. Error and uncertainty analysis. Types of errors: Gross error, systematic error, random error. Counting Statistics, Statistical analysis of data: Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution. Design of experiments. Periodic and aperiodic signals. Fluctuations and noise in measurement system. Signal-to-noise ratio and noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise, 1/f noise. Calibration of an instrument.

UNIT-II

Transducers & industrial instrumentation (16 hrs.)
Transducers and sensors. Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75) and signal conditioning. Linear Position transducer: Strain gauge, Piezoelectric. Inductance change transducer: Linear variable differential transformer (LVDT), Capacitance change transducers. Radiation Sensors: Principle of Gas filled detector, ionization chamber, scintillation detector.

UNIT-III

Digital and Analog Systems (14 hrs.)
Comparison of analog and digital multimeters. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy, and resolution of measurement. Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge. Q-meter and its working operation. Digital LCR bridge.

UNIT-IV

Vacuum Systems and Optoelectronic Devices (14 hrs.)
Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system: Chamber, mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization). Solar cells, LEDs, Photoresistors, phototransistors, photodiodes, types of lasers.

Reference Books:

1. Measurement, Instrumentation and Experiment Design in Physics and Engineering, M. Sayer and A. Man Singh, PHI Learning Pvt. Ltd.
2. Experimental Methods for Engineers, J.P. Holman, McGraw Hill.
3. Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd.

4. Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.
5. Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill.
6. Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd.
7. Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk, Springer

EXPERIMENTAL TECHNIQUES LAB

Subject Code: BPHYD1-512 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Note:
1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

List of experiments:
1. Measurement of level using capacitive transducer.
2. To study the characteristics of a Thermostat and determine its parameters.
3. Study of distance measurement using ultrasonic transducer.
4. Calibrate Semiconductor type temperature sensor (AD590, LM35, or LM75)
5. To measure the change in temperature of ambient using Resistance Temperature Device (RTD)
6. Create vacuum in a small chamber using a mechanical (rotary) pump and measure the chamber pressure using a pressure gauge.
7. To prepare the thin film using thermal Evaporation Chamber.
8. Formation and Counting of alpha particle tracks on Solid State Nuclear Track.
9. To study the XRD spectra of thin films.
10. To study indoor particulate matter concentration.
11. Comparison of pickup of noise in cables of different types (co-axial, single shielded, double shielded, without shielding) of 2m length, understanding of importance of grounding using function generator of mV level & an oscilloscope.
12. To design and study the Sample and Hold Circuit.
13. Design and analyze the Clippers and Clampers circuits using junction diode.
14. To plot the frequency response of a microphone.
15. To measure Q of a coil and influence of frequency, using a Q-meter.

Reference Books:

16. Electronic circuits: Handbook of design and applications, U. Tietze and C. Schenk, 2008, Springer
17. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1990, Mc-Graw Hill
Measurement, Instrumentation and Experiment Design in Physics & Engineering, M. Sayer and A. Mansingh, 2005, PHI Learning.

NANO MATERIALS AND APPLICATIONS

Subject Code: BPHYD1-513 **L T P C 4 0 0 4** **Duration: 60 Hrs.**

Course Objective: To introduce concept of nanoscale systems, synthesis and characterisation of nanostructure materials, optical properties and electron transport and applications of nano-material.

Course Outcome: After the completion of the course, students will be able to solve the problems related to nanoscale systems, synthesis and characterisation of nanostructure materials, optical properties and electron transport and applications of nano-material.

UNIT-I (14 Hours)

Nanoscale Systems

Length scales in physics, Nanostructures: 1D, 2D and 3Dnanostructures (nanodots, thin films, nanowires, nanorods), Size Effects in nano systems, Quantum confinement:Applications of Schrodinger equation- Infinite potential well, potential step, potentialbox, Band structure and densityof states of materials at nanoscale. Quantum confinement of carriers in 3D, 2D, 1D nanostructures and itsconsequences.

UNIT-II(16 Hours)

Synthesis and Characterisation of Nanostructure Materials

Synthesis of nanostructure materials: Top down and Bottom upapproach, Photolithography, Ball milling, Gas phase condensation, Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, PulsedLaser deposition. Chemical vapor deposition (CVD), Sol-Gel, Electro deposition, Spraypyrolysis, Hydrothermal synthesis, Preparation through colloidal methods. Characterization:X-Ray Diffraction, Optical Microscopy, Scanning ElectronMicroscopy, Transmission Electron Microscopy, Atomic Force Microscopy, ScanningTunnelling Microscopy.

UNIT-III(15 Hours)

Optical Properties and Electron Transport

Coulomb interaction in nanostructures. Concept ofdielectric constant for nanostructures and charging of nanostructure. Quasi-particles andexcitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons. Radiativeprocesses: General formalization-absorption, emission and luminescence. Opticalproperties of heterostrctures and nanostructures. Electron transport: Carrier transport in nanostrcutures. Coulomb blockadeeffect, thermionic emission, tunneling and hoping conductivity.

UNIT-IV (15 Hours)

Applications of Nano Materials

Applications of nanoparticles, quantum dots, nanowires and thinfilms for photonic devices (LED, solar cells). Single electron transfer devices (noderivation). Nanomaterial Devices: Quantum dots hetero-structurelasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots- magnetic data storage. Micro Electromechanical Systems (MEMS), NanoElectromechanical Systems (NEMS).

Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)

3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
5. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).
6. Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011, Cambridge University Press.
7. Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

NANO MATERIALS AND APPLICATIONS LAB

Subject Code: BPHYD1-514 | **L T P C 0 0 4 2** | **Duration: 60 Hrs.**

Note:
1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To understand the experiments related with the nonmaterial and their applications.

Course Outcome: After the completion of the course, the students will be able to handle experiments related with the nonmaterial and their applications.

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.
7. Growth of quantum dots by thermal evaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing andsintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) andstudy transmittance spectra in UV-Visible region.
10. Prepare a thin film capacitor and measure capacitance as a function oftemperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study itsV-I characteristic.

