Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

DIT UNIVERSITY
Dehradun

Detailed Course Structure
of

BSc (H) Physics

Amended by the BoS and approved by the Academic Council at its 11th Meeting held on 29.04.2019

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch
Course Structure

Year: 1st **Semester: I**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	PY106	Mathematical Physics-I	3	1	0	4
CC	PY107	Mechanics	3	1	4	6
AEC	PY108	Renewable Energy and Energy Harvesting	3	0	0	3
AEC	HS101	Professional Communication	2	1	1	3.5
GEC	CH107	Physical Chemistry - I	3	1	2	5
SEC	ME104	Workshop Practice	0	0	2	1
		Total	**14**	**4**	**11**	**22.5**

Year: 1st **Semester: II**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	PY116	Electricity and Magnetism	3	1	4	6
CC	PY117	Waves and Optics	3	1	4	6
GEC	MA116	Ordinary differential Equation and Laplace Transform	3	1	0	4
SEC	HS102	Corporate Communication and Soft Skills	2	1	1	3.5
AEC	ME103	Engineering Graphics	0	0	3	1.5
		Total	**11**	**4**	**12**	**21**

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Year: 2nd **Semester: III**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	PY206	Mathematical Physics-II	3	1	0	4
CC	PY207	Thermal Physics	3	1	4	6
CC	PY208	Digital Systems and Applications	3	1	4	6
GEC	CA102	Programming in C	3	0	2	4
GEC	MA206	COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES (CBNST)	3	0	2	4
		Total	**15**	**3**	**12**	**24**

Year: 2nd **Semester: IV**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	PY216	Mathematical Physics-III	3	1	0	4
CC	PY217	Elements of Modern Physics	3	1	4	6
CC	PY218	Analog Systems and Applications	3	1	4	6
AEC	CH201	Environmental Science	2	0	0	2
SEC	PY219	Basic Instrumentation Skills	3	0	0	3
		Total	**14**	**3**	**8**	**21**

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Year: 3rd **Semester: V**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	PY306	Quantum Mechanics and Applications	3	1	0	4
CC	PY307	Solid State Physics	3	1	4	6
DSE	PY3**	DSE-I	3	1	0	4
DSE	PY3**	DSE-II	3	1	0	4
DSE	PY3**	DSE-III	3	1	0	4
PJCT	PY308	Minor Project	0	0	8	4
SEM	PY309	Seminar	0	0	4	2
		Total	**15**	**5**	**16**	**28**

DSE-I	
PY346	Nuclear and Particle Physics
PY347	Experimental Techniques
DSE-II	
PY348	Physics of Devices and Instrumentation
PY349	Applied Dynamics
DSE-III	
PY356	Advanced Mathematical Physics
PY377	Medical Physics

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Year: 3rd Semester: VI

Course Category	Course Code	Course Title	L	T	P	Credit
CC	PY326	Electromagnetic Theory	3	1	0	4
CC	PY327	Statistical Mechanics	3	1	0	4
DSE	PY3**	DSE-IV	3	1	0	4
DSE	PY3**	DSE-V	3	1	0	4
DSE	PY3**	DSE-VI	3	1	0	4
PJCT	PY328	Major Project	0	0	8	4
SEM	PY329	Seminar	0	0	4	2
		Total	**15**	**5**	**12**	**26**

DSE-IV	
PY358	Classical Dynamics
PY359	Atmospheric Physics
DSE-V	
PY366	Earth Science
PY367	Embedded systems- Introduction to Microcontroller
DSE-VI	
PY376	Biophysics
PY357	Nano Materials and Applications

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Summary of the Credit

Year	Semester	Credit
1	1	22.5
	2	21
2	3	24
	4	21
3	5	28
	6	26

Category wise classification of the Credit

Category		Credit	Number of Subjects
CC	Departmental Core Course	72	14
AEC	Ability Enhancement Course	10	4
SEC	Skill Enhancement Course	7.5	3
GEC	Generic Elective Course	18	4
DSE	Discipline Specific Course	24	6
PRJT/THESIS	Project	8	2
SEM	Seminar	4	2
VAT/EEP/APT			
Total		**143.5**	**35**

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Subject Code	PY106	**Subject Title**	Mathematical Physics-I						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	1st	**Semester**	I

Course Outline:

The course broadly covers vector analysis of different functions, vector differentiation and integration, gradient, divergence and curl of different variables, different orthogonal curvilinear co-ordinates.

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 Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1
Recapitulation: Limits, continuity, average and instantaneous quantities, differentaiation. Plotting Functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). First Order Differential Equations and Integrating Factor.
Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. 12 L

UNIT 2
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. 6 L

UNIT 3
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, Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates. 8 L

UNIT 4

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). 8 L

UNIT 5
Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. 5 L

Learning Outcome

1. Informally explain concept of limit of function of two variables
2. Solve ordinary second order differential equations important in the physical sciences
3. Explore the mathematical aspect of basic physical phenomenon like Divergence and Curl, which will be applied in other courses like Quantum Mechanics, Electricity and Magnetism etc.
4. Solve problems involving geometric relationships between lines and/or planes
5. Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics

Text book [TB]:

1. Vector Analysis, Murray R. Spiegel, Seymour Lipschutz, Dennis Spellman, second edition, Tata McGraw-Hill, 2009.
2. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., Jones and Bartlett Learning, 2012.

Reference books [RB]:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 7th Edn., Elsevier, 2013
2. Mathematical Physics, H. K. Dass, Rama Verma, S.Chand & Company Pvt. Ltd., 2014
3. Mathematical Tools for Physics, James Nearing, Dover Publications, 2010

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Subject Code	PY107	**Subject Title**	Mechanics						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	1st	**Semester**	I

Course Outline:

This course starts with the basic concepts of work, energy and collisions between particles. The course then covers the angular motion of bodies and moment of inertia, elasticity, fluid motion, laws of gravitation and special theory of relativity.

Course Objective:

The aim of this course is to introduce students to both elementary classical mechanics and the basic ideas of Special Relativity

Course Pre/Co- requisite (if any) : Basic knowledge of vectors

Detailed Syllabus

UNIT 1: Work, Energy and Collisions

Work and Kinetic Energy Theorem. Conservative and nonconservative 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. Elastic and inelastic collisions between particles. 7 L

UNIT 2

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

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube

10 L

UNIT 3

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. Basic idea of global positioning system (GPS). Physiological effects on astronauts. 9 L

UNIT 4

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems 5 L

UNIT 5

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. Transformation of Energy and Momentum. 8 L

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Learning Outcome

Having successfully completed this course the student will be able to:

1. To know Newton's laws of motion, potentials, conservation of energy, momentum and angular momentum, and be able to apply them to projectiles, circular motion, and gravity
2. Demonstrate rigid body and rotational dynamics using the concept of angular velocity and momentum.
3. Demonstrate an understanding of intermediate mechanics topics such as co-ordinate transformations, oscillatory motion, gravitation etc.
4. Understand the concept of non-inertial frames of reference, coriolis and centripetal accelerations and their applications
5. Understand the postulates of Special Relativity and their consequences in terms of Time dilation and length contraction, Lorentz transformations, relativistic kinematics and the relation between mass and energy

Text book [TB]:

1. Mechanics, D.S. Mathur, S. Chand & Co., 2012.
2. Introduction to Mechanics, D. Kleppner & R. Kolenkow, Cambridge University Press, 2017

Reference books [RB]:

1. Analytical Mechanics, G.R. Fowles and G.L. Cassiday., Cengage Learning India Pvt. Ltd., 2006
2. Introduction to Special Relativity, R. Resnick, John Wiley and Sons, 2007
3. Principles of Mechanics, J.L. Synge & B.A. Griffiths, Andesite Press, 2015

SR.NO.	LIST OF EXPERIMENTS
1	To determine the Moment of Inertia of a Flywheel
2	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method)
3	To determine the Modulus of Rigidity of a Wire by Maxwell's needle
4	To determine the Modulus of Rigidity of a Wire by Maxwell's needle
5	To determine the elastic Constants of a wire by Searle's method
6	To determine the value of g using Bar Pendulum
7	To measure the Young's Modulus using Bending of Beam
8	To determine the value of g using Kater's Pendulum
9	To determine the frequency of AC mains using sonometer.
10	To determine the frequency of AC mains or of an electric vibrator by Melde's experiment

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<table>
<tr><td>Subject Code</td><td>PY108</td><td>Subject Title</td><td colspan="7">Renewable Energy and Energy Harvesting</td></tr>
<tr><td>LTP</td><td>3 0 0</td><td>Credit</td><td>3</td><td>Subject Category</td><td>AEC</td><td>Year</td><td>1st</td><td>Semester</td><td>I</td></tr>
</table>

Course Outline:
The course gives the students an idea of natural energy resources and how they can be utilized for energy demand in near future

Course Objective:

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

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

Unit 1: Introduction and solar energy

Introduction to renewable energy, Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources.
Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. 10 L

Unit 2: Wind and ocean energy

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.
Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. 8 L

Unit 3: Tide and geothermal energy

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.
Geothermal Energy: Geothermal Resources, Geothermal Technologies 7 L

Unit-4: Electromagnetic Energy Harvesting

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications in presence of magnetic materials. 4 L

Unit- 5: Carbon capture technologies, fuel cells & environment

Carbon captured technologies, cell, batteries, power consumption
Environmental issues and Renewable sources of energy, sustainability 4 L

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Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:

1. Create awareness among students about Non-Conventional sources of energy technologies
2. Enable students to understand various renewable energy technologies and systems
3. Equip the students with knowledge and understanding of various possible mechanisms about renewable energy projects.
4. Discuss the positive and negative aspects of energy resources to natural and human aspects of the environment.

Text book [TB]:

1. Non-conventional energy sources, G.D Rai, Khanna Publishers, New Delhi. 2015
2. Non-conventional energy sources, AS.H Saeed & D. K. Sharma, SK Kateria and sons, N. Delhi, 2008
3. Non-conventional energy sources, B.H.Khan, III Ed, McGraw Hill Education,.

Reference books [RB]:

1. Solar Energy: Resource Assesment Handbook, Dr. P Jayakumar, 2009
2. Photovoltaics, J.Balfour, M.Shaw and S. Jarosek, Lawrence J Goodrich (USA).

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Subject Code	HS101	Subject Title	Professional Communication						
LTP	2-1-1	Credit	3.5	Subject Category	AEC	Year	1st	Semester	I

Course Objective:

1. To develop the LSRW skills of students for effective communication
2. To equip the students for business environment
3. To prepare the students understand and present themselves effectively

Unit-I
Effective Communication 7 L
Communication: Meaning, Types of Communication: General & Technical Communication
Barriers to Communication, Overcoming strategies.

