File Ref.No.109332/GA - IV - J3/2022/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic IV-Faculty of Science-Regulations for the Integrated PG Programmes under the Choice Based Credit Semester System(CCSS) in the University Teaching Departments-I & II semester Scheme & Syllabus of Integrated MSc Physics programme w.e.f 2022 Admns -Implemented-Orders Issued.

G & A - IV - J

U.O.No. 24312/2022/Admn Dated, Calicut University.P.O, 30.12.2022

Read:-1.U.O.No. 4342/2022/Admn Dated, 15.02.2022
2.U.O.No. 13570/2022/Admn Dated, 12.07.2022
3.Minutes of the meeting of Combined Board of Studies in Integrated MSc Physics and Integrated MSc Chemistry held on 26.09.2022
4.Minutes of the meeting of Faculty of Science held on 17.11.2022
5.Item No.II.F of the minutes of the meeting of LXXXIV of Academic Council held on 15.12.2022
6.Orders of the Vice Chancellor in the File No: 120153/GA - IV - J1/2018/Admn dtd 24.12.2022

ORDER

1. The Regulations for the Integrated PG Programmes under the Choice Based Credit Semester System(CCSS) in the University Teaching Departments w.e.f 2021 Admissions has been implemented, vide paper read(1) above and same has been modified, vide paper read (2) above.
2. The Combined Board of Studies in Integrated MSc Physics and Integrated MSc Chemistry has approved the Scheme & Syllabus of Core, Allied Core (Complementary) and common courses(General courses) for the first two semesters of Integrated M.Sc Physics programme and the Allied core for the Integrated M.Sc Bioscience Programme w.e.f 2022 Admns, vide paper read(3) above.
3. The Faculty of Science has approved the Minutes of the meeting of Combined Board of Studies in Integrated MSc Physics and Integrated MSc Chemistry held on 26.09.2022, vide paper read (4) above and same has been approved the LXXXIV meeting of Academic Council, vide paper read (5) above.
4. The Scheme & Syllabus of Core, Allied Core (Complementary) and common courses(General courses) for the first two semesters of Integrated M.Sc Physics programme and the Allied core for the Integrated M.Sc Bioscience Programme, In accordance with the Regulations for the Integrated PG Programmes in the University Teaching Department(CCSS), is therefore implemented in the University with effect from 2022 Admission.
5. Orders are issued accordingly. (Syllabus appended.)

Ajayakumar T.K

Assistant Registrar

To

The Director, School of Physical Science
Copy to: PS to VC/PA to R/PA to CE/JCE I/JCE V/EX & EG Sections/Integrated PG Section/GA I F Section/ CHMK Library/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

Scheme and Syllabus for the Integrated M.Sc Physics w.e.f 2022 admission, for semesters I and II

(as per regulations for the Integrated PG Programmes under the Choice Based Credit Semester System (CCSS) in the University Teaching Departments w.e.f 2021 admission
U.O.No. 13570/2022/Admn dt. 12.07.2022)

SEMESTER I

Sl. No.	Type of Course	Course Code	Name of the Course	Credit	Hours per week
1.	Common (English)	IENG1A01	English Language Skills - I	3	3
2	Common (English)	IENG1A02	Language Acquisition with Literature - I	3	3
3	Common (Additional Language)	IMAL1A07(3)IHIN 1A07(3) IARB1A07(3)	Malayalam Hindi Arabic	4	4
4	Core	IPHY1B01	General Physics -1 : Mechanics-I	4	4
	Core		Physics Practical - 1	**	2
5	Allied core	ICHE1C01	General Chemistry - 1	4	4
6	Allied core		Chemistry Practical - I	**	2
7	Allied core	IMTS1C01	Mathematics - I	4	4
8.	Common	ICMP1A05	Python Programming	2	2
9	Audit	IAUD1I01	Environmental Studies	3	
	Total			24*	

*Excluding Audit Course

** Practical Exam at the end of semester II

SEMESTER II

(2022 Admission)

Sl. No.	Type of Course	Course Code	Name of the Course	Credit	Hours per week
1.	Common (English)	IENG2A03	English Language Skills - II	4	4
2	Common (English)	IENG2A04	Language Acquisition with Literature - II	4	4
3	Common (Additional Language)	IMAL2A08(3) IHIN2A08(3) IARB2A08(3)	Malayalam Hindi Arabic	4	4
4	Core	IPHY2B01	General Physics -2 : Mechanics-II and Properties of Matter	3	4
5	Core	IPHY2H01	Physics Practical-1 & 2	2	2
6	Allied core	ICHE2C01	Inorganic Chemistry-1	3	4
7	Allied core	ICHE2H01	Chemistry Practical- 1 & 2	2	2
8	Allied core	IMTS2C02	Mathematics - II	4	4
9.	Common	IZOO2A01	Introduction to Biosciences	3	3
10	Audit	IAUD2I02	Disaster Management	3	0
	Total			29*	

*Excluding Audit course

Allied Core Courses offered to Integrated M.Sc Bioscience

(2022 Admission)

SEMESTER I

Sl.No.	Type of Course	Course Code	Name of the Course	Credit	Hours per week
1	Allied core	IBIO1C02	Physics Paper – 1: Mechanics and Optics	3	3
2	Allied core		Physics Practical - 1		2

SEMESTER II

Sl.No.	Type of Course	Course Code	Name of the Course	Credit	Hours per week
1	Allied core	IBIO2C05	Physics Paper – 2: Spectroscopy and Instrumentation	3	3
2.	Allied core	IBIO2H04	Physics Practicals-1	2	2

Detailed Syllabus

SEMESTER I

IPHY1B01 General Physics -1 : Mechanics-I

(2022 Admission)

(Core, Credits : 4, 64 hours)

Objectives
• To introduce the students to the world of physics through a journey from classical physics to the modern physics (qualitative only) • To give an exposure to vectors and give an outline of its use in physics as physics mostly deals with vector quantities. • To introduce the students to equations of motion in physics. The beauty and general nature of Newton's laws of motion will be exposed. Also the connection with symmetry and conservation laws will be made clear by invoking Newton's laws of motion. • To make the student the learn the work-energy theorem and the underlying conservation laws. Different types of potentials and the consequences are introduced through this. • To put a firm basis to the understanding of the key role of angular momentum in circular motion its consequences. The significance of spherical symmetry and angular momentum conservation will also be exposed. • To enable students nurture a general understanding of the central forces with special emphasis to inverse square law type.
Course outcome(s)
After completion of the full course, the student should be able to

CO1	Able to have an overview of different branches of physics and the development over the years.	
CO2	Grasp the basic ideas of vectors and their use in mechanics	
CO3	Understand general form of the equations of motion with special reference Newton's laws and the consequences.	
CO4	Develop an understanding of work-enrgy relationships and conservation principles. Also the role of angular momentum in classical physics will be understood with the reasoning behind it.	

1. Development of Physics (Qualitative only) (9 hours)

An overview of the ancient perspectives of the universe, Development of mechanics, Galileo and his emphasis on experiments and observations, Kepler's laws, Newton and deterministic universe, Maxwell and unification of electricity and magnetism and optics, Fundamental particles and unification of all forces of nature, Planck's hypothesis of quantum mechanics, Einstein and his theories of relativity, Contributions by great Indian Physicists S.N Bose, M.N.Saha, C.V. Raman, Raman effect, S. Chandrasekhar and Chandrasekhar's limit (derivations not required).