Reference Books:
1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

COMMUNICATION SYSTEMS

Subject Code: BPHYD1-515 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

UNIT-I

Introduction to Communication Systems (16 Hrs.)

Introduction to communication. Elements of communication systems: Information source, transmitter, channel, receiver, destination. Need of modulation. Electromagnetic spectrum and typical applications. Terminologies in the communication systems. Basics of signal representation and analysis: Sine wave and Fourier series review, frequency spectrum of non-sinusoidal waves. External noise: Atmospheric noise, extraterrestrial noise, industrial noise. Internal noise: Thermal agitation noise, shot noise, Transit-time noise. Noise figure: Signal-to-noise ratio, definition and calculation of noise figure, noise temperature.

UNIT-II

Amplitude Modulation Techniques (16 Hrs.)

Elements of analog communication, Theory of amplitude modulation technique: Amplitude modulation (AM) technique, double sideband carrier suppressed (DSBSC) technique, single sideband (SSB) technique, Vestigial sideband (VSB) modulation technique. Generation of amplitude modulated signals: Generation of AM signal, generation of DSBSC signal, generation of SSB signal, generation of VSB signal. Theory of angle modulation techniques: Frequency modulation, phase modulation, comparison of frequency and phase modulation. Generation of frequency modulation: FM methods, direct methods, indirect method.

UNIT-III

Pulse Modulation Techniques (12 Hrs.)

Introduction to pulse analog modulation techniques: Pulse amplitude modulation (PAM), pulse width modulation, pulse position modulation, demodulation of pulse analog modulated signals. Pulse digital modulation techniques: Pulse code modulation, delta modulation, differential pulse code modulation, demodulation of pulse digital modulated signals.

UNIT-IV

Radio Transmitters and Receivers (16 hrs.)

Introduction to radio communication. Radio transmitters: AM transmitters, SSB transmitters, FM transmitters. Receiver types: Tuned-radio frequency receivers, superheterodyne receiver. AM receivers: RF selection and characteristics, frequency changing and tracking, intermediate frequencies (IF) and IF amplifiers, detection and automatic gain control. FM receivers: Common circuits – comparison with AM receivers, amplitude limiting, basic FM demodulators. Radio detector. FM demodulator comparison. Stereo FM multiplex reception. Single- and Independent -Sideband receivers: Demodulation of SSB, receiver types.

Reference Books:

1. Electronic Communication Systems, G. Kennedy, B. Davis, SRM Prasanna, McGraw Hill Education (India) Pvt. Ltd., New Delhi, India.
2. D.J. Griffiths, ‘Introduction to Electrodynamics’, Pearson Education Ltd., New Delhi, 1991.

3. J.B. Marion, ‘Classical Electromagnetic Radiation’, Academic Press, New Delhi, 1995.
4. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
5. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
6. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.
7. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
8. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

COMMUNICATION SYSTEMS LAB

Subject Code: BPHYD1-516	L T P C 0 0 4 2	Duration: 60 Hrs.

Note:

1. Any other subject related experiment can also be included.

Course Objective: To learn and understand various modulation and demodulation techniques in time and frequency domain. The course will provide hand on training to the students for handling various related instruments.

List of experiments:

1. Simulations of communication systems using MATLAB>
2. Representation of signals and systems.by signal sampling and reconstruction.
3. Verification of Sampling Theorem.
4. Study of generation of Unipolar NRZ, Polar NRZ, Unipolar RZ and Polar RZ line code.
3. Study of generation and detection of Pulse Code Modulation (PCM).
4. Study of generation and detection of Delta Modulation.
5. Study of generation and detection of Amplitude Shift Keying (ASK).
6. Study of generation and detection of Phase Shift Keying (PSK).
7. Study of generation and detection of Frequency Shift Keying (FSK).
8. Analysis of the process of Time Division Multiplexing and demultiplexing.

Reference Books:

1. Electronic Communication Systems, G. Kennedy, B. Davis, SRM Prasanna, McGraw Hill Education (India) Pvt. Ltd., New Delhi, India.
2 Haykin S., "Communications Systems", John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
4. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill,
Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000

NUCLEAR AND PARTICLE PHYSICS

Subject Code: BPHYD1-521 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To understand general properties of nuclei, nuclear models, nuclear reactions, interactions of nuclear radiation with matter and particle accelerators.

Course Outcome: After the completion of the course, students will be able to solve the problems related to general properties of nuclei, nuclear models, nuclear reactions, interactions of nuclear radiation with matter and particle accelerators

UNIT—I (15 Hours)

General Properties of Nuclei and Nuclear Models

Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of deutron problem, concept of nuclear force.

UNIT—II (15 Hours)

Radioactive decay and Nuclear Reactions

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

UNIT—III (15 Hours)

Interaction of Nuclear Radiations with Matter and Detection of Nuclear radiations

Energy loss due to ionization (Bethe Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors, Semiconductor Detectors (Si &Ge).

UNIT—IV (15 Hours)

Particle Physics and Particle Accelerators

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, color quantum number and gluons. Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

Reference Books:

1. Introductory Nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of Nuclear Physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the Physics of Nuclei &Particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons.
5. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi.
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
7. Nuclear Physics by Dr. S.N. Ghoshal, S.Chand& Company Pvt. Ltd.
8. Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991)

NUCLEAR AND PARTICLE PHYSICS LAB

Subject Code: BPHYD1-522	**L T P C**	**Duration: 60 Hrs.**
	0 0 4 2	

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

List of experiments:

1. Study of the characteristics of a GM tube and determination of its operating voltage, plateau length / slope.
2. To study the dead time of a GM Counter.
3. Verification of inverse square law for gamma rays.
4. Study of nuclear counting statistics.
5. Estimation of efficiency of the G.M. detector for beta and gamma sources.
6. To study beta particle range and maximum energy (Feather Analysis).
7. To study p-p interaction and find the cross-section of a reaction using a bubble chamber film.
8. To study n-p interaction and find the cross-section using a bubble chamber film.
9. To study k-d interaction and find its multiplicity and moments using a bubble chamber film.
10. To study a $\pi\mu$ event using emulsion track film.
11. To determine range of Alpha/Beta-particles in air at energy loss in thin foils.
12. To determine strength of alpha particles using SSNTD.
13. Estimation of Photon attenuation coefficient in high and low Z material.
14. Calculate the range of alpha particle.
15. Study of energy resolution characteristics of a scintillation spectrometer as a function of applied high voltage and to determine the best operating voltage.
16. Measurement of resolution for a given scintillation detector using Cs-137 source.
17. Finding the resolution of detector in terms of energy of Co-60 system.
18. Energy calibration of gamma ray spectrometer (Study of linearity).