Unit II
Effective Non Verbal Communication 3 L
Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics

Unit III
Effective Listening & Speaking Skills 7 L
Listening Comprehension: identifying General & Specific information, Note taking and drawing inferences
Introduction to Phonetics : Articulation of consonants and vowel sounds.
Public Speaking
Discussion Techniques

Unit IV
Reading Skills 4 L
Reading Strategies and Vocabulary Building
Reading Comprehension

Unit V
Effective Technical Writing Skills 9 L
Paragraph development
Technical Articles, Research Articles, Plagiarism
Intra office Correspondence: Notice, Agenda, Minutes and Memorandum,
Technical Proposal & Report

Learning Outcome:

At the end of this course, the student will be able to

CO 1 Communicate smoothly
CO 2 Write formal documents
CO 3 Present themselves effectively

TEXT BOOKS

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Raman, Meenakshi and Sangeeta Sharma,. Technical Communication: Principles and Practice, 2nd Edition. New Delhi: Oxford University Press. 2011.

REFERENCE BOOKS

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
4. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad.2010.
5. Tyagi, Kavita & Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.

SR.NO.	LIST OF EXPERIMENTS
1	Neutralization of Mother Tongue Influence through manner of articulation, Introductionto Speech Sounds – Practicing Vowel and Consonant sounds
2	Listening (Biographies through software)
3	Presentation of Biographies
4	Role Play on Situational Conversation
5	Role Play on Situational Conversation
6	Public Speaking
7	Public Speaking
8	Group Discussion
9	Group Discussion
10	Final evaluation based on Extempore
11	Final evaluation based on Extempore

Subject Code	CH-107	**Subject Title**	**PHYSICAL CHEMISTRY-I**						
LTP	3 1 2	**Credit**	**5**	**Subject Category**	GEC	**Year**	1st	**Semester**	I

COURSE OUTLINE:

The course covers the gaseous states kinetics and P-V-R relations in the first unit. The second unit is renders details of the types of crystalline packing and symmetry for prototype crystalline solids. The third unit covers the thermodynamics of gaseous expansions and compressions and changes in intrinsic parameters, like, enthalpy, internal energy during gaseous phase reactions. The fourth unit covers the chemical kinetics of molecular collisions and new bond formations attaining transition states and fifth unit gives insights of the effects of catalysts on the rate kinetics of reactions.

COURSE OBJECTIVE:

The objectives of this course involve learning of the basics concepts of Physical Chemistry, kinetics and thermodynamics of reactions.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of gaseous laws and equations regarding Pressure-Volume-Temperature dependency of gaseous molecules. Students should also have prior understanding of crystalline nature of well known salts (NaCl) to be further explained and basis of homogenous solutions and colloidal suspensions.

DETAILED SYLLABUS

Unit I: Gaseous state **7 L**

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.

Unit 2: Solid State & Colloidal State **9 L**

Definition of space lattice, unit cell, Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices (iii) Law of symmetry, Symmetry elements in crystals. X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method). Definition of colloids, classification of colloids; Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold
number. Liquids in liquids (emulsions) : types of emulsions, preparation, Emulsifier, Liquids in solids (gels) : classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.

Unit 3: Thermodynamics **9 L**

Definition of thermodynamic terms: System, Surroundings, etc., Types of systems, Intensive and extensive properties, State and path functions and their differentials, Thermodynamic process, Concept of heat and work.
First law of thermodynamics: Statement, Definition of internal energy and enthalpy, Heat capacity,
Heat capacities at constant volume and pressure and their relationship, Joule's law, Joule-Thomson coefficient and inversion temperature, Calculation of w, q, dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Application to cyclic process (The Carnot Theorem), Carnot cycle and its efficiency.
Thermochemistry: Standard state, Standard enthalpy of formation, Hess's law of constant heatsummation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data,Temperature dependence of enthalpy, Kirchhoff's equation, Numerical.

Unit 4 : Chemical Kinetics **8 L**

Chemical Kinetics and its scope, Rate of reaction, Factors influencing the rate of reaction: concentration, temperature, pressure, solvent, light, catalyst and surface area. Concentration dependence of rates, Mathematical characteristics of simple chemical reactions: zero order, first order, second order, pseudo order, half life and mean life period, Determination of the order of reaction: differentiation method, method of integration, method of half life period and isolation method, Radioactive decay as a first order phenomenon.Effect of temperature on rate of reaction, Arrhenius equation, Concept of activation energy.Parallel, Consecutive and Opposing reactions, Potential energy Surfaces

Unit V5: Catalysis **6 L**

Catalysis, characteristics of catalyzed reactions, classification of catalysis, homogeneous and heterogeneous catalysis, enzyme catalysis, miscellaneous examples.

Learning outcome:-

At the end of the course, the student will able to:

1. Explain the kinetic of gaseous diffusion and viscosity based on various parameters; understanding of gaseous mixture separation based on partial pressures.
2. Explain the crystal structures and symmetry elements present in various crystal based on the understanding of X-ray diffraction technique of Crystal lattices
3. Explain the colloidal states of matter, their formulation, stabilization and applications based on certain principles; such as Gold number and Hardy-Schulze law.
4. Explain the first law of Thermodynamics and its derivation; interpretation of Carnot cycle and able to work-out the enthalpies of different types of reactions
5. Understand the kinetics of reactions and dependency of reaction rate on various parameters and solve the reaction orders; their half-lives and various models of reaction progression.
6. Understand the nature of catalysts and kinetics of catalyzed reactions.

TEXT BOOKS

1. Physical Chemistry, Atkins, P. W. & Paula, J. de Atkin’s, 8th Ed., Oxford University Press (2006).
2. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

REFERENCE BOOKS

1. Physical Chemistry, Ball, D. W., 2nd Ed., Cengage Press, India (2007).
2. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

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SR.NO.	EXPERIMENT NAME
1	**Surface tension measurements** (use of organic solvents excluded). (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:** Study the effect of variation of viscosity of an aqueous solution with the concentration of solute.
3	**pH measurements** (a)Measurement of pH of different solutions using pH-meter. (b)Preparation of buffer solutions (i)Sodium acetate-acetic acid (ii)Ammonium chloride-ammonium hydroxide
4	**pH metric titrations of** (i)strong acid and strong base (ii)weak acid and strong base
5	**Chemical Kinetics** (i)To study the effect of acid strength on the hydrolysis of an ester. (ii)To compare the strengths of HCl and H2SO4 by studying the kinetics of hydrolysis of ethyl acetate.

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Subject Code	**ME104**	**Subject Title**	**Workshop Practice**						
LTP	0-0-2	**Credit**	1	**Subject Category**	SEC	**Year**	1^{st}	**Semester**	I

Course Outline:

Course Objective:
Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate

Course Pre/Co- requisite (if any):

UNIT 1: Machine Shop
To make a machined-component using lathe with mild steel round bar or hexagonal bar
Comprising of common turning operations with reference to drawing given in the manual.
Any one of the following jobs
Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

UNIT 2: Sheet metal Shop
To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint.
Any one of the following jobs
Jobs: Square tray, Scoop, Funnel

Fitting Shop
To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

UNIT 3: Welding Shop- Arc Welding
To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.
Any one of the following jobs
Jobs: Lap joint, Butt joint, Fillet/Corner joint

Gas & Spot Welding
To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. sheet

UNIT 4: Carpentry Shop
To make a wooden joint with soft wood as per the drawing provided in the manual.
Any one of the following jobs
Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

UNIT 5: Foundry Shop
Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry.
Demo of mould preparation

Minor Project:
To make a minor project by the students in batches comprising the operations performed in different shops

Learning Outcome

At the end of the course, the student will be able to:
CO1: Have Capability to identify hand tools and instruments for machining and other workshop practices.
CO2: Obtain basic skills in the trades of fitting, carpentry, welding and machining
CO3: Acquire measuring skills, using standard workshop instruments & tools.
CO4: Gain eye hand co-ordination, enhance psycho motor skills and attitude.

Text book [TB]:

1. A course in Workshop Technology Vol I and Vol II by Prof. B.S. RaghuwanshDhanpat Rai & Co.(P) Ltd.
2. Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury ,A.K. Hajara Choudhury & Nirjhar Roy ;Media Promoters & Publishers Pvt. Ltd, Mumbai

Reference Books [RB]:

WorkshopTechnology Part 1 , Part2 & Part3 by W.A.J. Chapman;CBS Publishers & Distributors, New Delhi.

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Subject Code	PY116	**Subject Title**	Electricity and Magnetism						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	1st	**Semester**	II

Course Outline:

The course starts with the review of vector analysis, then it covers electrostatics and magnetostatics and different applications.

Course Objective:

The aim of this course is to establish a grounding in electromagnetism in preparation for more advanced courses.

Course Pre/Co- requisite (if any) : Basic knowledge of vectors, electric and magnetic fields

Detailed Syllabus

Unit 1: Electric Field and Electric Potential

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of 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. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor.

12 **L**

Unit 2: Dielectric Properties of Matter

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. 5 **L**

Unit 3: Magnetic Field

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

8 **L**

Unit-4: Magnetic Properties of Matter & Electromagnetic Induction

Magnetization vector (**M).** Magnetic Intensity (**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis.

Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Energy stored in a Magnetic Field. Charge Conservation and Displacement current. 8 **L**

Unit- 5: Electrical Circuits & Network theorems

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor

Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Maximum Power Transfer theorem 4 **L**

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Applicable for 2019-22 Batch

Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:

1. To understand the basics and their use in problem solving.
2. To understand dielectric behavior in an electrostatic potential
3. To understand Biot- Savart law and Ampere's law and their use in problem solving.
4. To understand the magnetic properties and induction laws and use of induction laws in problem solving.
5. To understand the behavior of an electric circuit with ac and dc currents/ use of various theorems for problem solving.

Text book [TB]:

1. Introduction to Electrodynamics, David Griffiths, 4 edition, Pearson Education India Learning Private Limited; (2015)
2. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, Tata McGraw, 2012

Reference books [RB]:

1. Electricity and Magnetism, Edward M. Purcell, McGraw-Hill Education, 1986
2. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, Oxford Univ. Press, 1991

SR.NO.	LIST OF EXPERIMENTS
1	Identification of resistors, capacitors, Led, diode and transistor
2	Use of millimeter for measuring the values resistors & capacitors, the functioning of diode, zener, transistors & led, measurement of voltage and current and checking electric fuse.
3	To verify the Thevenin theorem.
4	To verify the Norton theorem.
5	To verify the Superposition theorem.
5	To determine self-inductance of a coil by Anderson's bridge.
6	To study charging and discharging of capacitor through resistance and determine time constant.
7	To determine the unknown value of resistance using wheat stone's bridge.
8	To compare capacitances using De'Sauty bridge.
9	To calculate the resistivity of a given wire using Carrey Foster bridge
10	To study the resonance in series LCR circuit with a source of given frequency.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY117	**Subject Title**	Waves and Optics						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	1st	**Semester**	II

Course Outline:

This course develops a strong background of simple harmonic motion, their superposition, wave motion, interference and diffraction.