2. Essential mathematical tools for introductory physics (9 hours)

Vector analysis : vector operations, vector algebra, component form, how vectors transform, application of vectors in physics.

Differential calculus : the operator del , gradient, divergence, curl, physical interpretation, product rules of del, second derivatives.

Integral calculus : Line integral, surface integral and volume integral, Fundamental theorem of gradients, Gauss divergence theorem (statement only), The fundamental theorem of curl, Stokes theorem (statement only)

Curvilinear coordinates : Spherical polar coordinates, cylindrical coordinates (Basic ideas)

3. Newton's laws (11 hours)

Newton's first law, Second law and third law, Inertial systems and fictitious forces, Some examples of Newton's laws, Astronaut's tug of war, Freight train, Constraints, Block on string, The whirling block, The conical pendulum, The fundamental forces of physics, Basic ideas of symmetry and conservation laws, Interpretation of Newton's laws based on symmetry principles, constants of motion. gravity and weight, gravitational force of a sphere, principle of equivalence.

4. Work and energy (12 hours)

Integrating the equation of motion in one dimension – mass thrown upward in a uniform gravitational field, Solving the equation of simple harmonic motion – work energy theorem in one dimension, vertical motion in an inverse square field, integrating the equation of motion in different dimensions, work energy theorem – conical pendulum; escape velocity, applying the work energy theorem, work done by a uniform force, work done by a central force, potential energy, potential energy of a uniform force field, potential energy of an inverse square force, what potential energy tells us about force- stability, energy diagrams, small oscillations in a bound system, molecular vibrations, nonconservative forces, general law of conservation of energy, power.

5. Angular momentum (12 hours)

Angular momentum of a particle – Angular momentum of a sliding block; Angular momentum of a conical pendulum, Torque – Central force motion and law of equal areas – Torque on a sliding block, Torque on a conical pendulum, Torque due to gravity, Angular momentum and fixed Axis rotation, Moment of inertia of some simple objects, The parallel axis theorem, Dynamics of pure rotation about an axis,

6. Gravitation and central forces (11 hours)

Central forces, Inverse-square law force. Newton’s law of universal gravitation, Gravitational field, Gravitational potential, Gravitational potential field due to a spherical shell - solid sphere, Equipotential surface. Escape velocity, Orbital velocity, Applications of geostationary satellites. Kepler’s laws- newton’s law deductions from Kepler's laws.

Books of study

1. An introduction to mechanics, 2nd edition – Daniel Kleppner and Robert J. Kolenkow - McGraw Hill (2013)
2. Introduction to Mathematical Physics, Charlie Harper, Prentice Hall of India Pvt Ltd. (1995), New Delhi
3. Great Physicists – the life and times of leading physicists from Galileo to Hawking, William H. Cropper, Oxford University Press 2001.
4. Mechanics, J. C. Upadhayaya, Ram Prasad Publication (2017)

Reference Books :

1. The Language of Physics, John P Cullerne and Anton Machacek, Oxford University Press 2008
2. Berkeley Physics Course : Vol 1: Mechanics, 2nd edition, Charles Kittel et al. - Mc Graw Hill (1973)
3. Vignettes in Physics Series – G Venkataraman, Universities Press/Sangam Books

SEMESTER I

Physics Practical - 1

(2022 Admission)

(Core, 32 hours)

(Examination at the end of semester II)

(Six experiments each have to be done in semester 1 and semester 2, respectively.)

List of experiments

Elasticity

1. Young's Modulus - by non-uniform bending-using pin and microscope-(load-extension graph)
2. Young's Modulus - uniform bending using optic lever
3. Young"s modulus – Cantilever – pin and microscope
4. Static torsion – Rigidity modulus
5. Flywheel – Moment of inertia (Calculate percentage error and standard deviation)
6. Moment of inertia (Rigidity modulus) – Torsion Pendulum

General (Application of Python programming – familiarisation using ExpEyes kit)

7.Characteristics of diode and Zener diode

8.. Transient current – growth and decay in LCR circuit

SEMESTER I

ICHE1C01 : GENERAL CHEMISTRY – 1

(2022 Admission)

(Allied Core, Credits : 4, 64 hours)

Objective (s)	To introduce the basic concepts of chemical sciences, Chemistry in everyday life and basic theory of acid base concepts. Explain the structure of atoms and to describe various aspects of chemical bonding To gain detailed knowledge of the principles analytical methods. To introduce concept of Periodic properties and properties of representative *s* and *p* block elements. To introduce the formalisms for the microscopic description of states of matter, and to explain the properties of gaseous state Introduces basic concepts in organic chemistry, functional groups and reaction intermediates.
Course outcome (s)	
CO1	To understand evolution of chemistry, Apply concepts of chemical sciences in everyday life and To distinguish between different acid base concepts.
CO2	To understand atomic structure and explain the theories of chemical bonding
CO3	To apply the fundamental principles behind volumetry and safety lab practices.
CO4	To analyze the periodic properties and characteristics of different elements.
CO5	To understand microscopic description of states of matter, intermolecular forces, and gaseous state.
CO6	To apply the concepts nomenclature, Functional groups, types of bond cleavage in organic compounds.

1. Chemistry: The Central science (10 hours)

Evolution of chemistry - Alchemy, Ancient concepts to particulate nature of matter, Laws of chemical combination. Branches of chemistry, Interdisciplinary areas involving Chemistry. Relevance of chemistry in everyday life - Industry, Agriculture, Food, Medicine, Textile, Paint, Cement, Various types of materials, Plastics, Rubber, etc.

Concepts of Acids and Bases: Arrhenius definition, Bronsted-Lowry definition and conjugate acid-base pairs, Lewis concept, Ionization of acids and bases. Lux-

Flood, Solvent system and Usanovich concepts. Metal and nonmetal hydroxy compounds, Acid anhydrides, amphoteric oxides, and hydroxides. Hard and soft acids and bases: Classification of acids and bases as Hard and Soft. Applications of HSAB concept, Limitations of HSAB concept.

Reference books

1. W. U. Malik, G. D. Tuli, R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand and Co., New Delhi, 2010(Reprint).
2. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Oxford University Press, New Delhi.
3. P. Atkins, T. Overton, J. Rourke, F. Armstrong and M. Hagerman, Shriver and Atkins' Inorganic Chemistry, 5 ed, W.H Freeman and Company, New York 2009.
4. G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3ed, Pearson, 2008.

2. Atomic Structure and Chemical Bonding (20 hours)

Atomic Structure: Review of early atom models, Bohr atom model and its limitations, Quantum mechanical model of atom – Planks quantum theory, quantization of energy, dual nature light, photoelectric effect, dual nature of matter - de Broglie equation - Heisenberg uncertainty principle - Schrödinger wave equation (mention only) - Atomic orbitals, Radial Probability.

Quantum numbers and their significance: Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle – Electronic configuration of atoms.

Chemical Bonding: Type of bonds: Ionic bond, Covalent bond & Coordinate bond. Intermolecular forces - Hydrogen bonding in H_2O - Dipole-dipole interactions.

VSEPR theory: Shapes of $BeCl_2$, BF_3, $SnCl_2$, CH_4, NH_3, H_2O, NH_4^+, SO_4^{2-}, PCl_5, SF_4, ClF_3, XeF_2, SF_6, IF_5, XeF_4, IF_7 and XeF_6.

Valence Bond theory - Hybridization involving s, p and d orbitals: sp (acetylene), sp^2 (ethylene), sp^3 (CH_4), sp^3d (PCl_5), sp^3d^2 (SF_6).