19. Spectrum analysis of Cs-137 and Co-60 and to explain some of the features of Compton edge and backscatter peak.
20. Unknown energy of a radioactive isotope
21. To study calibration of a beta-ray spectrometer.

Reference Books:

1. Knoll G.F.(2010).Radiation Detection and Measurement. Sussex, U.K: John Wiley & Sons.
2. Leo W.R.(2012). Techniques for Nuclear and Particle Physics Experiments: a how-to approach. New York, USA:Springer.
3. Beach K, Harbison S and Martin A.(2012). An Introduction to Radiation Protection. London, U.K:CRC Press.
4. Tsoulfanidis N, Landsberger S.(2010). Measurement and Detection of Radiation. London , U.K:CRC Press.
5. Nikjoo H, Uehara S, Emfietzoglou D.(2012). Interaction of Radiation with Matter. London, U.K:CRC Press.

PHYSICS OF EARTH

Subject Code: BPHYD1-523 **L T P C** **Duration: 90 Hrs.**

4 2 0 6

UNIT—I

The Earth and the Universe: (23Hrs.)

Origin of universe, creation of elements and earth. A Holistic understanding of our dynamic planet through Astronomy, Geology, Meteorology and Oceanography. Introduction to various branches of Earth Sciences. General characteristics and origin of the Universe. The Milky Way galaxy, solar system, Earth's orbit and spin, the Moon's orbit and spin. The terrestrial and Jovian planets. Meteorites & Asteroids. Earth in the Solar system, origin, size, shape, mass, density, rotational and revolution parameters and its age. Energy and particle fluxes incident on the Earth. The Cosmic Microwave Background.

Structure OF Earth: **(22 Hrs.)**

The Solid Earth: Mass, dimensions, shape and topography, internal structure, magnetic field, geothermal energy. The Hydrosphere: The oceans, their extent, depth, volume, chemical composition. River systems. The Atmosphere: variation of temperature, density and composition with altitude, clouds. The Cryosphere: Polar caps and ice sheets. Mountain glaciers. The Biosphere: Plants and animals. Chemical composition, mass. Marine and land organisms.

UNIT—III

Dynamical Processes: (23 Hrs.)

The Solid Earth: Origin of the magnetic field. Source of geothermal energy. Convection in Earth's core and production of its magnetic field. Mechanical layering of the Earth. Introduction to geophysical methods of earth investigations. Concept of plate tectonics; sea-floor spreading and continental drift. Introduction of Geodynamic elements of Earth: Mid Oceanic Ridges, trenches, transform faults and island arcs. Earthquake and earthquake belts. Volcanoes: types products and distribution. Biosphere: Water cycle, Carbon cycle, Nitrogen cycle, Phosphorous cycle. The role of cycles in maintaining a steady state.

UNIT—IV

Evolution and Disturbing the Earth Contemporary dilemmas:(22 Hrs.) Nature of stratigraphic records, Standard stratigraphic time scale and introduction to the concept of time in geological studies. Introduction to geochronological methods in their application in geological studies. History of development in concepts of uniformitarianism, catastrophism and neptunism. Law of superposition and faunal succession. Introduction to the geology and geomorphology of Indian subcontinent. Time line of major geological and biological events. Origin of life on Earth. Role of the biosphere in shaping the environment. Future of evolution of the Earth and solar system: Death of the Earth. Human population growth. Atmosphere: Green house gas emissions, climate change, air pollution. Hydrosphere: Fresh water depletion. Geosphere: Chemical effluents, nuclear waste. Biosphere: Biodiversity loss. Deforestation. Robustness and fragility of ecosystems.

Reference Books:

1. Planetary Surface Processes, H. Jay Melosh, Cambridge University Press, 2011.
2. Consider a Spherical Cow: A course in environmental problem solving, John Harte. University Science Books
3. Holme's Principles of Physical Geology. 1992. Chapman & Hall.
4. Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press.

BIOLOGICAL PHYSICS

Subject Code: BPHYD1-524 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

UNIT-I

Introduction to Biological Physics and Cells(16 Hrs.)
The exchange of matter and energy with environment, metabolism, evolution. The puzzle of biological order. Importance of cells in biological structures. Cell physiology: internal and external gross anatomy, types of cells, multicellularity. The overall flow of information in the cells. Self-replication as a distinct property of biological systems. Typical populations of molecules of various types present in cells, their rates of production and turnover. Energy required to make a bacterial cell. Time scales and spatial scales. Universality of microscopic processes and diversity of macroscopic form. Definitions of allometric scaling laws.

UNIT-II

Molecules of Life (16 Hrs.)
Small, medium and big-sized molecules, molecular assemblies, molecular motors, metabolites, proteins and nucleic acids: their sizes, types and roles in structures and processes. Transport, energy storage, membrane formation, catalysis, replication, transcription, translation, signalling. Simplified mathematical models of transcription and translation, small genetic circuits and signalling pathways. Random walks and applications to biology. The plasma membrane.

UNIT-III

Complexity of Life (16 hrs.)

At the cell level: The numbers of distinct metabolites, genes and proteins in a cell. Complex networks of molecular interactions: metabolic, regulatory and signalling networks. Dynamics of metabolic networks; the stoichiometric matrix. Models of cellular dynamics. The implausibility of life based on a simplified probability estimate, and the origin of life problem. At the level of a multicellular organism: Numbers and types of cells in multicellular organisms. Cell types as distinct attractors of a dynamical system. Stem cells and cellular differentiation. Pattern formation and development. Brain structure: neurons and neural networks. Brain as an information processing system. Associative memory models. Memories as attractors of the neural network dynamics.