Course Objective:

This course introduces the physics of waves, oscillations and the formalism of wave behavior in the context of physical optics.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

Unit 1: Superposition of Collinear 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 (1:1 and 1:2) and their uses 6 **L**

Unit 2: 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 5 **L**

Unit 3: Superposition of Two Harmonic Waves

Vibrations of Stretched Strings, 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. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.
7 **L**

Unit-4: Wave optics & 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 (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.
9 **L**

Unit- 5: Diffraction

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit.
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. 12 **L**

Learning Outcome

Having successfully completed this course the student will be able to:
1. Understand the principle of linear superposition of waves, use phasor description of waves and learn about construction of Lissajous figures
2. Develop the wave equation to find out the relationship between the speeds of propagation of waves.
3. Understand the meaning of wave impedance in case of vibrating strings, air columns and rods.
4. Learn how stationary/standing waves are produces by the superposition of incident and reflected waves in a string fixed at both ends.
5. Understand different modes of vibrations in strings, air columns and rods and learn how different harmonics are produced and also find how stringed instruments work.
6 Understand how wave nature of light can be used to explain the phenomenon of interference and diffraction.
7. Describe interference and diffraction for slits, gratings and interferometers

Text book [TB]:

1. Optics, Ajoy Ghatak, McGraw Hill Education, 2017.
2. The Physics of Waves and Oscillations, N.K. Bajaj, Tata McGraw Hill, 2004

Reference books [RB]:

1. The physics of vibrations and waves, H. J. Pain, Wiley, 2010
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, McGraw-Hill, 2011

SR.NO.	LIST OF EXPERIMENTS
1	(a) To determine wavelength of sodium light using Newton's Rings. (b) To determine the refractive index of a liquid using Newton's Rings.
2	To determine wavelength of sodium light using Fresnel's Biprism.
3	(a) To determine wavelength of prominent lines of mercury using plane diffraction grating. (b) To determine the dispersive power of a plane transmission diffraction grating.
4	To determine the specific rotation of cane sugar solution using bi-quartz polarimeter
5	To study the diffraction pattern of Single slit and hence determine the slit width.
6	(a) To verify cosine square law (Malus Law) for plane polarized light. (b) To study the nature of polarization using a quarter wave plate.
7	To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula
8	(a) To study photoelectric effect and determine the value of Planck's constant. (b) To verify inverse square law using photocell.
9	To determine the frequency of AC mains using sonometer.
10	To determine the frequency of AC mains or of an electric vibrator by Melde's experiment
11	To measure the numerical aperture (NA) of an optical fiber.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	MA116	Subject Title	ORDINARY DIFFERENTIAL EQUATION AND LAPLACE TRANSFORM						
LTP	3 1 0	Credit	4	Subject Category	GEC	Year	1^{st}	Semester	II

OBJECTIVE

This course provides an introduction to the fundamentals of ordinary differential equations and their solutions. It also provides a tool to determine analytical solution of initial value problems by method of Laplace transform.

UNIT I: Introduction to Differential Equations (ODE)

Review of Ordinary Differential Equations, Types of differential equations, Order, Degree, Linear & Non-Linear differential equations, Solution & Formation of differential equations, Linearly dependent and independent set of functions, Wronskian and its properties.

UNIT II: Differential Equations of first Order & first Degree

Differential Equations of first Order & first Degree: Separation of variables, Homogenous differential equations, Linear differential equations, Bernoulli's equation, Exact differential equations.

ODE of First Order but not of First Degree: Ricatti & Clairaut's equation, Singular solution, Orthogonal trajectories, Equations of the type $\frac{d^2y}{d^2x} = f(y)$.

UNIT III: Second and Higher Order ODE

Solution of homogeneous and non-homogeneous linear ODE with constant coefficients using inverse operator method and method of undetermined coefficients, Euler-Cauchy homogeneous linear differential equations, Simultaneous differential equations, Method of variation of parameters, Solution of second order differential equations by changing dependent and independent variable.

UNIT IV: Laplace Transform

Definition of Laplace transform, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, Error functions, Heaviside unit step function and Dirac delta function, Applications of Laplace transform to solve ordinary differential equations.

LEARNING OUTCOMES

After completing this course, students should demonstrate competency in the following skills:

- To understand the order and degree of differential equations and classify them to linear or nonlinear differential equations.
- To determine the solution of differential equation of first order and first degree.
- To understand and identify higher order linear differential equation and determine their solutions by various methods.
- To understand and recognize fundamentals of singular solutions, Clairaut's equations.
- To understand and apply Laplace transform to determine the solution of initial value problems.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 42^{nd} Edition, Khanna Publishers, 2012.

2. G. F. Simmons and G. Krantz Steven, "Differential Equations", 17^{th} Reprint, McGraw Hill Education (India) Private Ltd., 2016 .

Reference Books:

1. M. Tenenbaum, and H. Polard, "Ordinary Differential Equations", Dover Publications, 1985.
2. V.P. Mishra, and J. Sinha, "Elements of Engineering Mathematics", 3rd Edition, S.K. Kataria& Sons, 2013.
3. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, published by John Wiley & Sons, U.K, 2011.
4. B. Rai, D.P. Choudhary and H.I. Freedman, "A Course in Ordinary Differential Equations", 2nd Edition, Narosa Publishing House, 2013.
5. M. D. Raisinghania, "Ordinary and Partial Differential Equations", 19th Edition, S. Chand Publications, 2017.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	HS102	Subject Title	Corporate Communication & Soft Skills						
LTP	2-1-1	Credit	3.5	Subject Category	SEC	Year	1st	Semester	II

Course Outline:

Course Objective:

Course Pre/Co- requisite (if any) :

Unit I
Business Communication10 L
Importance & Features of Business Communication, Flow of Communication: Channels &Networks
Compunication: E mails & E- Tools
Business Presentation
Business Etiquette, Telephonic Etiquette
Business Letter Writing
Job Application Letter & Resume
Interview Skills, Impression Management

Unit II
Personal Skills for Corporate Communication **10** L
SWOT Analysis: Self Assessment, Identifying Strength & Weakness
Self Awareness, Self Disclosure & Self Management (Stress, Anger)
Goal Setting: Personal & Professional Goals, SMART-ER Goals
Human Perception: Understanding People, Perceptions, Attitudes
Personality (Personality Test)

Unit III **10** L
Professional Skills for Corporate Communication
Decision Making: Techniques, Six Thinking Hats
Creative Thinking, Lateral Thinking
Team Building & Leadership Skills
Time Management: Planning Organizing, Time Wasters
Conflict Resolution Skills
Negotiation Skills

REFERENCE BOOKS

1. The Seven Habits of Highly Effective People by Steven R. Covey. 2007.
2. How to win Friends and influence People by Dale Carnegie. 2009.
3. Soft Skills : Know Yourself & Know the World by Dr. Alex . S. Chand Publications 2001.
4. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalswamy Ramesh. 2008.
5. Managing Soft skills for Personality development by B. N Ghosh. 2006.
6. Personality Development by Elizabeth B. Hurlock. TMH Publication. 2010.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

SR.NO.	LIST OF EXPERIMENTS
1	Telephone Etiquette: Making an appointment, answering calls (Role Play)
2	Telephone Etiquette: Making an appointment, answering calls (Role Play)
3	Business Presentations (PPT Presentation)
4	Business Presentations (PPT Presentation)
5	Interview Skills: Mock Interview
6	Interview Skills: Mock Interview
7	Panel Discussion
8	Panel Discussion
9	Conflict & Negotiation (Situational Role Play)
10	Conflict & Negotiation (Situational Role Play)
11	Evaluation
12	Evaluation

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	**ME103**	**Subject Title**	**Engineering Graphics**						
LTP	0-0-3	**Credit**	1.5	**Subject Category**	AEC	**Year**	1st	**Semester**	II

Course Outline:

Course Objective:
The objectives of this course are to enable students to acquire and use engineering graphics skills as a means of accurately and clearly communicating ideas, information and instructions for technical communication.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction to Engineering Graphics
Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Involutes; Scales Plain, Diagonal

UNIT 2: Projection of Points and Planes
Orthographic Projections covering, Principles of Orthographic Projections, Projections of Points and lines inclined to both planes; Projections of planes inclined Planes

UNIT 3: Projection of Solids
Projections of solids in simple position, projections of solids with axes inclined to one reference plane and parallel to other. Projections of solids with axes inclined to both of the reference plane

UNIT 4: Section of Solids and Development of Surfaces
Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone, Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT 5: Isometric Projection and Auto CAD
Isometric Projections, Freehand Sketching, Simple and compound Solids, Conversion of Isometric Views to Orthographic Views (simple machine components according to first angle projection method), Basic AutoCAD commands & its applications

Learning Outcome

At the end of the course, the student will be able to:
CO1: Be able to use Engineering Drawing Skills as a means of accurately and clearly communicating ideas, information and instructions.
CO2: Acquire requisite knowledge, techniques and attitude for advanced study of engineering drawing.
CO3: Comprehend and draw a simple engineering drawing primarily in first angle Orthographic projections.
CO4: To create section views of simple engineering objects
CO5: To understand basic AutoCAD commands and appreciate the need of AutoCAD over Manual Drafting.

Text book [TB]:

1. N. D. Bhatt and V.M. Panchal, "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 53rd edition, 2016 reprint.
2. P.S. Gill, "Engineering graphics", S. K. Kataria& Sons, 13th edition, 2016

Reference Books [RB]:

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Narayana, K.L. & P Kannaiah (2012), Text book on Engineering Drawing, Scitech Publishers
4. D.M. Kulkarni, A.P. Rastogi, A.K. Sarkar, "Engineering Graphics with AutoCAD" , PHI Learning Pvt. Ltd., Ist edition, 2009.

(Corresponding set of) CAD Software Theory and User Manuals

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY206	**Subject Title**	Mathematical Physics-II						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	2^{nd}	**Semester**	III

Course Outline:

This course covers Fourier Series, Frobenius method and special functions, special integrals, partial differential equations and theory of errors.