Molecular Orbital theory: LCAO – Electronic configuration of H_2, B_2, C_2, N_2, O_2 and CO – Calculation of bond order – determination of HOMO and LUMO – Explanation of bond length and bond strength.

Reference books

1. C. N. R. Rao, *Understanding Chemistry*, Universities Press India Ltd., Hyderabad,1999.
2. Manas Chanda, *Atomic Structure and Chemical Bonding*, 4th Edn., Tata McGraw Hill Publishing Company, Noida,2007.

3. R. Puri, L. R. Sharma K. C. Kalia, *Principles of Inorganic Chemistry*, 31st Edn., Milestone Publishers and Distributors, New Delhi,2013.

4. General chemistry - Ebbing Gammon

3. Periodic Properties (7 hours)

Classification of elements; concepts of atomic, ionic, and covalent radii; oxidation state, ionization energy, electronegativity - Pauling and Mullikan scales, electron affinity, Effective nuclear charge – Slater rule and its applications, polarizability – Fajan's rule, Inert pair effect, and Lanthanoid contraction.

Standard electrode potential, Flame colour of s-block elements, Diagonal relationships - Inert pair effect.

Ionic compounds: Lattice energy of ionic compounds – Born-Lande equation (derivation not expected) - Solvation enthalpy and solubility of ionic compounds - Born-Haber cycle and its applications - Properties of ionic compounds.

Polarity in covalent compounds - Percentage of ionic character - Dipole moment and molecular structure, Polarizing power - Fajans rule.

Reference books

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, 31st Edn. Milestone Publishers and Distributers – New Delhi. 2013
2. Satya Prakash, Advanced Inorganic Chemistry, Vol 1, 5th Edn. S. Chand and Sons, New Delhi, 2012
3. J. D. Lee, Concise Inorganic Chemistry, 5th Edn, Oxford University Press.
4. W. U. Malik, G. D. Tuli, R. D. Madan, *Selected Topics in Inorganic Chemistry*, S. Chand and Co., New Delhi,2010.
5. D. F. Shriver, P. W. Atkins, *Inorganic Chemistry*, 5rd Edn., Oxford University Press (2010)

4. Analytical Principles (12 hours)

Laboratory Hygiene and Safety: Awareness of Material Safety Data Sheet (MSDS). Storage and handling of chemicals. Simple first aids: Electric shocks, fire, cut by glass and inhalation of poisonous gases - Accidents due to acids and alkalies - Burns due to phenol and bromine. Disposal of sodium and broken mercury thermometer - Use of calcium chloride and silica gel in desiccators. – R & S Phrases (elementary idea only) – Safe laboratory practices – Lab safety signs. Personal Protective Equipment (PPE).

Accuracy, precision, types of error - absolute and relative error, methods of eliminating or minimizing errors. Methods of expressing precision: mean, median, deviation, average deviation and coefficient of variation. Significant figures and its application.

Mole concept. Equivalent mass. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and millimoles. Numerical Problems related to basic concepts.

Volumetric Analysis: Introduction - Primary and secondary standards – Standard solutions - Theory of titrations involving acids and bases, $KMnO_4$, $K_2Cr_2O_7$, I_2 and liberated I_2 - Complexometric titrations. Indicators: Theory of acid-base, redox, adsorption and complexometric indicators.

Reference books

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, 31st Edn., Milestone Publishers and Distributors, New Delhi,2013.

2. Satya Prakash, Advanced Inorganic Chemistry, Vol. 1, 5th Edn., S. Chand and Sons, New Delhi,2012.

3. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6th Edn., Pearson Education, Noida,2013.

5. States of Matter - Gaseous state (7 hours)

Kinetic theory of gases, Deviation from ideal behavior. Law of corresponding states. Molecular velocities, Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, Compressibility factor - van der Waals equation of state, virial equation, PV isotherms of real gases, Continuity of states - Critical phenomena - Critical constants and their determination, Principle of corresponding state. Liquefaction of gases (based on Joule Thomson- effect), Intermolecular forces

Reference books

1. P. Atkins, J. de Paula and J. Keeler, Atkins' Physical Chemistry, 11th Ed., Oxford University Press (2018).
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry
3. 2. T. Engel and P. Reid, Physical Chemistry, 3rd Ed., Pearson (2013).
4. 3. R. J. Silbey, R. A. Alberty and M. G. Bawendi, Physical Chemistry, 4th Ed., Wiley Student Edition

6. Introductory Organic Chemistry (8 hours)

IUPAC nomenclature: Alkanes, cyclo-alkanes, alkenes, alkynes, halogen compounds, Functional groups and structural diversity, Hybridization and Geometry of Molecules: methane, ethane, ethylene, acetylene. Electronic Effects: Inductive, resonance, hyper conjugation, and steric effect. Cleavage of bonds: homolytic and heterolytic C-C bond fission. Reaction Intermediates and their stability: carbocations, carbanions, free radicals, carbenes and nitrenes. Basic concepts of organic reactions: Addition, Substitution, Elimination and Rearrangements.

Reference books:

1. Fundamentals of Organic Chemistry, Solomons, John Wiley
2. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, P. Wothers, Oxford Univ.
3. A Textbook of Organic Chemistry, by Bahl Arun & Bahl B.S.
4. J. McMurry, Organic Chemistry, 9ed., Cengage Learning, 2015.
5. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, 7ed., Addison-Wesley, 2009

SEMESTER - I

Chemistry Practical 1 – Inorganic Qualitative and Quantitative Analysis I

(Allied Core, Total Hours: 32, Hours/Week: 2)

(Examination at the end of Semester II)

Objective (s)	To enable the students to gain skills in preparation of standard solutions and in quantitative analysis using titrimetric, gravimetric and colorimetric methods.
Course outcome (s)	
CO1	To enable the students to develop skills in quatitative analysis and preparing inorganic complexes.
CO2	To understand the principles behind quantitative analysis.
CO3	To apply appropriate techniques of quantitative analysis in estimations.
CO4	To analyse the strength of different solutions.

General Instructions

1. Use safety coat, goggles, shoes and gloves in the laboratory.

2. For weighing electronic balance may be used. Basic knowledge of the use of chemical balance is necessary.

3. Practical examination will be conducted at the end of semester II.

General Chemistry Lab

Basic Laboratory Skills - Demonstration & concepts

Awareness of Material Safety Data Sheet (MSDS). Storage and handling of chemicals. Simple first aids: Electric shocks, fire, cut by glass and inhalation of poisonous gases - Accidents due to acids and alkalis - Burns due to phenol and bromine. Disposal of sodium and broken mercury thermometer

Use of calcium chloride and silica gel in desiccators. R & S Phrases (elementary idea only) – Safe laboratory practices – Lab safety signs. Personal Protective Equipment (PPE) Demonstration & concept of good lab practices including chemical/glassware handling and waste management.

Calibration and handling of balances, basic principles & experiments related to sample/reagent preparation: practical concept of Molarity, Molality, Normality, equivalence, weight %, vol.%, Preparation of standard solutions, Dilution 0.1 M to 0.001 M solutions.

Calibration of Thermometer using 80-82 °C (Naphthalene), 113.5-114 °C (Acetanilide) 132.5-133 °C (Urea), 100 °C (Distilled Water)

Determination of Melting Point (any three): Naphthalene 80-82 °C, Benzoic Acid 121.5-122 °C Urea 132.5-133 °C, Succinic Acid 184.5-185 ° C, Cinnamic Acid 132.5-133 °C, Salicylic Acid 157.5-158 °C Acetanilide 113.5-114 °C, m-Dinitrobenzene 90 °C p-Dichlorobenzene 52 °C, Aspirin 135 °C 6. Determination of Boiling Point (any one) a. Ethanol 78 °C, Cyclohexane 81.4 °C, Toluene 110.6 °C 7.