UNIT-IV

Evolution (12 hrs.)

The mechanism of evolution: variation at the molecular level, selection at the level of the organism. Models of evolution. The concept of genotype-phenotype map and examples At the level of an ecosystem and the biosphere: Foodwebs, Feedback cycles and self- sustaining ecosystems.

Reference Books:

1. Physics in Molecular Biology; Kim Sneppen & Giovanni Zocchi (CUP 2005)
2. Biological Physics: Energy, Information, Life; Philip Nelson (W H Freeman & Co, NY, 2004).
3. Physical Biology of the Cell (2nd Edition), Rob Phillips et al (Garland Science, Taylor & Francis Group, London & NY, 2013)
4. An Introduction to Systems Biology; Uri Alon (Chapman and Hall/CRC, Special Indian Edition, 2013)
5. Evolution; M. Ridley (Blackwell Publishers, 2009, 3rd edition)

MATHEMATICAL PHYSICS- II

Subject Code: BPHYS1-601 **L T P C** **Duration: 90 Hrs.**
4 2 0 6

Course Objective: To learn and apply Frobenius method, theory of errors and special functions and integrals, and group theory.

Course Outcome: After the completion of the course students will be able to solve the problems related with Frobenius method, theory of errors and special functions and integrals, and group theory.

UNIT-I(19 Hours)

Frobenius Method
Singular Points of Second Order LinearDifferential equations and their importance. Frobenius method and its applications todifferential equations.

UNIT-II(25 Hours)

Special Functions
Legendre, Bessel, Hermite and Laguerre Differential Equations.Properties of Legendre Polynomials: Rodrigues Formula, Generating Function,Orthogonality. Simple recurrence relations. Expansion of function in a series ofLegendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple Recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x))and Orthogonality.

UNIT-III(24 Hours)

Special Integrals, Errors
Special Integrals:Beta and Gamma Functions and Relation between them.Expression of Integrals in terms of Gamma Functions. Error Function (ProbabilityIntegral). Theory of Errors:Systematic and Random Errors. Propagation of Errors. Normal Lawof Errors. Standard and Probable Error. Least-squares fit. Error on the slope andintercept of a fitted line.

UNIT-IV(22 Hours)

Group Theory
Defination of a group, Multiplication table, Abelian group, Sub-group, Cyclic group, Isomorphism, homeomorphism, permutation group, Definations of three dimensional rotational group and SU(2), O(3).

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
7. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

ELECTROMAGNETIC THEORY

Subject Code: BPHYS1-602 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To understand Maxwell's equations, propagation of EM waves, polarization, production and detection of EM waves, and optical fibres.

Course Outcome: After the completion of the course, students will be able to solve the problems related to Maxwell's equations, propagation of EM waves, polarization, production and detection of EM waves, and optical fibres.

UNIT-I(14 Hours)

Maxwell Equations

Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector.

UNIT-II(16 Hours)

Propagation of EM Wave

Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

UNIT-III(16 Hours)

Polarization, Production and Detection of Electromagnetic Waves

Description of Linear, Circular and Elliptical polarized light. Production & detection of Plane, Circularly and Elliptically Polarized Light.Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light Rotatory Polarization: Optical Rotation. Specific rotation. Laurent's half-shade polarimeter.

UNIT-IV(14 Hours)

Optical Fibres

Introduction of optical fibres, Numerical Aperture, Step and Graded Indices (Definitions Only), Single and Multiple Mode Fibres (Concept and Definition Only). Normalized frequency, modes of propagation, Advantages and application of optical fibre, fibre losses: material absorption, linear scattering, fibre bending, Pulse dispersion: intermodal and intermodal dispersion (no derivation), fibre connectors, fibre joints and couplers.

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning

6. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
7. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
   Additional Books for Reference
8. Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.
9. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
10. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University.

ELECTROMAGNETIC THEORY LAB

Subject Code: BPHYS1-603	L T P C 0 0 4 2	Duration: 60 Hrs.

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To understand the experiments related with the Electromagnetic Theory Lab.

Course Outcome: After the completion of the course, students will be able to handle the setups related to electromagnetic theory.

1.To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves.
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10.To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Reference Books

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

CLASSICAL DYNAMICS

Subject Code: BPHYD1-611	L T P C 4 2 0 6	Duration: 90 Hrs.

Course Objective: To understand Classical Mechanics of point particle, rotational dynamics, small amplitude oscillations and fluid dynamics.

Course Outcome: After the completion of the course, students will be able to solve and understand the problems related to Classical Mechanics of point particle, rotational dynamics, small amplitude oscillations and fluid dynamics.

UNIT-I(23 Hours)

Classical Mechanics of Point Particles

Review of Newtonian Mechanics; Applicationto the motion of a charge particle in external electric and magnetic fields- motion inuniform electric field, magnetic field- gyroradius and gyrofrequency, motion in crossedelectric and magnetic fields.Generalized coordinates and velocities, Hamilton'sprinciple, Lagrangian and the Euler-Lagrange equations.

UNIT-II(23 Hours)

Rotational Dynamics

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

UNIT-III(22 Hours)

Small Amplitude Oscillations

Minima of potential energy and points of stableequilibrium, expansion of the potential energy around a minimum, small amplitudeoscillations about the minimum, normal modes of oscillations example of N identicalmasses connected in a linear fashion to (N -1) - identical springs.

UNIT-IV(22 Hours)

Fluid Dynamics

Density and pressure P in a fluid, an element of fluid and itsvelocity, continuity equation and mass conservation, stream-lined motion, laminar flow,Poiseuille's equation for flow of a liquid through a pipe, qualitative description of turbulence, Reynolds number.