Course Objective:

The objectives of this course are to:
(i) Introduce students to the use of mathematical methods to solve various physics problems.
(ii) Provide students with basic skills necessary for the application of mathematical methods in physics.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

Unit 1:

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions. Expansion of functions with arbitrary period with application. Parseval Identity. 7 L

Unit 2:

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. 15 L

Unit 3:

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). 4 L

Unit-4:

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. 4 L

Unit- 5:

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes. 9 L

Learning Outcome

Upon completion of this course, students should be able to:

1: Know various types of periodic functions including Fourier expansions and explain how these functions can be used in physics. Use Fourier transform to obtain the Fourier series of periodic functions in physics.
2: Know various second order differential equations viz. Legendre, Bessel, Hermite and Laguerre Differential Equations.
3: Identify different special mathematical functions. Applying special mathematical functions appropriately in solving problems in physics.
4: Know the theory of error which has great importance in physics.
5: Know of partial differential equations in Cartesian, spherical and cylindrical systems. Because so many problems in quantum mechanics can be solved by transformation of one coordinate system to others.

Text book [TB]:

1. Mathematical Methods for Physicists, Arfken, Weber, Harris, Elsevier, 2005.
2. Mathematical Physics, H. K. Das, S. Chand & Company, 2005
3. Fourier Analysis by M.R. Spiegel, Tata McGraw-Hill, 2004.
4. Mathematics for Physicists, Susan M. Lea, Thomson Books/Cole, 2004.

Reference books [RB]:

1. Differential Equations, George F. Simmons, Tata McGraw-Hill, 2006.
2. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, Dover Pub., 1993.
3. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, Viva Books, 2003.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY207	**Subject Title**	Thermal Physics						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	2^{nd}	**Semester**	III

Course Outline:

This course covers temperature, heat exchange, heat capacity, phases of matter, ideal gas law, kinetic theory of gases, zeroth, first, second and third law of thermodynamics, entropy and their applications.

Course Objective:

The objective of this course is to develop a working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics and to use this knowledge to explore various applications. Many of these applications will relate to topics in materials science and the physics of condensed matter.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

Unit 1: Introduction to Thermodynamics

Zeroth and First Law 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, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.
Second Law of Thermodynamics: 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, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. 10 L

Unit 2: 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. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. 6 L

Unit 3: Thermodynamic Potentials

Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations 5 L

Unit-4: Maxwell's Thermodynamic Relations

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.
4 L

Unit- 5: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. Law of Equipartition of Energy (No proof required). 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.
Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 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

14 L

Learning Outcome

Having successfully completed this course, the student will be able to:
1: State the Zeroth, First, Second and Third Laws of thermodynamics, if appropriate in different but equivalent forms and demonstrate their equivalence
2: Understand all the concepts needed to state the laws of thermodynamics, such as 'thermodynamic equilibrium', 'exact' and 'inexact' differentials and 'reversible' and 'irreversible' processes
3: Use the laws of thermodynamics (particularly the first and second laws) to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines
4: Understand the meaning and significance of state variables in general, and of the variables P; V; T;U; S in particular, especially in the context of a simple fluid, and to manipulate these variables to solve a variety of thermodynamic problems
5: Understand the efficiency and properties of thermodynamic cycles for heat engines, refrigerators and heat pumps.
6: Define the enthalpy H, Helmholtz function F and the Gibbs function G and state their roles in determining equilibrium under different constraints

Text book [TB]:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, McGraw-Hill, 1981.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill, 1993

Reference books [RB]:

1. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, Indian Press, 1958
2. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, Springer, 2009.
3. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger, Narosa, 1988.
4. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed, Oxford University Press., 2012

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

SR.NO.	LIST OF EXPERIMENTS
1	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2	To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
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 calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement.
6	To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
7	To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
8	To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.
9	Determine a high resistance by leakage method using Ballistic Galvanometer.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY-208	**Subject Title**	Digital Systems and Applications						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	2nd	**Semester**	III

Course Outline:

This course provides an in depth study of the principles and applications of digital systems . The course covers the basic building blocks of digital systems and the process of building a digital design project and testing it. The laboratory exercises are designed to complement the theory of digital circuits

Course Objective:

1. To inculcate the knowledge in students about the logic circuits and their applications.
2. To demonstrate the knowledge of logic circuits & digital systems for various applications.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1

Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. Negative and Positive logic, 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.

8 L

UNIT 2

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Max terms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. 8 L

UNIT 3

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. (4 Lectures) Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. 8 L

UNIT 4

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. 8 L

UNIT 5

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). (2 Lectures) Counters(4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

7 L

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:

1. The binary, decimal and other numbers systems with their conversion.
2. Boolean algebra and use of simple logic gates for it.
3. The use of simple logic circuits in MUX, DMUX, encoder, decoders as data processing circuits.
4. The use of simple logic circuits in different sequential circuits.
5. The use of sequential circuits in registers, A/D & D/A converters.

Text book [TB]:

1. Digital Circuits and systems, Venugopal, Tata McGraw Hill, 2011.
2. Logic circuit design, Shimon P. Vingron, Springer, 2012.
3. Fundamentals of Digital Circuits, Anand Kumar, PHI Learning Pvt. Ltd., 2016.

Reference books [RB]:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, Tata McGraw, 2010.
2. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, PHI Learning, 1985.

SR.NO.	LIST OF EXPERIMENTS
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.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	**CA102**	**Subject Title**	**Programming in C**						
LTP	**3-0-2**	**Credit**	4	**Subject Category**	GEC	**Year**	2nd	**Semester**	III

Course Objective:

To understand computer programming and its roles in problem solving, Understand and develop well-structured programs using C language, basic file handling operation through implementing in C language.

Detailed Syllabus

UNIT 1

Problem analysis, need for programmed languages, introduction to algorithms, algorithmic representations, Pseudo codes flow charts and decision tables, structured programming and modular programming

UNIT2

Over view of C, Constant, variables, data, types and size, variable declaration, operators and expressions, type conversion, conditional expression, special operators, precedence rules. Decision making, looping and control structures. Data input/output. Input/output: Unformatted & formatted I/O function in C, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(),putch(), putchar(), puts().

UNIT3

Arrays and String: defining and processing an array, one dimensional arrays, multidimensional arrays, passing arrays to functions, Handling of character strings. Pointers: Declaration, operations on pointers, array of pointers, pointers to arrays. Structure and Unions: Defining and processing a structure, user defined data types, structure and Pointers, nested structure, self-referential structures, and unions

UNIT4

Program structure: Storage classes, automatic, external, and static variables. Data files: Opening, closing, creating, and processing and unformatted data field.

UNIT 5

File Management in C: introduction to data files, opening & closing a file, file types, fopen, fgets, fputs, fscanf, fprintf, fclose.

Text book [TB]:

1. **Programming in ANSI C**, Balaguruswamy, Tata McGraw-Hill, 4th Edition, 2008.

2. **Problem Solving and Program Design in C,**Jeri R. Hanly& Elliot P, Pearson, 7thEdition, 2013.

Reference Books

1.The C programming Language., Dennis Ritchie, Pearson,6th Edition,2015.

2.Structured programming approach using C,ForouzanCeilber, Thomson learning publication, 3rdEdition, 2007.

3. Pointers in C ,YashwantKanetkar, BPB Publication,3rd Edition,2003.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

<table>
<tr><td>Subject Code</td><td>MA206</td><td>Subject Title</td><td colspan="7">COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES (CBNST)</td></tr>
<tr><td>LTP</td><td>3 0 2</td><td>Credit</td><td>4</td><td>Subject Category</td><td>GEC</td><td>Year</td><td>2nd</td><td>Semester</td><td>III</td></tr>
</table>

Objective: To enable students to obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis and gain experience in the implementation of numerical methods using a computer.

Unit I:

Errors: Approximations and Errors in Computation.

Solution of Polynomial and Transcendental Equations: Bisection method, Regula-Falsi method, Newton-Raphson method, rate of convergence.

Unit II: Interpolation

Finite differences, Newton's forward and backward interpolation formula, Central difference interpolation, Gauss's forward and backward interpolation formula, Stirling's interpolation formula, Divided differences, Lagrange, Newton's Divided difference formula.

Unit III: Numerical Differentiation and Numerical Integration

First and second order derivatives of Newton's forward & backward interpolation, Newton - Cote's Quadrature Formula: Trapezoidal, Simpson's rules, Gaussian quadrature formula.

Unit IV: Solution of Simultaneous Linear Algebraic Equations

Direct methods: Gauss elimination, Gauss Jordan method, LU Decomposition method; Iterative methods: Gauss – Jacobi iteration method, Gauss - Seidal iteration method.

Principle of Least Square and Curve Fitting: Fitting a straight line, Parabola and exponential curve.

Unit V:

Numerical Solution of Ordinary Differential Equations: Single step methods: Picard's method, Taylor series method, Euler's method, Modified Euler's method, Runge - Kutta method of fourth order (First order, Second order & Simultaneous Differential Equations), Predictor - Corrector methods: Milne's method, Adams - Bashforth method.

LEARNING OUTCOME: Students will be able to:

- obtain an intuitive and working understanding of numerical methods.
- apply numerical methods to basic problems of numerical methods.
- use various software tools for the implementation and application of numerical methods Basics of different types of measuring instruments based on the fundamental theory of operation.
- implement frequency chart, regression analysis, linear square fit and polynomial fitting methods of problem solving.

Text Book:

1. Curtis F. Gerald and Patrick O. Wheatley, "Applied Numerical Analysis", 7th Edition, Pearson Education Lt, 2004.

Reference Books

1. S.S. Sastry, "Introductory Methods of Numerical Analysis", 5th Edition, PHI learning Pvt. Ltd, 2012.
2. M.K Jain, S.R.K Iyengar and R.K Jain, "Numerical Methods for Scientific and Engineering Computation", 6thEdition, New age International Publishers, 2012.
3. F. B. Hildebrand, "Introduction to Numerical Analysis", 2nd Edition, McGraw-Hill Book Company Inc. 1974.
4. B. S. Grewal, "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, India, 2013.

List of Practicals:

(1) Bisection Method.	(2) Simpson's $\frac{3}{8}rd$ rule.
(3) Regula Falsi Method.	(4) Gauss Elimination Method.
(5) Newton Raphson Method.	(6) Gauss Jordan Method.
(7) Newton's Forward Interpolation Formula.	(8) Gauss - Jacobi Method.
(9) Newton's Backward Interpolation Formula.	(10)Gauss - Seidal Method
(11)Newton's Divided Difference Formula.	(12)Fitting a Straight Line and Parabola.
(13)Trapezoidal rule.	(14)Modified Euler's Method.
(15)Simpson's $\frac{1}{3}rd$ rule.	(16)Fourth Order Runge - Kutta Method.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY216	**Subject Title**	Mathematical Physics-III						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	2nd	**Semester**	IV

Course Outline:

The course covers analysis of complex variables, Fourier and Laplace transforms which find applications in advanced courses during Masters in Physics.