Sublimation (Simple and Vacuum):Camphor, Naphtalene, Phthalic Acid and Succinic Acid.1 M to 0.001 M solutions.

Introduction to Inorganic Qualitative Analysis –

(Analysis of Acid and Basic radicals- Discussion on Preliminary tests, Test with sodium carbonate extract, Specific tests in solution, Basis of inter group separation)

1. Analysis of group 1, II,III, IV,V, and group VI cations
2. Analysis of mixture of cations in solution: NH_4^+, $Pb^{2+,}$ Cu2+, Cd2+, $Bi^{2+,}$ Al3+, Fe2+, Fe3+, Ni2+, Co2+, Mn2+, Zn2+, Ca2+, Sr2+, Ba2+, Mg2+ etc.
   A minimum of 6 experiments are to be performed.

Introduction to Volumetric Analysis

1. Weighing using electronic balance.

2. Preparation of standard solutions and their dilutions.

Neutralization Titrations

1. Strong acid – strong base titration.

2. Strong acid – weak base titration.

3. Weak acid – strong base titration.

4. Titration of HCl + CH_3COOH mixture *Vs* NaOH using two different indicators to determine the composition.

Redox Titrations

a) Permanganometry

1. Estimation of oxalic acid.

2. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt.

3. Estimation of calcium.

SEMESTER I

ICMP1A05 : Python Programming

(2022 Admission)

(Common, Credits : 2, 36 hours)

Objective (s)	Develop logical thinking. Expose the students to the computational approach in physics. Learn one of the widely used programming languages, with an aim to solve physics related problems.
Course outcome (s)	
CO1	Acquires essential knowledge on the syntax and semantics of python.
CO2	Develops skills to design algorithm and write programs accordingly.
CO3	Learns the techniques of numerical computations using built-in functions.
CO4	Learns to plot numerical data and visualise it according to the requirement.

1. Preliminaries (4 hours)

Introduction to algorithm, flowchart, high level Computer programming languages, Compilers and Interpreters. (Exercises)

2. Introduction to Python language (20 hours)

Advantages and unique features of Python language - Interactive mode and script mode- Writing and execution of programs - various data types in Python - Reading keyboard input: The raw_input function and input function - print command, formatted printing - open and write function - Variables, operators, expressions and statements - String operations, Lists, list operations (len, append, insert, del, remove, reverse, sort, +, *, max, min, count, in, not in, sum), sets, set operations (set, add, remove, in, not in, union, intersection, symmetric difference) -Tuples and Dictionaries, various control and looping statements: (if, if..else, if..ellif, while, for, break, continue) - user defined functions - Modules - File input and file output - Pickling. (Exercises)

Books for study:

1.Python for Education by Dr. B P Ajithkumar, IUAC, New Delhi; e-book freely downloadable from www.expeyes.in/documents/mapy.pdf

2.Introduction to Python for Engineers and Scientists by Dr.Sandeep Nagar, Apress publications.

3. Python Tutorial Release 3.0.1 by Guido van Rossum, Fred L. Drake, Jr., editor.

(http://www.altaway.com/resources/python/tutorial.pdf)

3. Numpy and Matplotlib modules (12 hours)

Numpy module: Introduction, creation of arrays and matrices, various array operations, matrix multiplication, inversion. Matplotlib module.

Books for study

Python for Education by Dr. B P Ajithkumar, IUAC, New Delhi; e-book freely downloadable from www.expeyes.in/documents/mapy.pdf

SEMESTER II

IPHY2B01: General Physics-2 : Mechanics II and Properties of Matter

(2022 Admission)

(Core, Credits :3, 48 hours)

Objectives		
• To introduce the concepts of non-inertial frames of references and the emergence of fictitious forces. • To impart the knoledge on velocity, acceleration and hence the forces poping up in a rotating coordinate system. Also to enable students understand the deflection of falling bodies under the action of coriolis force and relate it to the weather conditions. • To give a more subtle idea of harmonic oscillator as a symbol and its role in various phenomena. Also enable to understand free and forced or driven oscillations. The unique features of harmonic oscillator potential will be given due importance. • Give exposure at the fundamental level to wave phenomena – physics of wave equations and their solutions.		
Course outcome(s)		
After completion of the full course, the student should be able to		
CO1	Analyse the motion of particles in non-inertial frames and its importance with regard to the rotation of earth	An
CO2	Develop the knowledge on specific features of harmonic oscillators with special emphasis to the nature of the associated potential. Taking it as a symbol, identify phenomena obeying the conditions of harmonic oscillations.	
CO3	Understand wave phenomena from the point of view of classical mechanics and will be able to solve wave equations and analyse the solutions.	
CO4	Able to understand elasticity and elastic properties of selected solid objects and also properties like surface tension and viscosity and factors affecting them.	

1. Non-inertial Systems and Fictitious Forces (10 hours)

Galilean Transformations – Uniformly Accelerating Systems – The Apparent Force of Gravity – The Principle of Equivalence – Physics in a Rotating Coordinate System – Time Derivative of a Vector in a Rotating Coordinate System – Velocity and Acceleration in a Rotating Coordinate System – Fictitious Forces in a Rotating Coordinate System – Deflection of a Falling Mass – Motion on the Rotating Earth – Weather Systems – Foucault's Pendulum

[Sections 9.2 to 9.5.4 of An Introduction to Mechanics (2nd Edn.), Daniel Kleppner and Robert Kolenkow, Cambridge University Press (2014)].

2. Harmonic Oscillator (10 hours)

Simple Harmonic Motion: Review – Nomenclature – Incorporating Initial Conditions – Energy of the Harmonic Oscillator – Damped Harmonic Oscillator – Solving the Equation of Motion for the Damped Oscillator – Energy Dissipation in the Damped Oscillator – The Q of an Oscillator – The

Q of Two Simple Oscillators – Driven Harmonic Oscillator – Solving the Equation of Motion for the Driven Harmonic Oscillator – Energy Stored in a Driven Harmonic Oscillator – Resonance [Sections 11.1 to 11.4.2, Note 11.2 and Note 11.3 of An Introduction to Mechanics (2nd Edn.) by Daniel Kleppner and Robert Kolenkow].