Reference Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley.
4. The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003, Elsevier.
5. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
6. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
7. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
8. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
9. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

ASTRONOMY AND ASTROPHYSICS

Subject Code: BPHYD1-612 **L T P C** **Duration: 90 Hrs.**
4 2 0 6

UNIT-I

The Language of Astrophysics (22 Hrs.)

A window on the universe, An Ideal gas and Ideal gas law, The Meaning of Temperature, Black Body radiation: Formal Definition, A Classical Quandary, Black body radiation from a star, The Surface Temperature, Luminosity and Radius of a Star, Measuring Stellar Distances by Trigonometric Parallax, Discrete Spectra: Emission Spectra, Absorption Spectra, Doppler Effect.

UNIT-II

The Interstellar Medium and Evidence for Stellar Evolution (22 Hrs.)

The Sun's place in the Galaxy, Hartmann and the Interstellar Medium, 21 cm radiation and the structure of Galaxy:- Hyperfine Transition in Hydrogen, Transition Amplification by collision, 21 cm Radiation and the Interstellar Gas, Emission Nebule and small clusters of Star, Interstellar Dust and Dark Clouds, Molecules and Molecular Clouds. Evidence for stellar birth and Evolution.

UNIT-III

Stellar Evolution I: On the Road to Main Sequence (23 Hrs.)

Solving the Initial Problems of Stellar collapse: First Gravity, The Big Squeeze- Spiral Density waves and Supernova Explosions, Accretion of Matter, The formation of Interstellar Grains, Shedding Matter and Angular Momentum, Stellar Magnetic fields, Magnetic Drag and Finally Collapse, Quasihydrostatic Equilibrium: P and T Inside a QHE cloud or star, The virial Theorem, The onset of QuasihydrostaticEquillibrium, Energy Transfer by Photons: Absorption Cross section vs. Temperature, Temperature Gradients and Radiative Transfer, The Mass-Luminosity Relationship; Convective transfer of Energy; Evolution from onset of QHE to the Main Sequence.

UNIT-IV

Astronomical Techniques: Basic Optical Definitions for Astronomy (Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes).GMRT, Ladakh, radio Ligo telescope. World 4, in india also.

Reference Books:-

1. Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
2. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing.
3. The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books.
4. Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
5. K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.
6. BaidyanathBasu, 'An introduction to Astro physics', Second printing, Prentice - Hall of India Private limited, New Delhi,2001.
7. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.

APPLIED DYNAMICS

Subject Code: BPHYD1-613 **L T P C 4 2 0 6** **Duration: 90 Hrs.**

UNIT-I

Introduction to Dynamical Systems (23 Hrs.)

Basics to dynamical systems with emphasis on continuous first order dynamical system, knowledge of phase space, flows and trajectories. Simple mechanical systems as first order dynamical systems: free particle, particle under uniform gravity, simple and damped harmonic oscillator, examples of dynamical systems: in biology: population models e.g. exponential growth and decay, logistic growth, species competition, predator-prey dynamics; In chemistry: rate equations for chemical reactions e.g. auto catalysis and bistability. Sketching flows and trajectories in phase space; sketching variables as functions of time.

UNIT-II

Chaos and Nonlinear Time Series Analysis (22 Hrs.)

Basics of Chaos: Chaos in nonlinear finite-difference equations-logistic map: dynamics from time series, parameter dependence-steady, periodic and chaos states, Cobweb iteration, fixed points, defining chaos-aperiodic, bounded, deterministic and sensitive dependence on initial conditions, period-doubling route to chaos, nonlinear time series analysis and chaos characterization. Sinai billiard and its variants, electron motion in mesoscopic conductors as chaotic billiard ball problem. Non-linear time series analysis and chaotic characterization: detecting chaos from return map.

UNIT-III

Basics of Fractals (22 Hrs.)

Introduction to fractals, examples of fractals in nature, types of fractals, Self-similar fractals and fractal geometry, need for fractal dimensions to describe self-similar structure. Deterministic fractal vs. self-similar fractal structure, concept of random fractals, Fractals in dynamics – Serpinski gasket and DLA, Koch curve and its variants, Random Koch curve.

UNIT-IV

Elementary Fluid Dynamics (23 hrs.)

Elementary Fluid Dynamics: Importance of fluids: Fluids in the pure sciences, fluids in technology. Experimental and theoretical analysis of fluids, computational fluid dynamics. Basic physics of fluids: The continuum hypothesis- concept of fluid element or fluid parcel; Definition of a fluid- shear stress; Fluid properties- viscosity, thermal conductivity, mass diffusivity, other fluid properties and equation of state; Flow phenomena- flow dimensionality, steady and unsteady flows, uniform & non-uniform flows, viscous &inviscid flows, incompressible & compressible flows, laminar and turbulent flows, rotational and irrotational flows, separated & unseparated flows. Flow visualization - streamlines, pathlines, Streaklines.

Reference Books:

1. Nonlinear Dynamics and Chaos, S.H. Strogatz, Levant Books, Kolkata, 2007.

2. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.

3. An Introduction to Fluid Dynamics, G.K. Batchelor, Cambridge Univ. Press, 2002.

Fluid Mechanics, 2nd Edition, L. D. Landau and E. M. Lifshitz, Pergamon Press, Oxford, 1987.

MEDICAL PHYSICS

Subject Code: BPHYD1-621 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective: To give knowledge to students about the physics of the body,radiation and radiation protection, physics of diagnostic and therapeutic systems and medical imaging and Radiation Oncology physics.

UNIT-I(15 Hours)

Physics of the body
Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity withterms like-Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal and Distal.Mechanics of the body: Skeleton, forces, and body stability. Muscles and dynamics ofbody movement. Physics of Locomotors Systems: joints and movements, Stability andEquilibrium. Energy household of the body:Energy balance in the body, Energyconsumption of the body, Heat losses of the body, Thermal Regulation. Pressure system of body:Physics of breathing, Physics of cardiovascular system. Nature and characteristics of sound, Production of speech,Physics of the ear, Diagnostics with sound and ultrasound. Optical system of the body:Physics of the eye. Electrical system of the body:Physics of the nervous system,Electrical signals and information transfer.