Course Objective:

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

Course Pre/Co- requisite (if any) : The student must have gone through Mathematical Physics-I PY106

Detailed Syllabus

Unit 1: Complex Analysis

Brief Revision of Complex Numbers, Functions of Complex Variables Analyticity and Cauchy-Riemann Conditions, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts, Integration of a function of a complex variable, Cauchy's Integral formula. Laurent and Taylor's expansion. Residues and Residue Theorem. 20 L

Unit 2: Fourier Transforms

Fourier Integral theorem. Fourier Transform. Examples, Representation of Dirac delta function as a Fourier Integral, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms, Three dimensional Fourier transforms with examples, application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations. 10 L

Unit 3: Laplace Transforms

Laplace Transform (LT) of Elementary functions, Properties of LTs: Change of Scale Theorem, Shifting Theorem, LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs, Convolution Theorem. Inverse LT. Applications of Laplace Transforms. 10 L

Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:
1. The use of Complex Numbers and Residues and Residue Theorem
2. The use of singular functions, and poles, branch points, order of singularity etc.
3. The use of Fourier Integral theorem and properties of Fourier transforms
4. The application of Fourier Transforms as 1D Wave and Diffusion/Heat Flow Equations
5. The use of Laplace Transform (LT) of Elementary functions
6. The application of change of scale theorem and shift theorem

Text book [TB]:

1. Mathematical Physics, H. K. Das, S. Chand & Company, 2010
2. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed, Cambridge University Press., 2006
3. Mathematics for Physicists, P. Dennery and A.Krzywicki, Dover Publications, 1996

Reference books [RB]:

1. Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed, Cambridge Univ. Press., 2011
2. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed, Tata McGraw-Hill, 2003
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, Jones & Bartlett, 1940,

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY217	**Subject Title**	Elements of Modern Physics						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	2nd	**Semester**	IV

Course Outline:

In this course, the students will get an introductory approach on various branches of physics like quantum mechanics, atomic, molecular and nuclear physics which will establish their fundamental base for learning these subjects separately.

Course Objective:

Students will apply understanding and skill related to the principles and concepts of modern physics essential for graduate school and/or professional employment in the field

Course Pre/Co- requisite (if any) :student must be familiar with basic integration and differentiation

Detailed Syllabus

UNIT 1

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. 6 L

UNIT 2

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. 6 L

UNIT 3

Linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.
One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier. 11 L

UNIT 4

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235 10 L

UNIT 5

Lasers:Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Ruby Laser and He-Ne Laser. 6 L

Learning Outcome

Having successfully completed this course, the student will be able to:

1. Outline the scientific foundation for modern physics according the Course Main Content
2. Perform quantum mechanical calculation for simple systems
3. Apply quantum mechanical principles in science and technology
4. Outline the most important experimental methods in modern physics

Text book [TB]:

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

Reference books [RB]:

1. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, PHI Learning, 2004
2. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
3. Quantum Physics, E.H.Wichman, Vol.4., Berkeley Physics, Tata McGraw-Hill Co, 1971
4. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
5. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, McGraw Hill, 2003

SR.NO.	LIST OF EXPERIMENTS
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 Thomson Method.
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 study the atomic spectra of a 2 electron system
12	To determine Lande's g factor using electron spin resonance spectrometer

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY-218	**Subject Title**	Analog Systems and Applications						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	2nd	**Semester**	IV

Course Outline:

This is a course on the design and applications of analog integrated circuits. This course introduces basic op-amp principles and show how the op-amp can be used to solve a variety of application problems. Much attention is given to basic op-amp configurations, linear and non-linear applications of op-amp and active filter synthesis, including switched capacitor configurations. It also deals with oscillators, waveform generators and data converters.

Course Objective:

1. To inculcate the knowledge about basics of electronics in students.
2. To demonstrate the use of analog electronics devices for different applications.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. 8 L

UNIT 2

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

8 L

UNIT 3

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

8 L

UNIT 4

Amplifiers: Transistor Biasing and Stabilization Circuits. Coupled Amplifier: RC-coupled amplifier and its frequency response. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.
Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. 8 L

UNIT 5

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. (9 Lectures) Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D and D/A Converter.

7 L

Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:

1. The basics of electronics such as barrier formation in PN junction diode.
2. The different types of diodes and their application as rectifiers and voltage regulator.
3. The characteristics of Bipolar Junction Transistors in different configurations.
4. The RC circuits and their use with BJTs in Amplifiers and Oscillators.
5. The concept of differential amplifier and use of Operational amplifier for different applications.

Text book [TB]:

1. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, PHI Learning, 2015.
2. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, Tata Mc-Graw Hill, 2011.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, Prentice Hall, 2007.
4. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk, Springer, 2015.

Reference books [RB]:

1. Electronics: Fundamentals and Applications, J.D. Ryder, Prentice Hall, 1974.
2. Semiconductor Devices: Physics and Technology, S.M. Sze, Wiley India, 2012.
3. Integrated Electronics, J. Millman and C.C. Halkias, Tata Mc-Graw Hill, 2001.

SR.NO.	LIST OF EXPERIMENTS
1	To study V-I characteristics of PN junction 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 design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6	To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
7	To design a Wien bridge oscillator for given frequency using an op-amp.
8	To design a phase shift oscillator of given specifications using BJT.
9	To study the Colpitt`s oscillator.
10	To investigate the use of an op-amp as an Integrator.
11	To investigate the use of an op-amp as a Differentiator.
12	To design a circuit to simulate the solution of a 1st/2nd order differential equation.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	CH201	Subject Title	ENVIRONMENTAL SCIENCE						
LTP	2 0 0	Credit	2	Subject Category	AEC	Year	2nd	Semester	IV

OBJECTIVE

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

Unit 1: Basics of Environment and Natural Resources: **04** L

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

Unit 2: Ecosystems: **04** L

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen, Hydrological). Species interactions in ecosystems. Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

Unit 3: Biodiversity and its conservation: **04** L

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

Unit-4 Environmental Pollutions: **05** L

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

Unit-5 Social Issues and Environment: **04** L

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

Field work: **03** L

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.
- Study of a common ecosystem-pond, river, hill slopes, etc.

Course Outcome:

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

CO1. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.

CO2. Able to identify the structure and functioning of natural ecosystems.
CO3. Establish man-wildlife harmonious relationship.
CO4. Adapt to 3R (Reuse, Recovery, Recycle).Identify the causes and control measures related to Pollutions.
CO 5. Illustrate and analyse various Case Studies related to Environmental issues and Env. Legislation.

TEXT BOOKS

1. BharuchaErach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.
2. Kaushik A & Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.
3. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

REFERENCES

1. Miller T.G. Jr. 2002. Environmental Science, Wadsworth Publishing Co. (TB).
2. De A.K.,1996. Environmental Chemistry, Wiley Eastern Ltd.
3. Sharma, P.D. 2005. Ecology and environment, Rastogi Publication.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY219	**Subject Title**	Basic Instrumentation Skills						
LTP	3 0 0	**Credit**	3	**Subject Category**	SEC	**Year**	2nd	**Semester**	IV

Course Outline:

This course covers the basic concepts of an instrumentation systems, voltmeter, ammeter, analog and digital measuring devices, cathode ray oscilloscope, wave from generators and analyzers. It develops the fundamental base of students for studying advanced instrumentation systems in higher studies and also familiarizes the students with working principles of some basic instruments.

Course Objective:

This course is to get exposure with various aspects of instruments and their usage through hands-on mode

Course Pre/Co- requisite (if any) : The student must have knowledge of amplifiers, oscillators and network analysis

Detailed Syllabus

Unit 1: Basic of Measurement

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects, Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance, specifications of a multimeter and their significance. 7 L

Unit 2: Electronic Voltmeter

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity, principles of voltage, measurement (block diagram only), specifications of an electronic voltmeter and its significance. AC millivoltmeter: Type of AC millivoltmeters, amplifier- rectifier, and rectifier- amplifier, block diagram ac millivoltmeter and its significance. 7 L

Unit 3: Cathode Ray oscilloscope

Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition, time base operation, synchronization, front panel controls, specifications of a CRO its significance and uses. 9 L

Unit-4: Signal Generators and Analysis Instruments

Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator and wave analysis. 7 L

Unit- 5: Impedance Bridges & Q-Meters, Digital Multimeter

Working principles and specifications of basic (balancing type) RLC bridge, digital LCR bridges, block diagram & working principles of a Q- Meter

Principle and working of digital meters, comparison of analog & digital instruments, working principles of digital voltmeter, block diagram and working of a digital multimeter, working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. 10 L

Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:

1. To apply knowledge of basic instruments to the higher study experiments
2. To design and conduct experiments, as well as to analyze and interpret data
3. To function on multidisciplinary teams
4. To design new circuits and experiments
5. To use the techniques, skills, and modern engineering tools necessary for instrumentation

Text book [TB]:

1. A text book in Electrical Technology, B L Theraja, S Chand and Co. 2005

Reference books [RB]:

1. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed, Tata Mc-Graw Hill., 2012
2. Digital Electronics, Subrata Ghoshal, Cengage Learning, 2012

SR.NO.	LIST OF EXPERIMENTS
1	To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2	To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3	To measure Q of a coil and its dependence on frequency, using a Q- meter.
4	Measurement of voltage, frequency, time period and phase angle using CRO.
5	Measurement of time period, frequency, average period using universal counter/ frequency counter.
6	Measurement of rise, fall and delay times using a CRO.
7	Measurement of distortion of a RF signal generator using distortion factor meter.
8	Measurement of R, L and C using a LCR bridge/ universal bridge.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY306	**Subject Title**	Quantum Mechanics and Applications						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	3rd	**Semester**	V

Course Outline:

This course covers Schrodinger's time dependent and time-independent wave equations and their applications to different bound potentials, quantum theory of hydrogen like atoms and the behavior of atoms in electric and magnetic fields.

Course Objective:

The objective of this course is to study the basic principles of quantum mechanics, explain the operator formulation of quantum mechanics, learn the concept of wave function, Schrodinger equation and their applications and to study role of uncertainty in quantum physics

Course Pre/Co- requisite (if any) : It is recommended that before taking this course the student must have studied the course PY217 Elements of Modern Physics

Detailed Syllabus

UNIT 1: 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
7 L

UNIT 2: Time independent Schrodinger equation

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; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle 8 L

UNIT 3: General discussion of bound states in an arbitrary potential

application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle 7 L

UNIT 4: Quantum theory of hydrogen-like atoms

time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells 7 L

UNIT 5: Atoms in Electric & Magnetic Fields

Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only)

Many electron atoms: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atomsL-S and J-J couplings. Hund's Rule 10 L

Learning Outcome

1: Pinpoint the historical aspects of development of quantum mechanics.
2: Understand and explain the differences between classical and quantum mechanics.
3: Understand the idea of wave function.
4: Understand the uncertainty relations.
5: Solve Schrodinger equation for simple potentials.