3. Wave Motion (10 hours)

Wave Motion – General Equation of Wave Motion – Plane Progressive Harmonic Wave – Principle of Superposition – Energy Density for a Plane Progressive Wave – Intensity of Wave and Spherical Waves – Transverse Waves in Stretched Strings – Modes of Transverse Vibrations of Stretched String – Longitudinal Waves in Rods – Longitudinal Waves in Gases – Newton-Laplace Formula – Fourier‟s Theorem – Conditions for the Applicability of Fourier‟s Theorem – Analysis of a Square Wave Using Fourier Series – Wave Velocity and Group Velocity
[Sections 11.1 to 11.9, 11.12 and 11.13 of Mechanics by J. C. Upadhyaya]

4. Properties of matter 1- Elasticity (10 hours)

Elastic modulii. (Elementary ideas)- Work done per unit volume - Poisson‟s ratio and theoretical limits - relation between various elastic constants - Twisting couple on
a cylinder (Derivation not required)- Torsion pendulum-Determination of rigidity modulus of a wire-Bending of beams-bending moment- I-form girders- Cantilever loaded at the free end – Beam loaded uniformly (Derivation not required)

Unit V – Properties of matter - 2 – Surface Tension and Viscosity (8 hours)

Surface tension (Elementary ideas)-Excess pressure inside a liquid drop and bubble (Effect of electrostatic pressure on a bubble-change in radius)-Work done in blowing the bubble (problem based on the formation of bigger drop by a number of smaller drops)

Viscosity-Coefficient of viscosity-Derivation of poiseuille‟s equation, stokes equation-Determination of viscosity by Poiseuille‟s method -Brownian motion –Viscosity of gases

Books for study

1. Elements of Properties of matter- D. S. Mathur, S Chand and Co., New Delhi
2. General properties of matter- J C Upadhaya, Ram Prasad Publications, 2019

Reference Books

1. Mechanics – Somnath Datta – Pearson Education
2. Berkeley Physics Course : Vol.1 : Mechanics, 2 nd Edn. – Kittel et al. – McGraw-Hill
3. Newtonian Mechanics – A P French – Viva Books
4. Classical Dynamics of Particles and Systems, 5 th Edn. – Stephen Thornton, Jerry Marion – Brooks/Cole
5. NPTEL video lectures available online

SEMESTER II

IPHY2H01: Physics Practical - 1 & Physics Practical - 2

(2022 Admission)

(Core, Credits:2, 64 hours)

(Examination at the end of Semester II, including experiments done in Semester I)

(Six experiments each have to be done in semester 1 and semester 2, respectively.)

List of experiments (for semesters I to IV)

Elasticity

1. Young's Modulus - by non-uniform bending-using pin and microscope-(load-extension graph)
2. Young's Modulus - uniform bending using optic lever
3. Young‟s modulus – Cantilever – pin and microscope
4. Static torsion – Rigidity modulus
5. Flywheel – Moment of inertia (Calculate percentage error and standard deviation)
6. Moment of inertia (Rigidity modulus) – Torsion Pendulum

Oscillations and Waves

6. Torsion Pendulum – Moment of Inertia
7. Compound pendulum – Acceleration due to gravity, Radius of gyration
8. Kater‟s pendulum – Acceleration due to gravity
9. Lissajous figures – frequency and phase shift of sinusoidal signals using CRO
10. Melde‟s string arrangement – Frequency, relative density of liquid and solid (both modes)

Optics

11. Liquid lens – Refractive index of liquid and glass - determine R using a)water & b) Buoy‟s method
12. Spectrometer – Solid prism-Refractive index of the material of the prism, measuring angle of minimum deviation
13. Spectrometer – Solid prism – Dispersive power
14. Spectrometer – Cauchy‟s constants
15. Single slit diffraction using LASER
16. Newton's rings – wavelength of sodium light

Electricity and Magnetism

17. Deflection magnetometer – Tan A, Tan B, Tan C positions – magnetic dipole moment
18. (a) Searle‟s vibration magnetometer- ratio of magnetic dipole moments

(b) Searle‟s and box type vibration magnetometers – m & Bh .

19. Circular coil – Variation of field with distance – m & Bh

20. Potentiometer – Calibration of ammeterCharacteristics of diode and Zener diode (Expeyes kit can also be used)

27. Transient current – growth and decay in LCR circuit (Expeyes kit can be used)

21. Potentiometer – Calibration of low range voltmeter

22. Potentiometer – Calibration high range voltmeter

23. Verification of (a) Thevenin‟s theorem and (b) Maximum power transfer theorem

24. Mirror Galvanometer – Figure of merit

25. Determination of dielectric constant of liquid/thin sheet

26. Characteristics of diode and Zener diode (Expeyes kit can also be used)

27. Transient current – growth and decay in LCR circuit (Expeyes kit can be used)

Semester II

ICHE2C01: Inorganic Chemistry-1

(2022 Admission)

(Allied core for Integrated M.Sc Physics, Integrated M.Sc Bioscience - Course Code for Bioscience : IBIO2C01, Credits :3, 48 hours)

Course Outcome:

After the completion of the course the students shall be able to

- Explain electronic configuration hemical bonding and structure in detail, with especial emphases on Inorganic compounds.
- To explain chemical principles necessary to provide explanations and description for existence, behavior, and properties of elements and their compounds.
- Describe concisely the properties of the s,p d, and f block elements and their compounds.
- Apply the chemical principles to explain the properties of coordination compounds.
- Explain the properties of non-aqueous solvents.
- Demonstrate and the understanding of nuclear chemistry.

1. Chemistry of Representative Elements (10 hours)

Review of periodic properties and chemical bonding. Comparative study of s and p block elements, diagonal relationships - Inert pair effect. Ionic compounds: Born Lande equation (No derivation), Born-Haber cycle and its applications, Lewis acidity of boron halides - Preparation, properties, structure and uses of Diborane, Boric acid, Borazine and Boron nitride. Structures of oxides of N and P, oxy acids of N and P, Structure and acidic strength of oxy and peroxy acids of sulphur, oxy acids of chlorine. Preparation, properties and uses of ammonia, nitric acid, ozone, hydrogen peroxide, sulphuric acid and hydrochloric acid. Chemical properties of the noble gases, chemistry of xenon, structure and bonding of xenon compounds.

2. Transition and Inner Transition Elements (12 hours)

Characteristic properties of d- and f- block elements, General group trends with special reference to electronic configuration, colour, and variable valency, ability to form complexes, magnetic and catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Chemistry of first transition series in various oxidation states. Explanation of metallic properties of transition metals based on theories of Metallic Bonding- Free electron theory, valence bond theory and band theory Lanthanides: Occurrence of lanthanides, Isolation of lanthanides from monazite

sand – Separation by ion exchange method. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides. Actinides: Electronic configuration and general characteristics

3. Coordination Chemistry-1 (10 hours)

Coordinate bond, Werner‘s theory, ligand, coordination number, homoleptic and heteroleptic complex, isomerism in coordination compounds, bonding theories: EAN rule -Valence Bond theory and its limitation, Crystal filed theory ,CFSE of low spin and high spin octahedral complexes ,Spectrochemical series , Jahn-Teller Theorem, Molecular orbital theory for octahedral complexes (with sigma bonds only). Colour of the coordination complexes. Electronic spectra, Magnetic properties. Stability of complexes: Inert and labile complexes, Factors influencing stability. Chelate effect, polynuclear complexes, Application of complexes in qualitative and quantitative analysis

4. Chemistry of Non-aqueous Solvents (8 hours)

Non-aqueous Solvents: Classification – General properties – Self ionization and leveling effect Reactions in non-aqueous solvents with reference to liquid NH3, H2SO4, liquid HF, HSO3F, liquid SO2. N2O4, PCl5, BrF3 super acids, ionic liquid: molten salts solvent systems, ionic liquid at ambient temperature; supercritical fluids: properties of supercritical fluids and their uses as solvents.