UNIT-II(15 Hours)

Radiation and radiation protection
Principles of radiation protection,protective materials-radiation effects, somatic, genetic stochastic and deterministiceffect. Personal monitoring devices: TLD film badge, pocket dosimeter, OSL dosimeter.Radiation dosimeter. Natural radioactivity, Biological effects of radiation, Radiationmonitors**.** Steps to reduce radiation to Patient, Staff and Public. Dose Limits forOccupational workers and Public. AERB: Existence and Purpose. Radiation Physics:Radiation units exposure, absorbed dose, units: rad, gray,relative biological effectiveness, effective dose- Rem & Sievert, inverse square law.Interaction of radiation with matter Compton & photoelectric effect, linear attenuationcoefficient. Radiation Detectors: ionization (Thimble chamber, condenser chamber),chamber. Geiger Muller counter, Scintillation counters and Solid State detectors, TFT.

UNIT-III(15 Hours)

Physics of diagnostic and therapeutic systems
X-RAYS:Electromagnetic spectrum, production of x-rays, x-ray spectra,Brehmsstrahlung, Characteristic x-ray. X-ray tubes & types: Coolidge tube, x-ray tubedesign, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, qualityand intensity of x-ray. X-ray generator circuits, half wave and full wave rectification,filament circuit, kilo voltage circuit. Single and three phase electric supply. Powerratings. Types of X-Ray Generator, high frequency generator, exposure timers andswitches, HT cables. Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging,Radioisotope imaging equipment, Single photon and positron emission tomography.Therapeutic nuclear medicine: Interaction between radiation and matter Dose andisodose in radiation treatment. Medical Instrumentation: Basic Ideas of Endoscope andCautery, Sleep Apnea and Cpap Machines, Ventilator and its modes.

UNIT-IV(15 Hours)

Medical Imaging and Radiation Oncology Physics

Evolution of Medical Imaging, X-ray diagnosticsand imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRIRadiological imaging, Ultrasound imaging, Physics of Doppler with applications andmodes, Vascular Doppler. Radiography: Filters, grids, cassette, X-ray film, filmprocessing, fluoroscopy. Computed tomography scanner- principle and function,display, generations, mammography. Thyroid uptake system and Gamma camera (OnlyPrinciple, function and display). External Beam Therapy (Basic Idea):Telecobalt, Conformal Radiation Therapy (CRT), 3DCRT, IMRT, Image GuidedRadiotherapy, EPID, Rapid Arc, Proton Therapy, Gamma Knife, Cyber Knife. ContactBeam Therapy (Basic Idea): Brachytherapy- LDR and HDR, Intra OperativeBrachytherapy. Radiotherapy, kilo voltage machines, deep therapy machines, Telecobaltmachines, Medical linear accelerator. Basics of Teletherapy units, deep X-ray,Telecobalt units, Radiation protection, external beam characteristics, dose maximum andbuild up – bolus, percentage depth dose, tissue maximum ratio and tissue phantom ratio,Planned target Volume and Gross Tumour Volume.

Reference Books:

1. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978).
2. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
3. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry -Lippincot Williams and Wilkins (1990).
4. Physics of the human body, Irving P. Herman, Springer (2007).
5. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition (2003)
6. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002).
7. Handbook of Physics in Diagnostic Imaging: R.S.Livingstone: B.I. Publication Pvt Ltd.
8. The Physics of Radiology-H E Johns and Cunningham.

MEDICAL PHYSICS LAB

Subject Code: BPHYD1-622 **L T P C** **0 0 4 2** **Duration: 60 Hrs.**

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective: To give practical knowledge of experiments related to medical physics.

Course Outcome: After the completion of the course, students will be able to handle the setups related to medical physics.

1. Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure.
2. Understanding the working of a manual optical eye-testing machine and to learneye-testing procedure.
3. Correction of Myopia (short sightedness) using a combination of lenses on anoptical bench/breadboard.
4. Correction of Hypermetropia/Hyperopia (long sightedness) using a combinationof lenses on an optical bench/breadboard.
5. To learn working of Thermoluminescent dosimeter (TLD) badges and measurethe background radiation.

6. Familiarization with Geiger-Muller (GM) Counter and to measure backgroundradiation.
7. Familiarization with Radiation meter and to measure background radiation.
8. Familiarization with the Use of a Vascular Doppler.

Reference Books:

1. Basic Radiological Physics, Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
2. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
3. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition (2003)
4. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
5. Handbook of Physics in Diagnostic Imaging: Roshan S. Livingstone: B. I.Publications Pvt Ltd.
6. The Physics of Radiology-H E Johns and Cunningham.

PHYSICS OF DEVICES AND COMMUNICATION

Subject Code: BPHYD1-623 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

UNIT-I

Devices (15 Lectures)

Characteristic and small signal equivalent circuits of UJT and JFET. Metal semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode. Multivibrators: A stable and Monostable Multivibrators using transistors.

UNIT-II

Processing of Devices (15 Lectures)

Basic process flow for IC fabrication, Electronic grade silicon.Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Feature size control and wet anisotropic etching. Lift off Technique. Diffusion and implantation.

UNIT-III

Power supply and Filters (15 Lectures)

Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection (3 Lectures)

Phase Locked Loop(PLL): Basic Principles, Phase detector(XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter– Function, Loop Filter Circuits, transient response, lock and capture. Basic idea of PLL IC (565 or 4046).

UNIT-IV

Digital Data Communication Standards (15 Lectures)

Serial Communications: RS232, Handshaking, Implementation of RS232 on PC. Universal Serial Bus (USB): USB standards, Types and elements of USB transfers. Devices (Basic idea of UART). Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.

Reference Books:

1. Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley & Sons
2. Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt. Ltd.
3. Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt. Ltd
4. Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd.
5. Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
6. Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt. Ltd.
7. Semiconductor Physics and Devices, D.A. Neamen, 2011, 4th Edition, McGraw Hill
8. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

PHYSICS OF DEVICES AND COMMUNICATION LAB

Subject Code: BPHYD1-624 **L T P C** **0 0 4 2** **Duration: 60 Hrs.**

<u>Note:</u> Any 10 experiments can be performed in a semester. Any other subject related experiment can also be included.