Text book [TB]:

1. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed., Pearson Education, 2016
2. Quantum Mechanics, Leonard I. Schiff, 3rd Edn., Tata McGraw Hill, 2017

Reference books [RB]:

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed, McGraw Hill, 2017
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., Wiley, 2006

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY307	**Subject Title**	SOLID STATE PHYSICS						
LTP	3 1 4	**Credit**	6	**Subject Category**	CC	**Year**	3rd	**Semester**	V

Course Outline:
The course covers the physical understanding of matter from an atomic view point. Topics covered include the structure, magnetic and electrical properties of matter. Fundamental theories in solid state physics are introduced and then extended to show the relevance to important applications in current -day technology, industry, and research. The course has a theoretical lecture component and makes extensive use of examples and exercises to illustrate the material.

Course Objective:

To study some of the basic properties of the condensed phase of materials especially solids and their application in interdisciplinary fields.

Course Pre/Co- requisite (if any) : No enforced requisites. But, it is desired that the student has gone through courses like thermal physics and mathematics at the first and second year university level

Detailed Syllabus

UNIT 1

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. 7 L

UNIT 2

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law.
7 L

UNIT 3

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.
7 L

UNIT 4

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Ferroelectric Properties of Materials: Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.
10 L

UNIT 5

Elementary band theory: 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) 8 L

Learning Outcome

Students will have understanding of
1: Structures in solids and their determination using XRD.
2: Behavior of electrons in solids including the concept of energy bands and effect of the same on material properties.
3: Electrical, thermal, magnetic and dielectric properties of solids
4: Idea about the different type of phases transitions in solid materials
5: Various applications of crystalline materials in the new age electronics

Text book [TB]:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, Wiley India Pvt. Ltd, 2004.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, Prentice-Hall of India, 2006

Reference books [RB]:

1. Solid State Physics, M.A. Wahab, Narosa Publications, 2011

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY346	**Subject Title**	NUCLEAR AND PARTICLE PHYSICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	V

Course Outline:

The course starts with basic concepts of a nucleus and covers the phenomenology and experimental foundations of particle and nuclear physics including the fundamental forces and particles and composites.

Course Objective:

The emphasis of the course is on developing fundamental knowledge of nuclear and particle physics and the basic govering laws behind various phenomena.

Course Pre/Co- requisite (if any) : Student must have studied elements of modern physics

Detailed Syllabus

UNIT 1

Familiarization with Nucleus: Geiger-Marsden Experiment, mass, size, binding energy, nuclear binding energy in terms of atomic binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot. 8 L

UNIT 2

Semi-emperical formula mass and significance of its various terms, condition of nuclear stability, Symmetric and asymmetric distribution of nucleons.
Two-nucleon problem- Nuclear spin and Parity of Deutron, Deutron as a special case of central potential, two nucleon separation energies. 8 L

UNIT 3

Nuclear Models: Liquid drop model approach, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. 8 L

UNIT 4

Alpha decay- basics of α-decay processes, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. β-decay- energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.
Gamma decay-Gamma rays emission & kinematics, internal conversion.
Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, Pair production, neutron interaction with matter. 8 L

UNIT 5

Detector for Nuclear Radiations: Gas detectors, GM Counter, basic principle of Scintillation detectors and construction of photo-multiplier tube (PMT).
Particle Accelerators: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.
Particle physics: Types of particles and their families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model. 8 L

Learning Outcome

Students will have an understanding of
1: Historical background of the nuclear physics
2: The various factors affecting the binding energy of the nucleus
3: Strength of nuclear forces and different nuclear models
4: Radioactive decays and kinematics of nuclear reactions
5: Various nuclear detectors, accelerators and particles

Text book [TB]:

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).

Reference books [RB]:

1. Radiation detection and measurement, G.F. Knoll, John Wiley & Sons, 2000.
2. Basic ideas and concepts in Nuclear Physics- An Introductory Approach by K. Heyde, IOP- Institute of Physics Publishing, 2004

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY347	**Subject Title**	EXPERIMENTAL TECHNIQUES						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	V

Course Outline:
The course covers basic requirements of a measurement system, study of signals and systems, shielding and grounding, transducers and industrial instrumentation and digital systems.

Course Objective:

This course aims to provide the knowledge about basic experimental techniques which will enable a strong background for research also.

Course Pre/Co- requisite (if any) : The student must have studied the course basic instrumentation skills, digital and analog electronics

Detailed Syllabus

UNIT 1

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

UNIT 2

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

UNIT 3

Shielding and Grounding: Methods of safety grounding. Energy coupling. Grounding. Shielding: Electrostatic shielding. Electromagnetic Interference. 3 L

UNIT 4

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

UNIT 5

Digital Multimeter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement. Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge. Q-meter and its working operation. Digital LCR bridge.

Vacuum Systems: Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization). 10 L

Learning Outcome

After completing this course the student will be able to learn about
1: Types of error and other statistical analysis of a given data
2: Various types of signals and sources of noise in a signal
3: Various method of grounding and shielding an instrument
4: Working principle and applications of different transducers
5: Woking of vacuum pumps and their applications in different fields

Text book [TB]:

1. Measurement, Instrumentation and Experiment Design in Physics and Engineering, M. Sayer and A. Mansingh, PHI Learning Pvt. Ltd, 1999.
2. Experimental Methods for Engineers, J.P. Holman, McGraw Hill, 2017
3. Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd, 2012.

Reference books [RB]:

1. Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill, 2017
2. Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd, 2008

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY348	**Subject Title**	Physics of Devices and Instrumentations						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	V

Course Outline:

The course covers semiconductor based devices, power supply and filters, multivibrators, phase locked loops, basics of IC fabrication, digital data communication standards.

Course Objective:

The emphasis of the course is to learn the physics behind the working of semiconductor devices and their use in instrumentation.

Course Pre/Co- requisite (if any) : The student must have studied analog systems and applications

Detailed Syllabus

UNIT 1

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO_2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode.
8 L

UNIT 2

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection
Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters
Multivibrators: Astable and Monostable Multivibrators using transistors. 8 L

UNIT 3

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). 8 L

UNIT 4

Processing of Devices: 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. 8 L

UNIT 5

Digital Data Communication Standards: 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.
Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband

frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK 8 L

Learning Outcome

Students will have an understanding of
1: Characteristics of basic semiconductor devices such as UJT, JFET, MOSFET, etc.
2: Power supply for a required circuit and application of various types of filters in it.
3: Manufacturing of passive components using various processing techniques.
4: Inter-devices for communication.
5: Modulation techniques for communication purpose.

Text book [TB]:

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

Reference books [RB]:

1. Electronic Devices and Circuits, A. Mottershead, PHI Learning Pvt. Ltd, 1998.
2. Electronic Communication systems, G. Kennedy, Tata McGraw Hill, 1999.
3. Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed PHI Learning Pvt. Ltd., 2009
4. PC based instrumentation; Concepts & Practice, N.Mathivanan, Prentice-Hall of India, 2007

Subject Code	PY349	**Subject Title**	APPLIED DYNAMICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	V

Course Outline:

The course covers dynamical systems, chaos, fractals and elementary fluid dynamics to develop a strong base for theoretical research in physics and mathematics.

Course Objective:

The objective of the course is to impart amongst the student the concepts of fundamental physics and mathematics applicable while reaching out for solutions to problems encountered while working on problems with wide applicable perspectives.

Course Pre/Co- requisite (if any) : The students must have studied PY107, PY106, PY206

Detailed Syllabus

UNIT 1

Introduction to Dynamical systems: Definition of a continuous first order dynamical system. The idea of phase space, flows and trajectories. Simple mechanical systems as first order dynamical systems : the free particle, particle under uniform gravity, simple and damped harmonic oscillator. Sketching flows and trajectories in phase space; sketching variables as functions of time, relating the equations and pictures to the underlying physical intuition.
Other examples of dynamical systems –
In Biology: Population models e.g. exponential growth and decay, logistic growth,
species competition, predator-prey dynamics, simple genetic circuits
In Chemistry: Rate equations for chemical reactions e.g. auto catalysis, bistability
In Economics: Examples from game theory.
Illustrative examples from other disciplines.
Fixed points, attractors, stability of fixed points, basin of attraction, notion of qualitative analysis of dynamical systems, with applications to the above examples.
Computing and visualizing trajectories on the computer using a software packages. Discrete dynamical systems. The logistic map as an example. 14 L

UNIT 2

Introduction to Chaos and Fractals: Examples of 2-dimensional billiard, Projection of the trajectory on momentum space. Sinai Billiard and its variants. Computational visualization of trajectories in the Sinai Billiard. Randomization and ergodicity in the divergence of nearby phase space trajectories, and dependence of time scale of divergence on the size of obstacle. Electron motion in mesoscopic conductors as a chaotic billiard problem. Other examples of chaotic systems; visualization of their trajectories on the computer.
Self similarity and fractal geometry: Fractals in nature – trees, coastlines, earthquakes, etc. Need for fractal dimension to describe self-similar structure. Deterministic fractal vs. self-similar fractal structure. Fractals in dynamics – Serpinski gasket and DLA.
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: Detecting chaos from return map. Power spectrum, autocorrelation, Lyapunov exponent, correlation dimension. 15 L

UNIT 3

Elementary Fluid Dynamics: Importance of fluids: Fluids in the pure sciences, fluids in technology. Study of fluids: Theoretical approach, experimental fluid dynamics, computational fluid dynamics. Basic physics of fluids: The continuum hypothesisconcept 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.

10 L

Learning Outcome

Having successfully completed this course, the student will be able to :

1: Be capable of interpreting the concept of phase space.
2: Use computer programming to visualize properties of systems applicable in phase space.
3: Understand the theory behind chaos
4: Apply mathematics to interpret various perspectives associated with chaos including non-linearity
5: Be capable of understanding the physics behind fluids.

Text book [TB]:

1. Nonlinear Dynamics and Chaos, S.H. Strogatz, Levant Books, Kolkata, 2007
2. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, 1st ed., Springer, 1995. Corr. 2nd printing 1997 edition (1 November 1997)

Reference books [RB]:

1. An Introduction to Fluid Dynamics, G.K.Batchelor, Cambridge Univ. Press, 2002
2. Fluid Mechanics, L. D. Landau and E. M. Lifshitz, 2nd Edition, Pergamon Press, Oxford, 1987.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY356	Subject Title	ADVANCED MATHEMATICAL PHYSICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	V

Course Outline:

The course covers vector space, linear transformations, tensors and calculus of variations which will develop a strong fundamental base for research in theoretical physics

Course Objective:

The key objective of this course is to familiarize students with a range of essential mathematical tools for solving the advanced problems in theoretical physics.