5. Nuclear chemistry (8 hours)

Nuclear forces, Radioactivity: Characteristics of radioactive decay, Decay kinetics, types of decay, α, β, γ- emissions, artificial radioactivity. Nuclear fission and fusion; Nuclear Reactors: Classification of reactors, reactor power, and application of radioactivity, Decay series -group displacement law - Isotopes: Detection - Aston's mass spectrograph -Separation of isotopes - Application of radioactive isotopes - 14C dating -Radio diagnosis and radiotherapy, nuclear waste Management

Reference books

1. Basic Inorganic Chemistry by F. A. Cotton & Wilkinson, John Wiley
2. Inorganic Chemistry by J. E. Huhey, Harpes& Row
3. Comprehensive Co-ordination Chemistry by G. Wilkinson, et.al. Pergamon
4. Concise Inorganic Chemistry by J D Lee.
5. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry
6. D. F. Shriver, P. W. Atkins, Inorganic Chemistry

SEMSTER II

ICHE2H01 : Chemistry Practical I & Chemistry Practical II

(2022 Admission)

(Allied Core : Credit: 2, 64 hours)

(Exam at the end of Semester II , including experiments done in Semester I)

Chemistry Practical II - Inorganic Qualitative & Quantitative Analysis (32 hours)

Qualitative Analysis

Analysis of Mixture of Acid and Basic radicals - Analysis of mixture of group I, II,III, IV,V, and group VI cations along with two acid radicals, Removal of interfering acid radicals.

A minimum of 6 experiments are to be performed.

Quantitative Analysis

Redox Titrations

Dichrometry

1. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt using internal indicator.

2. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt using external indicator.

3. Estimation of ferric iron (after reduction with stannous chloride) using internal indicator.

c) Iodimetry and Iodometry

1. Estimation of iodine.

2. Estimation of copper.

3. Estimation of chromium.

Module IV: Precipitation Titration (using adsorption indicator)

1. Estimation of chloride in neutral medium.

Module V: Complexometric Titrations

1. Estimation of magnesium.

2. Estimation of calcium.

3. Determination of hardness of water.

Module VI: Some Estimations of Practical Importance

1. Determination of acetic acid content in vinegar by titration with NaOH.

2. Determination of alkali content in antacid tablets by titration with HCl.

3. Determination of available chlorine in bleaching powder.

4. Determination of COD of water samples.

5. Estimation of citric acid in lemon or orange.

Semester II

IZOO2A01: Introduction to Biosciences

(2022 Admission)

(Common, Credits :3, 48 hours)

Course description: The course will introduce students to the basics of life, covering the studies of living organisms, from the tiny and simple through to the complexities of plants and animals, ending with a basic understanding of how interactions between an organism and environment shape all aspects of the organism's biology.

Aims and objectives:

- To provide an understanding of basic concepts and scales of biological organisation.
- To provide an overview of the different scopes of biology to the students.

Learning outcomes:

- Ability to compare the fundamental differences in the life forms and how they may differ.
- Interpret the interactions of different life forms with each other and with the physical, chemical and biological world around them.
- Use the knowledge gained through scopes of biology for higher studies.

1. Survey of plant kingdom, survey of Animal kingdom (10 hours)

Introduction: History of Biology, Hierarchical levels of organization in living organisms. A brief account of the classification of plants; Diversity and range of thallus structure in Algae; a brief account of Lichens; General characters and habitat diversity of bryophytes; General characters and a brief account of diversity of Pteridophytes, Gymnosperms and Angiosperms in Western Ghats. Diversity, Major classification schemes, general characters, of the animal kingdom with the overview of the major phyla. A brief account of the recent developments in molecular phylogenetics.

Suggested Readings

1. Lee, R.E., 2008. *Phycology*, Cambridge University Press, Cambridge. 4th edition.

2. Sambamurthy A V S S, 2005. *A Text book of Algae*, Mittal Books Indi

3. Round, F. E. 1975. The Biology of Algae. Edward Arnold.

4. Vanderpoorten, A. and Goffinet, B. 2009. *Introduction to Bryophytes*. Cambridge University Press, Cambridge

5. chofield, W. B. 2001. Introduction to Bryology. The Blackburn Press.

6. Parihar, N. S. (1976) The biology and morphology of the Pteridophyta, Central Book Depot, Allahabad.

7. Biswas, C. and B. M. Johri (2004) The Gymnosperms, Narosa Publishing House, New Delhi.

8. Johri, Lata and Tyagi, 2012, A text book of Gymnosperm, Vedam e Books, New Delhi.

9. Gurucharan Singh, 2017. Plant Systematics Theory and Practice

10. Sharma O.P. Plant Taxonomy

11. Boolootian, R., and D. Heyneman. An Illustrated Laboratory Text in Zoology, 2nd ed. New York: Holt, Rinehart and Winston, 1969.
12. Fauchald, J. Z. The Polychaoeta Worms. Definitions and Keys to Orders. Families and Genera. Natural Museum of Los Angeles County, 1977.
13. Hickman, C. P. Integrated Principles of zoology, 4th ed. St. Louis: C. V.Mosby Co., 1970.
14. Oliver, J. A. The Natural History of North American Amphibians and Reptiles. New York: D. Van Nostrand Company, 1985.
15. Purdion, R. D. The Biology of Mollusca, 2nd ed New York: Pergamon Press, 1987.
16. Russell-Hunter, W.D. A Biology of Lower Invertebrates. London MacMillian Company, Ltd., 1983.
17. Storer, T. I., R. L. Usinger, and J. W. Nybakken. Elements of Zoology. New York: McGraw-Hill Book Company, 1980.
18. Romer, A. S. The Vertebrate Body. Philadelphia: W. B. Saunders Co., 1970.

2. Cytology (8 hours)

Introduction to the Cell: The origin and evolution of the cell: molecules to first cell, prokaryotes to eukaryotes, single cell to multicellular organisms, cell theory. Organization of cell: Intracellular organelles: The nucleus, mitochondria, lysosomes, peroxisomes, Golgi apparatus, plastids, vacuoles and endoplasmic reticulum. Cell membrane: Structure of model membrane, the lipid bilayer, membrane proteins, membrane carbohydrates. Components of cytoskeleton. Cell division and Cell Cycle.

Suggested Readings

1. Cooper G. 2018. The Cell: A molecular approach. Sinauer Associates Inc, 8th edition.
2. Robertis De. 2010. Cell and Molecular Biology, 8th edition. Lippincott Williams & Wilkins.
3. Karp G., Iwasa J. and Marshall W. 2018. Cell Biology. Wiley publication., 8th edition.
4. Lodish H., Berk A., Zipursky S. L., Matsudaira P., Baltimore D. and Darnell J. 2000. Molecular cell biology. Freeman Press, 4th edition.
5. Pollard. T. D. and Earnshaw, W.C. 2002. Cell Biology. Saunders, 3rd edition.

3. Microbiology (10 hours)

General features of microorganisms: bacteria, algae, fungi and protozoa. Major scientists and their discoveries, The spontaneous generation theory and its controversy; Germ theory of disease; Organization of archae, bacteria and eukaryotic cell; Woese's three kingdom classification system; Different groups of acellular microorganisms -viruses, viriods and prions. Scope of Microbiology. Methods in microbiology: Physical and chemical methods of sterilization; Pure culture techniques, Staining techniques, maintenance and preservation of microbial cultures.

Suggested Readings

1. Sherwood LM, Woolverton 2017. Prescott's Microbiology. 10th ed. C.J McGraw-Hill Education.
2. Pelczar Jr. M, 2001. Microbiology. 5th ed., McGraw Hill Education.

3. Albert B., Johnson A., Lewis J., Raff M., Roberts K. and Walter P. 2014. Molecular biology of the cell. Garland Sciences, 6th edition.