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters of given specification.
3. To design a common source JFET Amplifier and study its frequency response.
4. To study the output characteristics of a MOSFET.
5. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
6. To design an Astablemultivibrator of given specifications using transistor.
7. To study a PLL IC (Lock and capture range).
8. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.
9. Design the inverting and non-inverting amplifier using an Op-Amp of given gain.
10. Design and Verification of op-amp as integrator and differentiator
11. Design the 1st order active low pass and high pass filters of given cut off frequency
12. Design a Wein`s Bridge oscillator of given frequency.
13. Design clocked SR and JK Flip-Flop`s using NAND Gates
14. Design 4-bit asynchronous counter using Flip-Flop ICs
15. Design an Astablemultivibrator using IC555 of given duty cycle.

ATMOSPHERIC PHYSICS

Subject Code: BPHYD1-625 | **L T P C 4 0 0 4** | **Duration: 60 Hrs.**

UNIT—I

The Atmosphere and its Constituents: (16Hrs.)

History and Evolution of Earth's Atmosphere, Thermal structure of the Earth's Atmosphere, Ionosphere, Composition of atmosphere, Hydrostatic equation, Potential temperature, Atmospheric Thermodynamics, Greenhouse effect and effective temperature of Earth, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze. Atmospheric Trace Constituents, Atmospheric Ozone, Particulate Matter (Aerosols), Stratospheric Aerosol, Chemical Components of Tropospheric Aerosol, Cloud Condensation Nuclei (CCN), Carbonaceous Particles, Mineral Dust, Biomass Burning, Summary of Atmospheric Particulate Matter.

Atmospheric Radiation and its Absorbtion: (14 Hrs.)

Spectral distribution of the solar radiation, Radiative Flux in the Atmosphere, Beer − Lambert Law and Optical depth, Actinic Flux, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere Atmospheric Photochemistry, Absorption of Radiation by Atmospheric Gases, Absorption by O_2 and O_3.

UNIT—III

Atmospheric Aerosol and their Properties(15 Hrs.)

Classification and properties of aerosols, Production and removal mechanisms, the Size Distribution Function ,The Number Distribution nN(Dp), The Surface Area, Volume, and Mass Distributions, Distributions Based on lnDp and log Dp, Relating Size Distributions Based on Different Independent Variables, Properties of Size Distributions, Definition of the Lognormal Distribution, Plotting the Lognormal Distribution, Properties of the Lognormal Distribution Ambient Aerosol Size Distributions, Urban Aerosols, Marine Aerosols, Rural Continental Aerosols, Remote Continental Aerosols, Free Tropospheric Aerosols, Polar Aerosols, Desert Aerosols Radiative and health effects.

UNIT—IV

Observational Techniques for Aerosols (15 Hrs.)

Sampling and Measurement Using Inertial, Gravitational, Centrifugal, and Thermal TechniquesSampling and Analysis Using Filters, Methods for Chemical Analysis of Atmospheric Aerosols,Microscopy and Microanalysis of Individual Collected Particles, Real-Time Particle Analysis by Mass Spectrometry, Optical Measurement Techniques: Fundamentals and Applications, Real-Time Techniques for Aerodynamic Size Measurement, Instruments and Samplers Based on Diffusional Separation, Condensation Particle Counters, Electrical Mobility Methods for Submicrometer Particle Characterization, Instruments Based on Electrical Detection of Aerosols, Calibration of Aerosol Instruments, Lidar and its applications, Data analysis tools and techniques.

Reference Books:

1. Fundamental of Atmospheric Physics – Murry L Salby; Academic Press, Vol 61, 1996.
2. The Physics of Atmosphere – John T. Houghton; Cambridge University press; 59 3rd edn. 2002. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
3. Atmospheric Chemistry and Physics, John H. Seinfeld, Spyros N. Pandis; Wiley; third edition 2016
4. Radar for meteorological and atmospheric observations – S Fukao and K Hamazu, Springer Japan, 2014.
5. Aerosol Measurement: Principal, Techniques and Applications, Pramod Kulkarni and Klaus Willeke, Wiley; third edition 2011

ATMOSPHERIC PHYSICS LAB

Subject Code: BPHYD1-626 **L T P C** **0 0 4 2** **Duration: 60Hrs.**

Note: Any other subject related experiment can also be included.

1. Scilab/C++ based simulations experiments based on Atmospheric Physics problems like Numerical Simulation for atmospheric waves using dispersion relations (a) Atmospheric gravity waves (AGW) (b) Kelvin waves (c) Rossby waves, and mountain waves
2. To determine AQI of different locations (less polluted, heavily polluted) of city.
3. To plot the size distribution of aerosol using different scales.
4. Time series analysis of temperature using long term data over metropolitan cities in India – an approach to understand the climate change
5. Monitoring of SO_2, NOx, CO, SPM in air.
6. Wind Roses: their preparation and interpretation
7. Estimation of rainfall, humidity, temperature
8. Analysis of meteorological data: rainfall, humidity, temperature
9. Offline and online processing of LIDAR data
10. Handling of satellite data and plotting of atmospheric parameters using radio occultation technique

Reference Books:

1. Fundamental of Atmospheric Physics – Murry L Salby; Academic Press, Vol 61, 1996.
2. The Physics of Atmosphere – J.T. Houghton; Cambridge Univ. Press; 3rd edn. 2002.
3. An Introduction to dynamic meteorology – James R Holton; Academic Press, 2004.