Course Pre/Co- requisite (if any) : The student must have gone through PY106, PY216 and PY206

Detailed Syllabus

UNIT 1

Linear Algebra: Vector Spaces: Vector Spaces over Fields of Real and Complex numbers. Linear independence of vectors. Basis and dimension of a vector space. Change of basis. Subspace. Isomorphisms. Inner product of functions: the weight function. Triangle and Cauchy Schwartz InequalitiesSine and cosine functions in a Fourier series as an orthonormal basis. 9 L

UNIT 2

Linear Transformations: Introduction. Identity and inverse. Singular and non-singular transformations. Representation of linear transformations by matrices. Linear operators. Differential operators as linear operators on vector space of functions. Commutator of operators. Orthogonal and unitary operators and their matrix representations. Hermitian operators and their matrix representation. Properties of eigenvalues and eigenvectors of Hermitian and unitary operators. 9 L

UNIT 3

Tensors: Tensors as multilinear transformations (functionals) on vectors. Examples: Moment of Inertia, dielectric susceptibility. Components of a tensor in basis. Symmetric and antisymmetric tensors. The completely antisymmetric tensor. Non-orthonormal and reciprocal bases. Inner product of vectors and the metric tensor. Coordinate systems and coordinate basis vectors. Reciprocal coordinate basis. Change of basis: relation between coordinate basis vectors. Change of tensor components under change of coordinate system. Example: Inertial coordinates & bases in Minkowski space, Lorentz transformations as coordinate transformations,
10 L

UNIT 4

Calculus of Variations :Variational Principle: Euler's Equation. Application to Simple Problems (shape of a soap film, Fermat's Principle).Several Dependent Variables and Euler's Equations. Hamilton's Principle and the Euler-Lagrange equations of motion. Constrained Variations: Variations with constraints. Applications: motion of a simple pendulum, 8 L

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Learning Outcome

Student will be able to understand the knowledge of:

1. To acquire skills and knowledge among the students about real, complex numbers and their applications.
2. Enable students to understand Fourier series and its application in different fields.
3. Provide the knowledge and understanding of liner transforamsion and operator in various fields of physics.
4. Understanding the tensor analysis and its applications.
5. To acquire the knowledge of calculus of variations.

Text book [TB]:

1. Mathematical Tools for Physics, James Nearing, Dover Publications, 2010
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, and F.E. Harris, Elsevier, 1970.

Reference books [RB]:

1. Mathematical Methods for Physicis & Engineers, K.F.Riley, M.P.Hobson, S.J.Bence, 3rd Ed, Cambridge University Press, 2006

Subject Code	PY377	Subject Title	MEDICAL PHYSICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	VI

Course Outline:

The course starts with physics of body, various mechanics involved in body system, electrical signals and optics of the body. The course also covers diagnostic and therapeutic techniques, radiation physics and medical imaging.

Course Objective:

The objective of this course is to develop knowledge about the fundamental laws of physics behind the human body and the various instruments used in diagnosis.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1

PHYSICS OF THE BODY-I
Mechanics of the body: Muscles and the dynamics of body movement, Physics of body crashing. **Energy household of the body:** Energy balance in the body, Energy consumption of the body, Heat losses of the body, **Pressuresystem of the body:** Physics of breathing, Physics of cardiovascular system.
PHYSICS OF THE BODY-II
Acoustics of the body: 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. 12 L

UNIT 2

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I
X-RAYS: Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung, Characteristic x-ray, X-ray tube, Coolidge tube, x-ray tube design, tube cooling stationary mode. 7 L

UNIT 3

RADIATION PHYSICS: Radiation units, exposure, absorbed dose – units: rad, gray relative biological effectiveness, effective dose, inverse square law, interaction of radiation with matter, linear attenuation coefficient. Radiation Detectors, Thimble chamber, condenser chambers, Geiger counter, Scintillation counter, ionization chamber, Dosimeters , survey methods, area monitors, TLD and semiconductor detectors.
8 L

UNIT 4

MEDICAL IMAGING PHYSICS: X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging. Ultrasound imaging.
RADIATION AND RADIATION PROTECTION: Principles of radiation protection, protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Personal monitoring devices , TLD film badge, pocket dosimeter. 7 L

UNIT 5

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II

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 and isodose in radiation treatment 5 L

Learning Outcome

After completing this course the student will be able to:
1: learn abpout the physics behind various parts of human body
2: develop the knowledge of X-rays being used in diagnosis
3: learn the importance of radiation physics and interaction of radiation with matter
4: explore the role of physics in the mediacal imaging techniques
5: learn the basic principles of radio isotope imaging

Text book [TB]:

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. Physics of the human body, Irving P. Herman, Springer, 2007.

Reference books [RB]:

1. The Physics of Radiology-H E Johns and Cunningham.
2. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot, Second Edition, Williams and Wilkins, 2002
3. Physics of Radiation Therapy, F M Khan, 3rd edition, Williams and Wilkins, 2003

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY326	**Subject Title**	ELECTROMAGNETIC THEORY						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	3rd	**Semester**	VI

Course Outline:

This course would be a pre-requisite for the advanced level course at the M. Sc. Level. The course begins with a review of Maxwell equations. The course covers reflection, refraction and polarization of electromagnetic waves at different media, optical fibres and wave guides.

Course Objective:

To acquire the understanding of Maxwell's equations and be able to solve practical EM field problems. Strong fundamental concepts like EM wave propagation in different media, powerflow, polarization, reflections and transmission & optical wave guides can be used in future for transmission, propagation & reception of EM waves in communication systems.

Course Pre/Co- requisite (if any) : The student must have basic knowledge of electrostatics and magnetostatics.

Detailed Syllabus

UNIT 1

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.
7 L

UNIT 2

EM Wave Propagation in Unbounded Media: 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. 8 L

UNIT 3

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence)
7 L

UNIT 4

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter. 10 L

UNIT 5

Wave Guides: Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.
Optical Fibres:- Numerical Aperture. Step and Graded Indices (Definitions Only).
Single and Multiple Mode Fibres (Concept and Definition Only). 8 L

Learning Outcome

Having successfully completed this course, the student will be able to demonstrate knowledge and:
1. The use of basic properties of EM wave.
2. Understanding of properties and solution of wave equation for EM fields in free space and matter.
3. Understanding of behavior of EM wave at boundaries.
4. Understanding of polarization of EM waves.
5. Understanding of basics of optical wave guides.
6. Problem solving skills.

Text book [TB]:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed, Benjamin Cummings., 1998.
2. Electricity and Magnetism, D. Chattopadhyay, New Central Book Agency (P) Ltd, 2018.

Reference books [RB]:

1. Elements of Electromagnetics, M.N.O. Sadiku, Oxford University Press, 2001.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY327	**Subject Title**	STATISTICAL MECHANICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	3rd	**Semester**	VI

Course Outline:

The course gives an introduction to statistical mechanics and some important applications. The course discusses how probability theory can be used to derive relations between the microscopic and macroscopic properties of matter. Thermodynamic potentials. Phase space and distributions in phase space. Maxwell-Boltzmann distributions with applications. Statistical ensembles. Applications on crystals and gases. Quantum statistics, Bose-Einstein and Fermi-Dirac statistics, Bose-Einstein condensation. The basic theory for electrons in a metal.

Course Objective:

The objective of this course is to learn the properties of macroscopic systems using the knowledge of the properties of individual particles and their application in the various field of physical science.

Course Pre/Co- requisite (if any) : The student must have taken PY207 Thermal Physics before this course

Detailed Syllabus

UNIT 1

Classical Statistics: 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 Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. 10 L

UNIT 2

Classical Theory of Radiation: Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe. 8 L

UNIT 3

Quantum Theory of Radiation:Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.
8 L

UNIT 4

Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law. 6 L

UNIT 5

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit. 7 L

Learning Outcome

Students will have understanding of

1: Connection between statistics and thermodynamics and different ensemble theories to explain the behaviour of the systems.

2: Difference between classical statistics and quantum statistics.

3: Statistical behaviour of ideal Bose and Fermi systems.

4: Varius applications of the statistical mechanics in other field of science

5: Application and importance of the statistical mechanics in coputaion and computing.

Text book [TB]:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., Oxford University Press, 1996.
2. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir., Prentice Hall, 1991
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill, 1993

Reference books [RB]:

1. Statistical Physics, Berkeley Physics Course, F. Reif, Tata McGraw-Hill, 2008

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY358	Subject Title	CLASSICAL DYNAMICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	VI

Course Outline:

The course covers concepts of classical mechanics like Hamiltonian of a system applications of Lagrange equations to different systems, special theory of relativity, four vector, Maxwell equations in tensor form, electromagnetic radiation and its applications.

Course Objective:

The emphasis of the course is on giving the students first hand experience in solving intermediate and advanced level problems in classical mechanics, special theory of relativity and also impart the idea of radiation associated with movement of charges.

Course Pre/Co- requisite (if any) : The student must have studied PY107, PY116

Detailed Syllabus

UNIT 1

Classical Mechanics of Point Particles: Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as coupled oscillators. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Poisson brackets. Canonical transformations.

14 L

UNIT 2

Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energy-momentum relation. Doppler effect from a fourvector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of E and B. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields. 15 L

UNIT 3

Electromagnetic radiation: Review of retarded potentials. Potentials due to a moving charge: Lienard Wiechert potentials. Electric & Magnetic fields due to a moving charge: Power radiated, Larmor's formula and its relativistic generalisation. 10 L

Learning Outcome

On completion of the course the student will be able to
1: Have competence in understanding degrees of freedom of the system and develop equations of motion based on Lagrange's equation.
2: Interpret and associate canonical momenta with coordinates and work with Hamiltonian formulation.
3: Have insight in Special Theory of Relativity especially variation of various properties of the system .
4: Comprehend concepts of transformation of fields
5: Gain understanding of radiation applicable at fundamental levels.

Text book [TB]:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn.,Pearson Education, 2002.
2. Mechanics, L. D. Landau and E. M. Lifshitz, Pergamon, 1976.

Reference books [RB]:

1. Introduction to Electrodynamics, D.J. Griffiths, Pearson Education, 2012

Subject Code	PY359	Subject Title	ATMOSPHERIC PHYSICS						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

Course Outline:

The course develops a strong base on general features of Earth's atmosphere, atmospheric dynamics, atmospheric waves, atmospheric aerosols, radar and Lidar.