4. Genetics & Molecular biology (10 hours)

Principles of heredity, Deviations from Mendelian inheritance, Chromosomal Basis of Inheritance; Structural organization of chromosomes; Chromosomes in Prokaryotes and Eukaryotes, Nucleic acids, Mechanism of DNA replication, Gene expression; Regulation of gene expression in prokaryotes and Eukaryotes

Suggested Readings

2. Snustad PD, Simmons MJ. 2015. Principles of Genetics, 7th edition. Wiley.
3. Klug WS, Cummings MR, Spencer CA, Palladino MA, Darrell Killian. 2018. Concepts of Genetics, 12th edition. Pearson.
4. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. 2015. Introduction to Genetic Analysis, 11th edition. W.H. Freeman & Worth Publishers.
5. Pierce BA. 2016. Genetics: A Conceptual Approach 6th edition. W. H. Freeman.
6. Hartwell L, Goldberg ML, Fischer J, Hood L. 2017. Genetics: From Genes to Genomes 6th edition. McGraw-Hill Education.
7. Hartl DL and Jones EW. 2011. Genetics: Analysis of Genes and Genomes, 7th edition. USA: Jones and Barlett Publishers.
8. Strickberger MW. 2015. Genetics, 3rd edition. Pearson.
9. Brooker R. 2017. Genetics: Analysis and Principles, 5th edition. McGraw-Hill Higher Education
10. Tamarin R, 7th edition. 2017. Principles of Genetics. McGraw Hill Education.
11. Elrod S, Stansfield W. 2010. Schaum's Outline of Genetics, 5th edition. McGraw-Hill Education.
12. Hartl DL, Clark AG. 2006. Principles of Population Genetics 4th edition. Sinauer Associates is an imprint of Oxford University Press.
13. Watson JD, Tania AB, Stephen PB, Alexander G, Michael L, Richard L. 2017. Molecular Biology of the Gene, 7th edition. Pearson Education.
14. Krebs JE, Goldstein ES, Kilpatrick ST. 2017. Lewin's GENES XII. Jones and Bartlett Publishers, Inc.
15. Russell PJ. 2011. Genetics: A Molecular Approach, 3rd edition. Pearson.

5. Ecology (10 hours)

The course will introduce students to the basics of what life is, scales of biological organization and how interactions between an organism and its environment shape all aspects of the organism's biology.

Concepts and elements of Biotic and Abiotic environment; Biomes; Ecosystem-trophic levels, trophic structure, energy transformation, gross and net production, primary productivity, secondary productivity; Ecosystem types- grassland, tundra, forest, deserts, salt & freshwater ecosystem; Population ecology- Community ecology-structure and dynamics; Species interactions- symbiosis,

mutualism, competition, predation, parasitism; Biodiversity and Conservation; Impact of climate change on biodiversity.

Suggested Readings

1. Nicholas J. Gotelli, A primer of Ecology Oxford University Press, 4th Edition 2008.
2. Begon et al., Ecology: From Individuals to Ecosystem Wiley-Blackwell, 4th Edition 2005.
3. Colin R. Townsend, Michael Begon, John L. Harper. Essentials of ecology Blackwell Pub. 4th Edition 2008.
4. Manuel C Molles, Ecology: Concepts and Applications Mc Graw Hill 7th Edition 2014.
5. Douglas J Futuyma, Evolution Oxford University Press 3rd Edition 2013.

Integrated M.Sc Bioscience (2022 Admission)

SEMESTER I

IBIO1C02: Physics Paper 1 : Mechanics and Optics

(Allied core, 48

Hours, Credits : 3)

Section A : Mechanics

(22 Hrs)

	Course Outcome (CO)
C01	Understand and apply the basic concepts of Newtonian Mechanics to Physical Systems
C02	Understand and apply the basic idea of work-energy theorem to physical systems
C03	Understand and apply the rotational dynamics of rigid bodies

1. Newton's Laws (9 hours)

Newton's First Law, Second Law and Third Law – Standards and units – Some applications of Newton's laws – The astronauts' tug of war, Freight train– The everyday forces of physics – Gravity and Weight; Turtle in an elevator; Gravitational field – Electrostatic force – Contact forces; Block and string; Dangling rope; Pulleys; Block and wedge with friction; Viscosity – Linear restoring force; Spring and block : The equation for simple harmonic motion; Spring and gun : Illustration of initial conditions – Dynamics of a system of particles – The Bola – Centre of mass – Centre of mass motion – Conservation of momentum

[Chapter 2 and 3 of Introduction to Mechanics (1stEdn.) by Daniel Kleppner and Robert J. Kolenkow]

2. Work and Energy (6 hours)

Integrating the equation of motion in one dimension – Mass thrown upward in a uniform gravitational field; Solving the equation of simple harmonic motion – Work-energy theorem in one dimension – Vertical motion in an inverse square filed Work-energy - Escape velocity – Applying the work-energy theorem –Work done by a central force; Potential energy – Potential

energy of a uniform force field; Potential energy of an inverse square force – What potential energy tells us about force – Stability – Energy diagrams – Smalloscillations in a bound system – Molecular vibrations – Nonconservative forces –Power

[Chapter 4 of An Introduction to Mechanics (1st Edn.) by Daniel Kleppner and Robert J. Kolenkow.

3. Angular Momentum (7 hours)

Angular momentum of a particle – Angular momentum of a sliding block; Angular momentum of the conical pendulum – Torque – Torque on a sliding block; Torque on the conical pendulum– Angular momentum and fixed axis rotation – Moments of inertia of some simple objects – The parallel axis theorem –Atwood's machine with a massive pulley – The simple pendulum – The physical pendulum – Motion involving both translation and rotation – Angular momentum of a rolling wheel – Work-energy theorem for a rigid body – Drum rolling down a plane : energy method –Conservation of angular momentum

[Chapter 6 and 7of An Introduction to Mechanics (1st Edn.) by Daniel Kleppner and Robert J. Kolenkow]

Reference books

1. An Introduction to Mechanics, 1st Edn. – Daniel Kleppner and Robert J. Kolenkow – McGraw-Hill

2. Berkeley Physics Course, Vol.1 : Mechanics, 2nd Edn. – Kittel *et al.* – McGraw-Hill

Section B *Optics*

(26 hours)

	Course Outcome (CO)
CO1	Understand and apply the basic concepts of interference and diffraction
CO2	Understand and apply the concepts of polarization
CO3	Understand and apply the important principles of laser physics
CO4	Understand and apply the concepts of Fibre optics

1, Interference (7 hours)

Superposition of two sinusoidal waves (resultant amplitude and intensity)., constructive and destructive interference- Fresnel's two mirror arrangement - Interference by a plane film- colours of thin films- Newton's rings (Reflected system)-Determination of wavelength

(Chapters 12, 13 of Optics by Ajoy Ghatak ,Third edition)

2. Diffraction (6 hours)

Fresnel and Fraunhoffer class of diffraction Fraunhofer single slit diffraction pattern- Intensity distribution (qualitative ideas only)- plane diffraction Grating- Experiment with grating - resolving power and dispersive power.

(Chapters 16,17 of Optics by Ajoy Ghatak)

3. Polarisation (5 hours)

Elementary idea- Brewster' law- Double refraction- positive and negative crystals- Quarter and half wave plate- production of plane, elliptically and circularly polarized light- optical activity

(Chapter 19 of Optics by Ajoy Ghatak)

4. Laser physics (4 Hours)

Induced absorption- spontaneous emission and stimulated emission- population inversion

Principle of Laser-Types of laser- Ruby laser, Helium Neon laser

(Chapter 23 of Optics by Ajoy Ghatak)

5 Fibre Optics (4 hours)

Optical fibre, Numerical aperture, step index fibre, pulse dispersion, graded index fibre, optical fibre communication.