DIGITAL SIGNAL PROCESSING

Subject Code: BPHYD1-627 **L T P C** **Duration: 60Hrs.**
4 0 0 4

UNIT—I

Concepts of Signals, Systems and Filters: Classification of Signals, Transformations of the Independent Variable, Periodic and Aperiodic Signals, Energy and Power Signals, Even and Odd Signals, Discrete-Time Systems, System Properties. Impulse Response, Convolution Sum; Graphical Method; Analytical Method, Properties of Convolution; Commutative; Associative; Distributive; Shift; Sum Property System Response to Periodic Inputs, Relationship Between LTI System Properties and the Impulse Response; Causality; Stability; Invertibility, Unit Step Response. Phase Delay and Group delay, Zero-Phase Filter, Linear-Phase Filter, Simple FIR Digital Filters, Simple IIR Digital Filters, All pass Filters, Averaging Filters, Notch Filters.

UNIT—II

Discrete-Time Fourier Transform: Fourier Transform Representation of Aperiodic DiscreteTime Signals, Periodicity of DTFT, Properties; Linearity; Time Shifting; Frequency Shifting; Differencing in Time Domain; Differentiation in Frequency Domain; Convolution Property. The z-Transform: Bilateral (Two-Sided) z-Transform, Inverse z-Transform, Relationship Between z-Transform and Discrete-Time Fourier Transform, z-plane, Region-of-Convergence; Properties of ROC, Properties; Time Reversal; Differentiation in the z-Domain; Power Series Expansion Method (or Long Division Method); Analysis and Characterization of LTI Systems; Transfer Function and Difference-Equation System. Solving Difference Equations.

UNIT—III

Discrete and Fast Fourier Transform: Frequency Domain Sampling (Sampling of DTFT), The Discrete Fourier Transform (DFT) and its Inverse, DFT as a Linear transformation, Properties; Periodicity; Linearity; Circular Time Shifting; Circular Frequency Shifting; Circular Time Reversal; Multiplication Property; Parseval's Relation, Linear Convolution Using the DFT (Linear Convolution Using Circular Convolution), Circular Convolution as Linear Convolution with aliasing. Direct Computation of the DFT, Symmetry and Periodicity Properties of the Twiddle factor (WN), Radix-2 FFT Algorithms; Decimation-In-Time (DIT) FFT Algorithm; Decimation-In-Frequency (DIF) FFT Algorithm, Inverse DFT Using FFT Algorithms.

UNIT—IV

Realization of Digital Filters: Non Recursive and Recursive Structures, Canonic and Non Canonic Structures, Equivalent Structures (Transposed Structure), FIR Filter structures; DirectForm; Cascade-Form; Basic structures for IIR systems; Direct-Form I. Finite Impulse Response Digital Filter: Advantages and Disadvantages of Digital Filters, Types of Digital Filters: FIR and IIR Filters; Difference Between FIR and IIR Filters, Desirability of Linear-Phase Filters, Frequency Response of Linear-Phase FIR Filters, Impulse Responses of Ideal Filters, Windowing Method; Rectangular; Triangular; Kaiser Window, FIR Digital Differentiators. Infinite Impulse Response Digital Filter: Design of IIR Filters from Analog Filters, IIR Filter Design by Approximation of Derivatives, Backward Difference Algorithm, Impulse Invariance Method.

Reference Books:

1. Digital Signal Processing, Tarun Kumar Rawat, 2015, Oxford University Press, India
2. Digital Signal Processing, S. K. Mitra, McGraw Hill, India.
3. Modern Digital and Analog Communication Systems, B.P. Lathi, 1998, 3rd Edn. Oxford University Press.
4. Fundamentals of Digital Signal processing using MATLAB, R.J. Schilling and S.L. Harris, 2005, Cengage Learning.
5. Fundamentals of signals and systems, P.D. Cha and J.I. Molinder, 2007, Cambridge University Press.
6. Digital Signal Processing Principles Algorithm & Applications, J.G. Proakis and D.G.Manolakis, 2007, 4th Edn., Prentice Hall.

DIGITAL SIGNAL PROCESSING LAB

Subject Code: BPHYD1-628	L T P C 0 0 4 2	Duration: 60Hrs.

Note: Any 10 experiments can be performed in a semester. Any other subject related experiment can also be included.

1. Waveform generation -Square, Triangular and Trapezoidal.
2. Computation of DFT, IDFT using Direct and FFT methods.
3. Design of Butterworth and Chebyshev of LP & HP filters.
4. Design of LPF using rectangular and Hamming, Kaiser Windows.
5. Generation of sine wave and square wave using DSP trainer kit.
6. Response of Low pass and High pass filters using DSP trainer kit.
7. Key pad interfacing with DSP.
8. LED interfacing with DSP.
9. DC Motor 4- quadrant speed control using DSP.
10. Three phase 1M speed control using DSP.
11. Brushless DC Motor Control.

Scilab based simulations experiments:

12. Write a program to generate and plot the following sequences: (a) Unit sample sequence $\delta(n)$,(b) unit step sequence $u(n)$, (c) ramp sequence $r(n)$, (d) real valued exponential sequence $x(n)=(0.8)^n u(n)$ for $0 \le n \le 50$.
13. Given a casual system: $y(n) = 0.9y(n - 1) + x(n)$ (a) Find $H(z)$ and sketch its pole-zero plot(b) Plot the frequency response $|H(e^{i\omega})|$ and $H(e^{i\omega})$.
14. Design a digital filter to eliminate the lower frequency sinusoid of $x(t) = \sin 7t + \sin 200t$. The sampling frequency is $f_s = 500$ Hz. Plot its pole zero diagram, magnitude response, input and output of the filter.
15. Using a rectangular window, design a FIR low-pass filter with a pass-band gain of unity, cutoff frequency of 1000 Hz and working at a sampling frequency of 5 KHz. Take the length of the impulse response as 17.
16. Design an FIR filter to meet the following specifications: passband edge Fp = 2 KHz ; stopband edge Fs = 5 Khz; Passband attenuation Ap = 2 Db; Stopband attenuation As = 42 dB; Sampling frequency Fs = 20 KHz.
17. The frequency response of a linear phase digital differentiator is given by $H_d(e^{i\omega}) = i\omega e^{-i\tau\omega}$ $|\omega| \le \pi$ Using a Hamming window of length M = 21, design a digital FIR differentiator. Plot the amplitude response.