Course Objective:

The main objective of this course is to provide the detailed information of meteorology to the students.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1

General features of Earth's atmosphere: Thermal structure of the Earth's Atmosphere, Ionosphere, Composition of atmosphere, Hydrostatic equation, Atmospheric Thermodynamics, Greenhouse effect and effective temperature of Earth, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze. Instruments for meteorological observations, including RS/RW, meteorological processes and different systems, fronts, Cyclones and anticyclones, thunderstorms.

8 L

UNIT 2

Atmospheric Dynamics: Scale analysis, Fundamental forces, Basic conservation laws, The Vectorial form of the momentum equation in rotating coordinate system, scale analysis of equation of motion, Applications of the basic equations, Circulations and vorticity, Atmospheric oscillations, Mesoscale circulations, The general circulations, Tropical dynamics. 8 L

UNIT 3

Atmospheric Waves: Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption, non-linear consideration

7 L

UNIT 4

Atmospheric Radar and Lidar: Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications, Application of Lidar to study atmospheric phenomenon. Data analysis tools and techniques.

8 L

UNIT 5

Atmospheric Aerosols: Spectral distribution of the solar radiation, Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Observational techniques for aerosols, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere, Aerosol studies using Lidars. 8 L

Learning Outcome

Student will be able to understand the knowledge of:
1. To be able to understand general features of earth's atmosphere.

2. Enable to aciqure the knowledge of atmospheric dynamics.

3. Knowledge and understanding of atmospheric waves.
4. Understanding the atmospheric Radar and Lidar.
5. To acquire the knowledge of the atmospheric aerosols.

Text book [TB]:

1. Fundamental of Atmospheric Physics, Murry L Salby, Vol 61 Academic Press, 1996
2. An Introduction to dynamic meteorology, James R Holton; Academic Press, 2004

Reference books [RB]:

1. Radar for meteorological and atmospheric observations, S Fukao and K Hamazu, Springer Japan, 2014

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY366	Subject Title	EARTH SCIENCE						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	VI

Course Outline:

The course starts with the study of origin of universe, milky way, solar system and develops fundamental knowledge of structure and shape of planet earth, interior of earth, rivers, biosphere, chemical composition, dynamical processes like origin of oceans, ocean current, origin of life on earth, and the factors disturbing earth's atmosphere.

Course Objective:

The main goal of this course is to equip students with understanding of earth's science and its important aspects in everyday life.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1

The Earth and the Universe: 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.
9 L

UNIT 2

Structure:The Solid Earth: Mass, dimensions, shape and topography, internal structure, magnetic field, geothermal energy. How do we learn about Earth's interior? 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. 6 L

UNIT 3

Dynamical Processes: 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. Geodynamic elements of Earth: Mid Oceanic Ridges, trenches, transform faults and island arcs. Origin of oceans, continents, mountains and rift valleys. Earthquake and earthquake belts. Volcanoes: types products and distribution. The Hydrosphere: Ocean circulations. Oceanic current system and effect of coriolis forces. Concepts of eustasy, tend – air-sea interaction; wave erosion and beach processes. Tides. Tsunamis. The Atmosphere: Atmospheric circulation. Weather and climatic changes. Earth's heat budget. Cyclones.Climate: Earth's temperature and greenhouse effect, Paleoclimate and recent climate changes, The Indian monsoon system. Biosphere: Water cycle, Carbon cycle, Nitrogen cycle, Phosphorous cycle. The role of cycles in maintaining a steady state. 8 L

UNIT 4

Evolution: 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.
1. Time line of major geological and biological events.
2. Origin of life on Earth.
3. Role of the biosphere in shaping the environment.
4. Future of evolution of the Earth and solar system: Death of the Earth. 8 L

UNIT 5

Disturbing the Earth – Contemporary dilemmas , 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.
8 L

Learning Outcome

Student will be able to understand the knowledge of:
1. To be able to understand earth, universe and its general characteristic.
2. Enable to aciqure the knowledge of earth's structure.
3. Knowledge and understanding of dynamical processes and volcanoes.
4. Understanding the earth's evolution.
5. To acquire the knowledge of the earth's biodiversity.

Text book [TB]:

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

Reference books [RB]:

1. Holme's Principles of Physical Geology. Chapman & Hall, 1992.
2. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment, Emiliani C, Cambridge University Press, 1992.

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY367	**Subject Title**	EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	VI

Course Outline:

The course covers basic introduction to microcontroller-based embedded systems design, development and implementation. It includes embedded system types, 8051-microcontroller architecture, programming , I/O interfacing, task scheduling, interrupt management and other related topics.

Course Objective:

This course aims to discuss the major components that constitute an embedded system, Implement small programs to solve well-defined problems on an embedded platform, Develop familiarity with tools used to develop in an embedded environment.

Course Pre/Co- requisite (if any) : students must have studied digital systems and applications

Detailed Syllabus

UNIT 1

Embedded system introduction: Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges & design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers.
Review of microprocessors: Organization of Microprocessor based system, 8085µp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts.
10 L

UNIT 2

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.
8051 I/O port programming: Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description & their functions, I/O port programming in 8051 (using assembly language), I/O programming: Bit manipulation. 8 L

UNIT 3

Programming: 8051 addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic and logic instructions, 8051 programming in C: for time delay & I/O operations and manipulation, for arithmetic and logic operations, for ASCII and BCD conversions. 7 L

UNIT 4

Timer and counter programming: Programming 8051 timers, counter programming.

Serial port programming with and without interrupt: Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority in the 8051. 7 L

UNIT 5

Interfacing 8051 microcontroller to peripherals: Parallel and serial ADC, DAC interfacing, LCD interfacing.
7 L

Learning Outcome

Upon successful completion, students will have the knowledge and skills to:
1: Understand what is a microcontroller, microcomputer,embedded system.
2: Understand different components of a micro-controller andtheir interactions.
3: Become familiar with programming environment used todevelop embedded systems
4: Understand key concepts of embedded systems like IO,timers, interrupts, interaction with peripheral devices
5: Learn debugging techniques for an embedded system

Text book [TB]:

1. Embedded Systems: Architecture, Programming & Design, R.Kamal,Tata McGraw Hill, 2008
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed, Pearson Education India, 2014.

Reference books [RB]:

1. Embedded microcomputor system: Real time interfacing, J.W.Valvano, Cengage learning, 2011.
2. Microcontrollers in practice, I. Susnea and M. Mitescu, Springer, 2011

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY376	**Subject Title**	BIO-PHYSICS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	VI

Course Outline:

The course starts with the study of different domains of physics in biology, it correlates different laws of physics with the processes going on inside the body of a living system like thermodynamics laws, fluid mechanics, diffusion and transport phenomenon.

Course Objective:

To help the student get theoretical perspective of the physics behind the processes pertaining to life at uni-cellular and multi-cellular levels.

Course Pre/Co- requisite (if any) : The student must have studied PY207, must have studied biology during school

Detailed Syllabus

UNIT 1

Building Blocks & Structure of Living State: Atoms and ions, molecules essential for life, what is life. Living state interactions: Forces and molecular bonds, electric & thermal interactions, electric dipoles, casimir interactions, domains of physics in biology. 7 L

UNIT 2

Heat Transfer in biomaterials: Heat Transfer Mechanism, The Heat equation, Joule heating of tissue. Living State Thermodynamics: Thermodynamic equilibrium, first law of thermodynamics and conservation of energy. Entropy and second law of thermodynamics, Physics of many particle systems, Two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein folding and unfolding. 9 L

UNIT 3

Open systems and chemical thermodynamics: Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin. 8 L

UNIT 4

Diffusion and transport Maxwell-Boltzmann statistics, Fick's law of diffusion, sedimentation of Cell Cultures, diffusion in a centrifuge, diffusion in an electric field, Lateral diffusion in membranes, Navier stokes equation, low Reynold's Number Transport, Active and passive membrane transport. 8 L

UNIT 5

Fluids: Laminar and turbulent fluid flow, Bernoulli's equation, equation of continuity, venture effect, Fluid dynamics of circulatory systems, capillary action. Bioenergetics and Molecular motors: Kinesins, Dyneins, and microtubule dynamics, Brownian motion, ATP synthesis in Mitochondria, Photosynthesis in Chloroplasts, Light absorption in biomolecules, vibrational spectra of bio-biomolecules. 7 L

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Learning Outcome

On completion of the course the student will be able to :
1: Gain competence in the arena of the fundamental blocks that constitute life
2: Understand the role of thermodynamics governing protein folding, which are intrinsic to life.
3: Apply proper ensemble in explaining various life related phenomena
4: Gain competence in exchange properties of membrane.
5: Have full insight in motion and energy related to biomolecules.

Text book [TB]:

1. Introductory Biophysics: Perspectives on the living state, J. Claycomb, JQP Tran, 1 edition, Jones & Bartelett Publishers, 2010.
2. Aspects of Biophysics, Hughe S W, John Willy and Sons.

Reference books [RB]:

1. Essentials of Biophysics by P Narayanan, Second edition, New Age International, 2007

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Subject Code	PY357	**Subject Title**	NANO MATERIALS AND APPLICATIONS						
LTP	3 1 0	**Credit**	4	**Subject Category**	DSE	**Year**	3rd	**Semester**	V

Course Outline:

The course develops a strong background of nanoscale materials, concept of quantum confinement, synthesis and characterization techniques for nanoscale materials, optical properties and applications.

Course Objective:

This course introduces the fundamentals of nano-scale science and technology. Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus

UNIT 1

NANOSCALE SYSTEMS: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences. 8 L

UNIT 2

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots. 8 L

UNIT 3

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy. 7 L

UNIT 4

OPTICAL PROPERTIES: Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures. 8 L

UNIT 5

APPLICATIONS: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).
8 L

Course Structure of BSc Physics (H)
Applicable for 2019-22 Batch

Learning Outcome

Upon successful completion, students will have the knowledge and skills to:
1: Explain the fundamental principles of nanotechnology and their application to biomedical engineering.
2: Apply engineering and physics concepts to the nano-scale and non-continuum domain.
3: Identify and compare state-of-the-art nanofabrication methods
4: Explore the characterization techniques for analysis of different properties of nanomaterials
5: Study the applications of nanomaterials in different fields

Text book [TB]:

1. Nanotechnology: Principles & Practices, S.K. Kulkarni, 3rd edition, Capital Publishing Company, 2014
2. Introduction to Nanoscience and Technology, K.K. Chattopadhyay and A. N. Banerjee, PHI Learning Private Limited, 2009.

Reference books [RB]:

1. Textbook of Nanoscience and Nanotechnology, Universities Press (India) Pvt Limited, 2014