(Chapter 24 of Optics by Ajoy Ghatak)

Reference books

1. Optics- Ajay Ghatak , McGraw-Hill
2. Optics – Brijlal &Subramaniam & Avadhanulu, S Chand
3. Lasers – theory & applications- Thyagarajan & Ghatak

SEMESTER I

Physics Practicals-1

(Allied core, 32 Hours in each semester)

(Examination at the end of Semester II, includes experiments carried out in semester I)

(Any 5 experiments in each semester)

SEMESTER 1

1. Spectrometer- Refractive index of the material of prism
2. Torsion pendulum- Rigidity modulus
3. Young's modulus – Uniform bending –using optic lever
4. Moment of inertia of fly wheel
5. Young's modulus of a cantilever- Pin and microscope method
6. Static torsion – Rigidity modulus
7. Characteristics of diode and Zener diode

SEMESTER 2

8. Spectrometer- Grating- Normal incidence
9. Planck's constant using LED's (Minimum 4 nos.)
10. Laser-wavelength using transmission grating
11. Newton's rings- Wavelength of sodium light
12. Numerical aperture of an optical fibre by semiconductor laser
13. Half wave rectifier – Ripple factor

SEMESTER 3

14. Spectrometer – Quartz prism
15. Lee's Disc –thermal conductivity of a bad conductor
16. Single slit diffraction using LASER
17. Polarimeter- Specific rotation of sugar solution
18. Full wave rectifier – Ripple factor

Books of Study:

1. B.Sc Practical Physics- C L Arora
2. Practical Physics- S L Gupta & V Kumar

Additional Experiments

Semester I

19. Liquid lens – Refractive index of liquid
20. Field along the axis of a circular coil – Variation of the magnetic flux density

Semester II

21. Liquid lens – Refractive index of glass

22. Malu’s law
23. Field along the axis of a circular coil –Determination of B_h

Semester III

24. Searles vibration magnetometer
25. Surface tension – Capillary rise
26. Verification of Cauchy’s dispersion formula
27. Carey Foster’s Bridge

SEMESTER II

IBIO2C05: Physics Paper 2 : Spectroscopy and instrumentation

(48 Hours, Credits:3)

	Course Outcome (CO)
CO1	Understand the basic elements of spectroscopy.
CO2	Understand the basics ideas of microwave, infra red and Raman spectroscopy.
CO3	Understand the important principles of electronic spectra of atoms and spin resonance spectroscopy
CO4	Understand the fundamentals of medical instrumentation

1. Basic Elements of Spectroscopy (7 hours)

Characterisation of electromagnetic radiation; The quantisation of Energy; Regions of the Spectrum; Representation of the Spectra; Basic elements of practical spectroscopy; Signal to noise ratio, Resolving power; Width and Intensity of spectral transitions.

(Chapter 1, Fundamentals of Molecular Spectroscopy by Banwell and McCash)

2, Microwave Spectroscopy (6 Hrs)

The rotation of molecules; Rotational spectra; diatomic molecules and polyatomic molecules; Technique and instrumentation of microwave spectroscopy.

(Chapter 2, Fundamentals of Molecular Spectroscopy by Banwell and McCash)

3. Infrared Spectroscopy (7 hours)

The Vibrating diatomic molecule; The diatomic vibrating rotator; The vibration-rotation spectrum of CO; Breakdown of Born-Oppenheimer approximation; Vibration of polyatomic molecules; Technique and instrumentation of infra-red spectroscopy.

(Chapter 3, Fundamentals of Molecular Spectroscopy by Banwell and McCash)

4. Raman Spectroscopy (7 hours)

Raman Spectra – pure rotational and vibrational Raman spectra; Polarisation of light and the Raman effect; Structure determination from Raman and Infra-red spectroscopy; Techniques and instrumentation of Raman Spectroscopy.

(Chapter 4, Fundamentals of Molecular Spectroscopy by Banwell and McCash)

5. Electronic spectra of atoms (7 hours)

The structure of atoms; Electronic angular momentum; Many electron atoms; The angular momentum of many-electron atoms; photoelectron spectroscopy; The Zeeman effect; The influence of nuclear spin. Electronic spectra of diatomic molecules and polyatomic molecules. Techniques and instrumentation of electronic spectroscopy.

(Chapter 5, Fundamentals of Molecular Spectroscopy by Banwell and McCash) 6.

6. **Spin resonance spectroscopy (7 hours)**

Spin and applied field; Nuclear Magnetic Resonance spectroscopy: Hydrogen nuclei and nuclei other than hydrogen; Techniques and instrumentation of NMR; Electron Spin Resonance Spectroscopy (ESR).

(Chapter 7, Fundamentals of Molecular Spectroscopy by Banwell and McCash)

7. Fundamentals of medical instrumentation (7 hours)

Physiological systems of the body, sources of biomedical signals, basic medical instrumentation systems, performance, constraints and regulations, intelligent medical instrumentation systems. Origin of bioelectric signals, ECG, EEG, EMG

(Sections 1.1 to 1.8, 2.1 to 2.8 & 3.1 to 3.10 from " Handbook of Biomedical Instrumentation", R S Khandpur, Tata McGraw Hill)

Reference books

1. Fundamentals of Molecular Spectroscopy, (Fourth Edition) Colin N. Banwell and Elaine M. McCash , Tata McGraw Hill
2. G. Aruldhas, Molecular structure and spectroscopy
3. G.M Barrow, Introduction to molecular spectroscopy
4. Long.D.A, Raman spectroscopy
5. Handbook of Biomedical Instrumentation", R S Khandpur, Tata McGraw Hill

SEMESTER II

IBIO2H04: Physics Practicals-1

(32 Hours in each semester)

(Examination at the end of Semester II, includes experiments carried out in semester I)

(Any 5 experiments in each semester)

SEMESTER 1

1. Spectrometer- Refractive index of the material of prism
2. Torsion pendulum- Rigidity modulus
3. Young's modulus – Uniform bending –using optic lever
4. Moment of inertia of fly wheel
5. Young's modulus of a cantilever- Pin and microscope method
6. Static torsion – Rigidity modulus
7. Characteristics of diode and Zener diode

SEMESTER 2

8. Spectrometer- Grating- Normal incidence
9. Planck's constant using LED's (Minimum 4 nos.)
10. Laser-wavelength using transmission grating
11. Newton's rings- Wavelength of sodium light
12. Numerical aperture of an optical fibre by semiconductor laser
13. Half wave rectifier – Ripple factor

SEMESTER 3

14. Spectrometer – Quartz prism
15. Lee's Disc –thermal conductivity of a bad conductor
16. Single slit diffraction using LASER
17. Polarimeter- Specific rotation of sugar solution
18. Full wave rectifier – Ripple factor

Books of Study:

3. B.Sc Practical Physics- C L Arora
4. Practical Physics- S L Gupta & V Kumar

Additional Experiments

Semester I

19. Liquid lens – Refractive index of liquid
20. 20. Field along the axis of a circular coil – Variation of the magnetic flux density

Semester II

21. Liquid lens – Refractive index of glass
22. Malu's law
23. Field along the axis of a circular coil –Determination of B_h

Semester III

24. Searles vibration magnetometer
25. Surface tension – Capillary rise
26. Verification of Cauchy's dispersion formula
27. Carey Foster's Bridge